Republic of Kenya

FY2018 Ex-Post Evaluation of Japanese ODA Loan Project
"Sondu-Miriu Hydropower Project Sang'oro Power Plant"

External Evaluator: Ryuji Kasahara, IC Net Limited

0. Summary

This project was carried out for the purpose of expanding power supply by constructing a hydropower station with an installed capacity of 21.2 MW in the Kisumu District of Nyanza Province in Western Kenya, thereby contributing to the improvement of the living standards of Kenyans and the sustainable economic growth of the country.

As this project was in accord with Kenya's power development policy and development needs at the time of the appraisal and the ex-post evaluation and Japan's ODA policy at the time of the appraisal, the relevance of this project is high. As there was no change in the general outputs and the project costs and duration were within the plan, the efficiency of this project is high. The target values set as indicators of effectiveness were largely achieved. Additionally, as impacts from this project, this project has contributed to the alleviation of the tight power supply and demand as well as stable power supply. At the time of project implementation and the ex-post evaluation, while some issues were detected concerning the impacts on the natural environment, resettlement, land acquisition, employment, and work environment, no serious negative impact was observed. Therefore, effectiveness and impacts of this project are high. The sustainability of effects generated by this project has no major problem overall despite a room for improvement with respect to finances. Therefore, the sustainability of this project is fair.

In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description

Project Location Map

Sang'oro Power Station

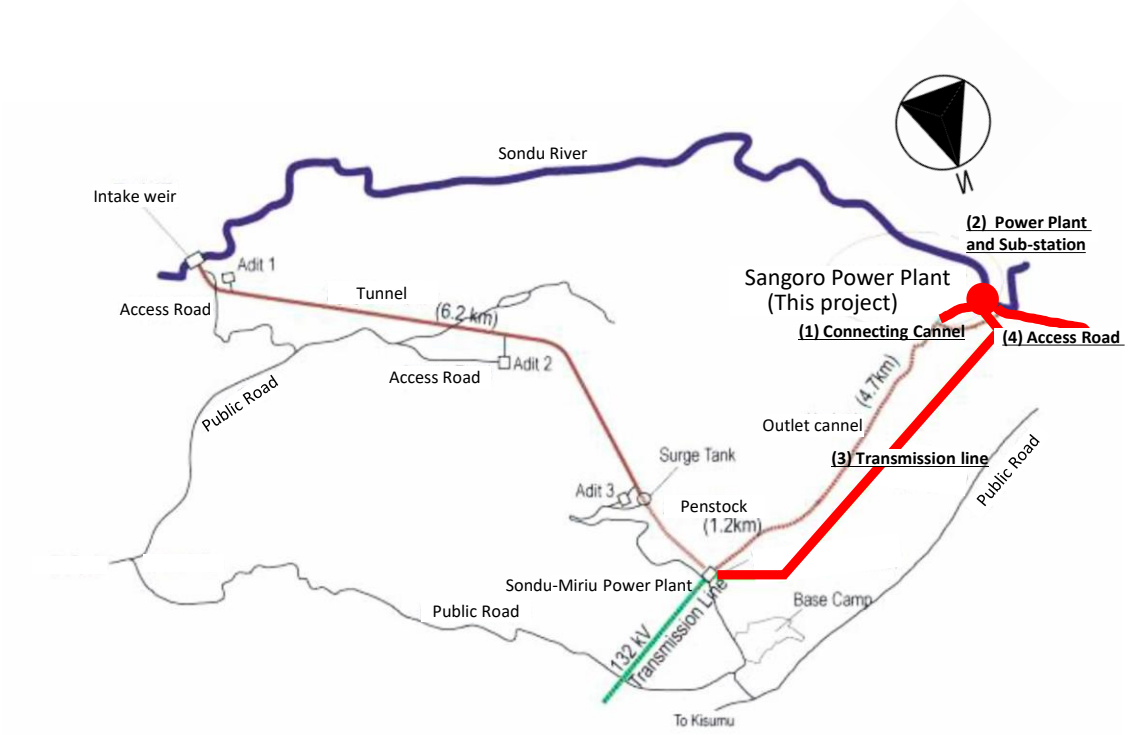
1.1 Background

Around 2005, at the time of this project's appraisal, Kenya was aiming for economic development and poverty reduction through infrastructure development. In those days, there was a tight power supply and demand in Kenya as the power supply could not keep up with the growing power demand because of such reasons as the deterioration of equipment. Thus, the development of electrical power was an urgent issue that the country needed to address, and the Kenyan government was considering measures to tackle the issue immediately. The government

worked out a medium-term power plant construction plan, but the projects implemented concretely as part of this plan were only the Olkaria Geothermal Power Station and the Sondu Miriu Power Station.[1]

Under these circumstances, the Kenyan government requested that a loan be granted for this project, which aimed to develop electrical power using the unused height difference downstream of the outlet channel of the Sondu Miriu Power Station, and JICA appraised the project. Completion of the Sondu Miriu Power Station was scheduled for 2007 and the development project was expected to be carried out in a short period of time if such a loan was granted. In addition, it was assumed that the construction cost of the project would be reduced because it could fully use the existing facilities.

Figure 1 and Figure 2 show a map of how the Sondu Miriu Power Station is related to this project, and photographs of the major components of the project, respectively.



Source: This figure has been created using materials provided by JICA.

Note: The red line on the map indicates the portion of the system that was covered by this project. The project consists mainly of (1) the connecting channels, head tank, and penstock, (2) the power station, generator, and substation, (3) power transmission lines, and (4) the access road.

Figure 1: Summary Map of the Project

[1] The Sondu/Miriu Hydropower Project (E/S) (LA was signed in October 1989), Sondu/Miriu Hydropower Project (LA was signed in March 1997), and Sondu/Miriu Hydropower Project (II) (LA was signed in February 2004)

(1) Connecting channel

(1) Penstock pipe and
(2) the power station

(2) Generator

(2) Substation

(3) Power transmission lines

(4) Access road

Source: Photographs were taken by the external evaluator.
Note: The numbers in the titles of the photographs correspond with those in the Figure 1 map.

Figure 2: Photographs Related to the Project

1.2 Project Outline

The objective of this project is to expand the power supply by constructing a hydropower station with an installed capacity of 21.2 MW in the Kisumu District of Nyanza Province in the western part of the Republic of Kenya, thereby contributing to the improvement of the living standards of Kenyans and the sustained growth of the Kenyan economy.

Loan Approved Amount/ Disbursed Amount	5,620 million yen / 4,318 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	January 10, 2007 / January 23, 2007	
Terms and Conditions	Interest Rate Repayment Period (Grace Period Conditions for Procurement	0.75% 40 years 10 years) General untied
Borrower / Executing Agency	Kenya Electricity Generating Company (KenGen) / Kenya Electricity Generating Company (KenGen)	
Project Completion	July 2013	
Target Area	Kisumu District of Nyanza Province in western Kenya	
Main Contractor	Sinohydro Corporation (China)	
Main Consultant(s)	Nippon Koei Co., Ltd. (Japan)	
Related Surveys (Feasibility Studies, etc.)	<JICA> Preliminary studies for the Sondu River multipurpose development project (1982), preparatory studies for the Sondu River multipurpose development project (1983), and feasibility studies for the Sondu River hydropower development plan (1985) <KenGen> Detailed design of an additional power station for the Sondu-Miriu/Sang'oro hydropower plant construction project (2000) and the implementation program for the	

	Sondu-Miriu/Sang'oro hydropower plant construction project (2005)
Related Projects	Electric power rehabilitation project (World Bank, European Investment Bank, Agence Française de Développement, and Nordic Development Fund, 2003–2014), Kenyan Electricity Modernization Project (World Bank, 2015–2020), and KenGen guarantee project (World Bank, 2018–2021)

2. Outline of the Evaluation Study

2.1 External Evaluator

Ryuji Kasahara (IC Net Limited)

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.
Duration of the Study: December 2018–February 2020
Duration of the Field Study: January 26–February 9, 2019; and May 11–17, 2019

2.3 Constraints during the Evaluation Study

(1) Because the evaluator could not obtain the project progress report and the completion report, both of which were compiled by consultants, it should be noted that the information obtained during the implementation period is overly dependent on interviews with the executing agency and with representatives of the residents.
(2) Kenya Electricity Transmission Company (KETRACO) is supposed to undertake the maintenance of the power transmission lines built under this project. However, in practice, Kenya Power and Lightning Company Limited (KPLC) was in charge from after completion of construction to the time of the ex-post evaluation. The lines were handed over to KETRACO but are being maintained by KPLC under a service level agreement between KETRACO and KPLC. KETRACO will undertake the maintenance in the future, but at the time of the ex-post evaluation, the evaluator could not pinpoint an exact date when the maintenance will be transferred. Therefore, the sustainability of the project was assessed based on KPLC's operation and maintenance system, technology and finances.

3. Results of the Evaluation (Rating: A[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of Kenya

At the time of the appraisal and the ex-post evaluation, the Kenyan government's national development policy documents and electric power sector development plan (*Least Cost Power Development Plan: LCPDP*)[4] highlighted the development of power sources as one of the government's development priorities, and this project was highly consistent with the government's policy. At the time of the appraisal, the Kenyan government viewed the importance of developing power sources as a way to "develop the economic infrastructure to ensure stable economic growth, and as a way to respond to the tight power supply and demand." At the time of the ex-post evaluation, the Kenyan government positioned it as "a means of laying the foundation for National Transformation and providing electricity at an affordable

[2] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[3] ③: High, ②: Fair, ①: Low
[4] This consists of the Kenyan government's medium-term plan, *Investment Program for the Economic Recovery Strategy for Wealth and Employment Creation (IP-ERS)*, and *LCPDP 2006–2026* at the time of the appraisal, its *Third Medium Term Plan 2018–2020*, *Kenya Vision 2030*, and *LCPDP 2007–2037* at the time of the ex-post evaluation.

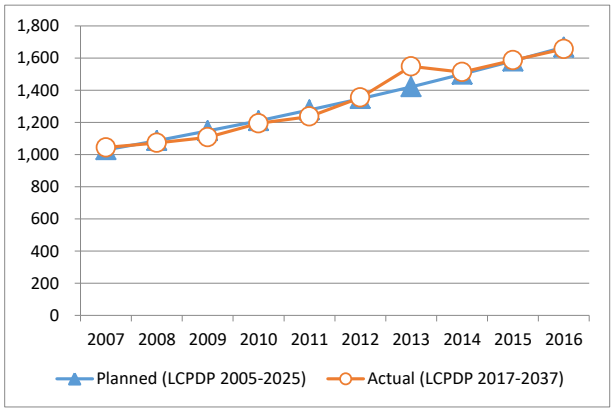
price, in an appropriate and stable manner to support industrial development." This project was listed in the *LCPDP* at the time of appraisal.

This project, which involved building a power station, was in accordance with the government's policy to promote the development of power sources.

3.1.2 Consistency with the Development Needs of Kenya

The peak electricity demand, which stood at 908 MW in 2005 at the time of the appraisal, was expected to grow at an annual rate of about 5% over the following decade. The actual peak electricity demand confirmed at the time of the ex-post evaluation almost corresponded with this prediction, indicating that an enough power capacity to meet the peak electricity demand nationwide had been maintained. In addition, the construction of a power station with an installed capacity of 21.2 MW under the project was in agreement with the government's need to meet the growth in peak electricity demand. In Figure 3, the blue line shows changes in peak electricity demand as estimated at the time of the appraisal with the red line indicating the actual changes confirmed at the time of the ex-post evaluation.

Meanwhile, at the time of the appraisal, there was an urgent need to stabilize the regional power supply by implementing the project in the Western region, particularly West Kenya,[5] where there were only a few power stations. In the same region, the biofuel power station in Mumias (21.5 MW) and the gas-fired power station in Muhoroni (30 MW)[6] were the only power stations newly built during the period from the time of the appraisal to the time of the ex-post evaluation, and even at the time of the ex-post evaluation, the number of power stations in the Western region was small. This project is considered consistent with the need to stabilize the regional power supply by building a power station in the region.



Source: LCPDP2005 and LCPDP 2017

Figure 3: Planned and Actual Peak Electricity Demand

3.1.3 Consistency with Japan's ODA Policy

At the time of the appraisal, the *Country Assistance Program* (2000) stated that the Japanese government would strive to develop economic infrastructure, including energy support development. The *Implementation Policy for Overseas Economic Cooperation Operations* (April 2005 to March 2008) at the time of the appraisal emphasized that the development of

[5] Power stations are controlled by dividing the country into four regions (The parentheses indicate sub-districts): Coast, Nairobi (Nairobi South, Nairobi North, and Nairobi West), Mt. Kenya (Mt. Kenya, North, and North Eastern) , and Western (North Rift, Central Rift, West Kenya, and South Nyanza). Because there have been slight changes to the division of the country since fiscal 2014, attention needs to be paid when analyzing the data by region. For reference, the region was formerly divided into Coast, Nairobi (Nairobi South, Nairobi North, and Nairobi West) , Mt. Kenya (Mt. Kenya North and Mt. Kenya South) , and Western (North Rift, Central Rift, and West Kenya) .

[6] This gas-fired power station was relocated from Embakasi (Nairobi).

electric power was important to bring and expand development effects, that in view of such importance, the Japanese government intended to grant an ODA loans, and that it should keep regional development in mind when granting ODA Loans. Therefore, the project (power generation project) , which kept the need to relieve the tight power supply and demand, and the need to stabilize regional power supply in mind, was consistent with Japan's aid policy at the time of the appraisal.

3.1.4 Appropriateness of the Project Plan and Approach

According to the executing agency's strategy document[7] at the time of the appraisal, considering the planning and construction period up to completion, the construction of a thermal power station was chosen as a measure to cope with the tight power supply and demand.[8]

At the time of the ex-post evaluation, the *Power Generation and Transmission Master Plan* (2015-2035) and the *Climate Change Adaptation Plan* (2015-2030), both formulated in 2015, highlighted the policy of reducing dependency on hydroelectric power generation, which is affected by rainfall, and developing electric power through geothermal power generation as a way to reduce such dependency. In other words, at the time of the appraisal, thermal power generation was considered as a principal means of developing electric power, and at the time of the ex-post evaluation, geothermal power generation was considered as such, indicating that at both points in time, hydroelectric power generation was not regarded as a principal means of developing electric power, although the need of hydroelectric power generation was recognized for a flexible capacity to the power system.

According to the planning department of the executing agency, by the time of the appraisal, the project planning and land acquisition required for the construction of a power station had been completed through the development of the Sondu Miriu Power Station; therefore, it was assumed that it was possible to complete the project early, and the project was added to the list of measures to cope with the tight power supply and demand.

Both at the time of the appraisal and at the time of the ex-post evaluation, there were only a small number of candidates for power stations using renewable energy efficiently that could be built in western Kenya. One of such few candidates was the current project whose approach was to make the most of the water flowing out of the Sondu Miriu Power Station to build an additional hydroelectric power station. In fact, as shown by the implementation of the Olkaria-Lessos-Kisumu Transmission Lines Construction Project (whose L/A was signed in December 2010), electricity needs to be transmitted to western Kenya from outside as the demand for power there grows.

Therefore, the project plan and approach were appropriate as a way to alleviate the tight power supply and demand and to stabilize the regional power supply.

In light of the above, this project has been highly relevant to the Kenya's development plan and development needs, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ③)

3.3 Effectiveness and Impacts[16] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

The effectiveness of the project was evaluated based on operation and effect indicators, which were included in the ex-ante evaluation paper at the time of the appraisal. The five indicators

[7] *KenGen 2007 Transformation Strategy*

[8] No large (medium-sized) hydroelectric power station was built after this project. It was assumed that the construction of a thermal power station was not a long-term solution because thermal power generation is costlier than other types of power generation (hydroelectric and geothermal) in terms of fuel expenses.

[16] Sub-rating for Effectiveness is to be put with consideration of Impacts..

used were: (1) Unplanned outage (days/year), (2) Capacity factor (%), (3) Planned outage (days/year), (4) Maximum output (MW), and (5) Amount of electricity at the transmission end (GWh/year). At the time of the appraisal, targets were set for two years after project completion. Based on the materials collected at the time of the ex-post evaluation, the effectiveness of the project was evaluated by considering the 2015 results as those for two years after project completion. Table 5 lists the targets, actual results, and the degree of achievement for the abovementioned five indicators.

Table 5: Targets and Actual Results for Operation and Effect Indicators

		Targets (Note 1)	Actual Results (Note 1)						
	Indicators	2015 2 years after project completion	2012* Completion of construction	2013 Project completion	2014 1 year after project completion	2015 2 years after project completion	Degree of achievement (Result/ target)	2016	2017
(1)	Unplanned outage (days/year) (Note 2)	2	31.3	9.7	7.8	2.0	100%	86.6	13.0
(2)	Capacity factor (%) (Note 2)	57.2	75.0	59.0	67.3	75.7	132%	48.4	69.6
(3)	Planned outage (days/year) (Note 3)	14	0.4	31.7	25.7	16.9	82%	12.5	11.9
(4)	Maximum output (MW)	21.2	21.2	21.2	21.2	21.2	100%	21.2	21.2
(5)	Amount of electricity at the transmission end (GWh/year) (Note 4)	106.2	117.3	109.3	124.6	140.3	132%	89.7	128.9

Source: Materials provided by JICA, the executing agency, etc.

*Data for (1) to (3) in July and August 2012 are missing.

Note 1: Because a new power station was being built, the base value for each indicator was zero, and its listing was omitted. Targets were set referring to the materials provided by JICA. Indicators were evaluated for one year; the fiscal year from July to June of the following year. Construction was completed in July 2012, but because it was assumed that the project was completed in July of fiscal 2013, fiscal 2015 was set as two years after project completion.

Note 2: At the time of the appraisal, the equipment use rate (%) was calculated using the following formula: (Amount of electricity at the transmission end (GWh/year) × 1,000) ÷ (Maximum output (MW) × 24 hours × 365 days). The same formula was also applied for this evaluation.

Note 3: The degree of achievement was calculated using the following formula: (Result/365 days) ÷ (Target/365 days).

Note 4: The amounts were calculated using the amount of electricity generated (kWhrs), which was provided by the executing agency, and in-facility power consumption.

Apart from Indicator (3) Planned outage (days/year), all indicators achieved their targets. However, the degree of achievement for Indicator (3) exceeded 80%, indicating that overall, the project largely achieved its targets. The following section explains more about each indicator.

Indicator (1) Unplanned outage (days/year) achieved the target. The target was two days/year, and the result was two days/year, making the degree of achievement 100%. However, the results in fiscal 2016 and 2017 dropped below the target. According to the executing agency, the reasons that the result fell far below the target were droughts for both years and particularly in fiscal 2016 the sudden functional failure of the generators' oil cooler. The countermeasure after the breakdown was explained in the section "3.4.4 Status of Operation and Maintenance."

The target and result for Indicator (2) Capacity factor (%) were 57.2% and 75.7%, respectively, with a degree of achievement of 132%. This indicator attained the target. In fiscal 2016, the target was not reached because there was a substantial number of unplanned power failures, but in 2017, the power supply recovered so as to exceed the target.

With its target and result at 14 days/year and 16.9 days/year, respectively, Indicator (3) Planned outage (days/year) had a degree of achievement of 82%. In fiscal 2015, the indicator went below the target, but in fiscal 2016 and 2017, it exceeded the target. Interviews with the

executing agency indicated that the reason the indicator fell below the target was the blackouts planned by KPLC, which was responsible for electricity distribution.

The target for Indicator (4) Maximum output (MW) was 21.2 MW, and the result was 21.2 MW, meaning that the target was achieved. The project aimed to achieve an output of 21.2 MW by operating the two generators it procured, and the result indicated that both generators were in operation at all times.

Indicator (5) Amount of electricity at the transmission end (GWh/year) achieved the target with a degree of achievement of 132%. The target was 106.2 GWh/year, and the result was 140.6 GWh/year. In fiscal 2016, the result was 89.9 GWh/year, falling below the target, because generator failures and droughts occurred simultaneously. However, in fiscal 2017, the result was 129.3 GWh/year, exceeding the target. According to the executing agency, the reason the result exceeded the target was that at the time of the appraisal, targets were set on the assumption that some of the water discharged from the Sondu Miriu Power Station would be used for the Kano Plain Irrigation Project, but then in 2015, that the irrigation project was not developed, the water expected for irrigation now being used for power generation.

Therefore, the efficiency of the project was high because the results generally exceeded the targets set for the hydroelectric power station constructed under the project.

3.3.1.2 Qualitative Effects (Other Effects)

Refer to Section 3.3.2 “Impacts.”

3.3.2 Impacts

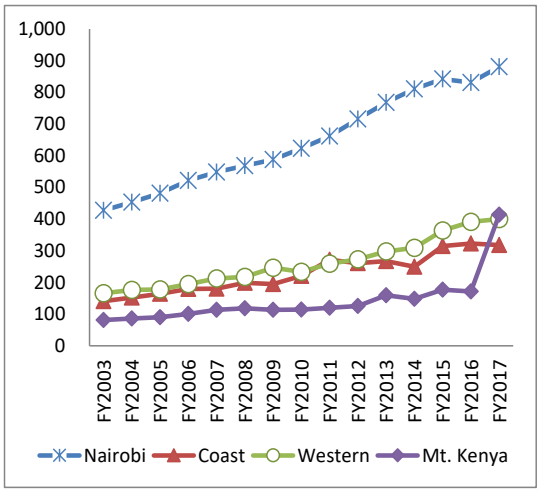
3.3.2.1 Intended Impacts

According to the documentation provided by JICA, the following three impacts of this Sang’oro Power Station development project were expected: ① to contribute to the improvement of citizens’ living standards and sustainable economic growth, ② to promote regional electrification through increasing power supply, and ③ to alleviate the tight power supply and demand, and to improve the stability of the power supply. Because various factors are intricately involved with the attainment of ① and ②, it is difficult to analyze in isolation any direct causal connection to this project. Therefore, ① and ② are treated as reference information for evaluation while ③ will be the main subject of evaluation. As shown below, the information on (1) power supply and demand, (2) electrification rate, (3) economic growth, and (4) the planned targets and actual achievements of power plant development is organized by region.[17]

(1) Power supply and demand

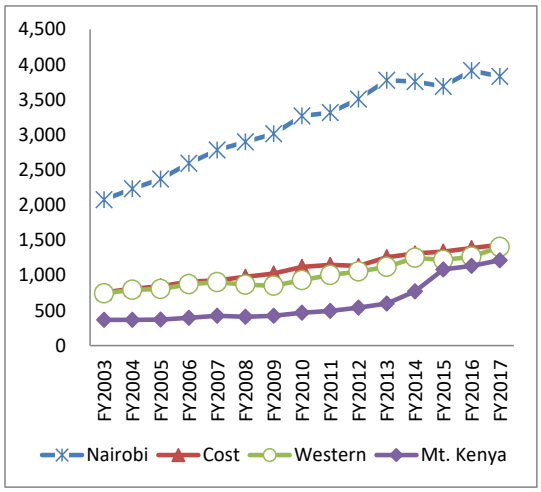
Figure 4 and Figure 5 show the trends of peak-time power demand (MW) and annual power supply (GWh/yr) by region. These also present an increasing trend in power demand and power supply in the western region, where power development has progressed through this project.

[17] The four KPLC divisions used in power management (Nairobi, Coast, Western, and Mt. Kenya) are used.



Source: KPLC Annual Report

Figure 4: Peak-time Power Demand by Region (MW)



Source: KPLC Annual Report

Figure 5: Power Supply and Consumption by Region (GWh/yr)

(2) Electrification

Table 6 shows the changes in the electrification rate in the entire country, urban areas, and rural areas. As a whole, electrification is progressing in rural areas. Increases in the electrification rate should also note factors aside from new power source development, such as improvements in access to existing power grids.[18]

Table 6: Electrification Rate (%)

	2003 (1)	2009 (2)	2014 (1)	2018 (3)
Urban areas	50.2	50.40	68.40	No data
Rural areas	4.6	5.10	12.60	No data
Entire country l	16.0	No data	36.00	75.00

Source: (1) Demographic and Health Survey, (2) Population Census, (3) National Electrification Plan 2018

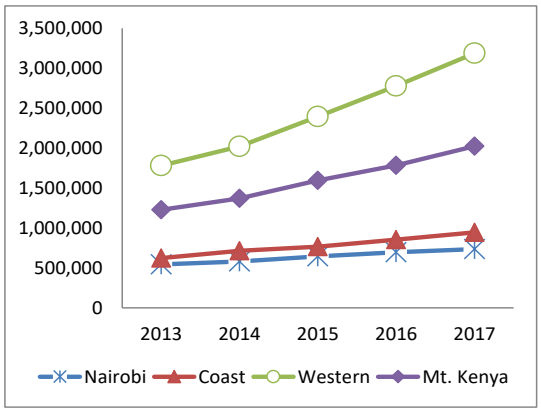
Note: Because the sources of information vary, it should be noted that definitions, such as urban-rural distinction, and the way information was collected are not consistent.

(3) Economic growth

Figure 6 and Figure 7 show the proportion of nominal regional GDP values and regional GDPs in the total GDP of Kenya.[19] The western region, where power development has progressed through this project, is showing an increasing trend in normal GDP value and proportion, which can be understood as enjoying positive economic growth.

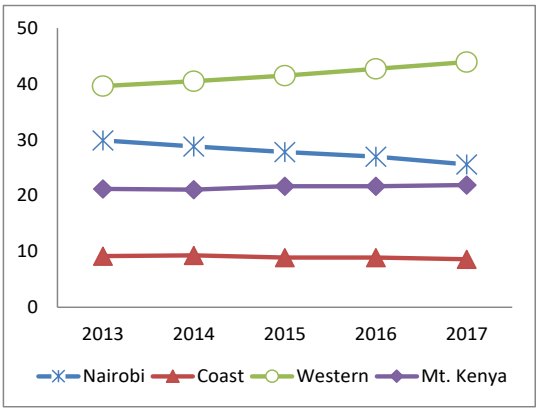
[18] According to KPLC's 2017 annual report, the Last Mile Connectivity Project ongoing from 2015 has been contributing to electrification.

[19] GDP by county, issued by the Kenya National Bureau of Statistics, is summarized into the four KPLC-based management regions. County means the local municipality in Kenya.



Source: Kenya National Bureau of Statistics 2019

Figure 6: Regional GDP per Capita (In nominal value, Unit: million Kenyan shillings)

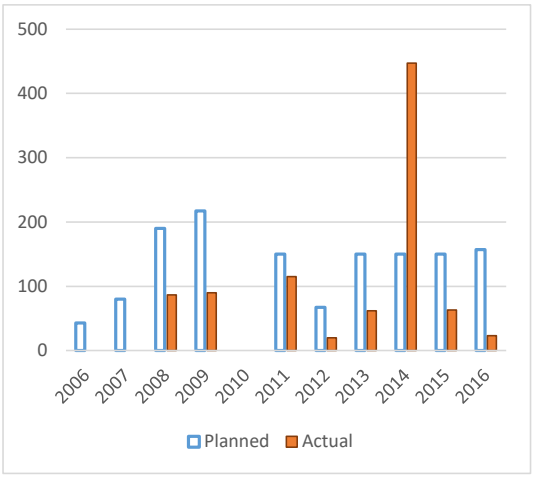


Source: Kenya National Bureau of Statistics 2019

Figure 7: Regional GDP per Capita (%)

(4) Planned targets and actual achievements of the power generation development

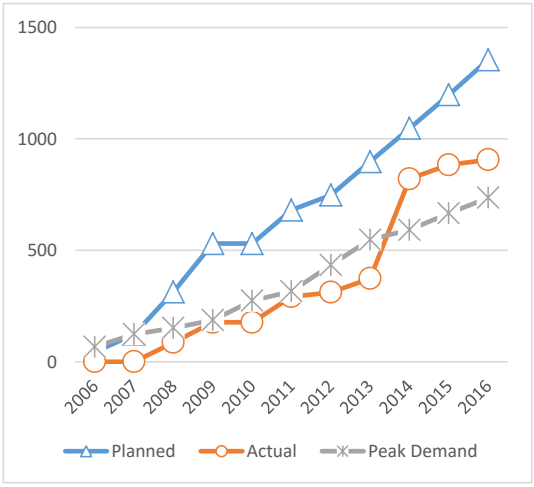
Figure 8 and Figure 9 compare the power capacity (MW) in the new construction plan for the power plant mentioned in the 2006 power development plan (*LCPDP*) and that of the actual achievements of the new power plant as provided by the 2016 power master plans.[20] The planned values and actual performance values diverge, which indicates that the new power plant construction was not progressing as planned and that the power development had not caught up with the increase in peak-time power demand.[21] It was in the midst of such a tight situation that the Sang'oro Power Station was constructed in 2012.



Source: LCPDP 2006, Power Master Plan 2016

Note: The planned target and achievement values are both zero for 2010.

Figure 8: Planned Targets and Achievements of Power Generation Development (MW)



Source: LCPDP 2006, Power Master Plan 2016

Figure 9: Planned Targets and Achievements of Power Generation Development (MW/Cumulative)

[20] *Least Cost Power Development Plan 2006–2026* and *Development of a Power Generation and Transmission Master Plan, 2015–2035*.

[21] Figure 8 does not indicate that the peak-time power demand (MW) exceeds the total installed capacity (MW). The total installed capacity as of 2006 was 1,197 MW, and the peak-time power demand was 987 MW, which means that there was a generation reserve margin of 210 MW. Figure 8 suggests that the generation reserve margin will be low at times with only the new power plant construction because the increase in new power plant construction has not fully caught up with the increase in peak-time power demand. This divergence is partially closed by the emergency Aggreko Power Station (120 MW), which commenced operations in 2008.

Based on the information described in (1), (2), and (3) above, it is difficult to adequately measure the contribution rate of this project alone on the impacts ① and ②. Nevertheless, a general positive relationship is observed between power supply and demand, as well as between electrification rate and economic growth. From the information in (4) above, the Sang'oro Power Station, which was constructed as a part of this project and started power generation in 2012, is deemed to have contributed to impact ③, namely the alleviation of the tight power supply and demand as well as stable power supply.

3.3.2.2 Other Positive and Negative Impacts

This section details other positive and negative impacts of this project with regard to (1) natural environment, (2) resettlement and land acquisition, and (3) others, including a) employment, b) workers' health and safety, c) relationship with other development projects, and d) the application of Clean Development Mechanism (CDM). A committee is established to facilitate the execution of this project by the stakeholders, including beneficiaries, sharing and understanding the issues of environmental and social considerations associated with the project and reviewing, discussing, and proposing measurements. The efforts of this committee, called the Technical Committee, are summarized under item (4).

In relation to the impact items, the evaluator conducted interviews with the members of the Technical Committee as well as the members of the Stakeholders' Coordination Committee[22] about the situation during and after the execution of this project.[23]

(1) Natural environment

The *Environment Impact Assessment Report* of this project is accepted by the National Environment Management Authority (NEMA) in September 2004.[24] The project had obtained permission for developing a power plant inside the Koguta Forest Reserve.

The submission of an annual environmental monitoring report was mandated by the NEMA during the execution of the project. According to the executing agency, it submitted quarterly environmental monitoring reports to NEMA. From the reports, the evaluator observed, it was confirmed that the executing agency was periodically monitoring air pollution, noise, and impact on the ecosystem during the execution of the project. No serious environmental destruction has been reported during on-site interviews.[25]

The recovery of the Koguta Forest Reserve is conducted by means of the executing agency providing saplings to the residents. No issues were reported regarding the rehabilitation of the Koguta Forest Reserve during interviews with the executing agency.

Additionally, after the completion of the project, KenGen, which is responsible for the maintenance of the Sang'oro Power Station, undertakes an annual internal environmental audit for the Sang'oro Power Station and submits the report thereof to NEMA.[26]

(2) Resettlement and land acquisition

At the time of the appraisal, compensation was planned for the acquisition of land for the

[22] From the Technical Committee's successful experience of being a vehicle for dialogue with the residents, the executing agency recently organized the Stakeholders' Coordination Committee, which has similar functions as the former. (Source: KenGen Weekly - The Official Weekly e-Newsletter: Vol.9 Issue 13 Friday, April 12, 2019.)

[23] The evaluator interviewed four members of the Technical Committee and four members of the Stakeholders' Coordination Committee.

[24] This project is a part of the Sondu/Miriu Hydropower Project, whose developmental construction started before the Kenyan environmental review system was established; therefore, at the time of the appraisal, it was determined unnecessary to acquire environmental compliance certification for this project alone. The environmental review system was established in Kenya based on the 1999 Environmental Management and Co-ordination Act. The NEMA was founded in 2002 to supervise the environmental review.

[25] The above monitoring report reported on inappropriate water quality, noise, and disposal.

[26] It is mandated to examine any impact on the Koguta Forest Reserve by means of site reconnaissance by the supervisory agency (Kenya Forest Service and NEMA) and the County Environmental Committee in the municipality after the completion of the project. As of the ex-post evaluation, this has not been conducted yet.

construction of transmission towers for power transmission lines for this project as well as for the way leave for power transmission lines. This compensation was paid based on the laws of Kenya. For the acquisition of land, a fixed amount of compensation is paid per land necessary for the construction of a transmission tower. For the way leave, the amount of compensation is decided in negotiation between the land owner and the executing agency. In addition to land, the structure constructed on the land for which compensation is paid, the constraint of livelihood, and inconvenience are considered and added to the total compensation amount. No gross negligence has been reported regarding the compensation for the relocation of buildings, etc.[27]

(3) Others

(a) Employment

The employment of local workers has been promoted through efforts such as the construction business operator establishing Recruitment Officers for the employment of local workers and the screening of applicants and referral of successful candidates to the construction business operator by a sub-committee (employment and economic opportunities) of the Technical Committee.

(b) Health and safety

At the time of the appraisal, the executing agency is required to ensure the workplace health and safety of civil engineering workers as well as take measures against adverse effects in society such as the spread of HIV/AIDS. In fact, the executing agency has been providing facilities to the Voluntary Counseling and Testing Center, which it is established under the Sondu-Miriu Hydropower Project. The environmental monitoring report, which the evaluator reviewed, reported that the distribution of safety gear to civil engineering workers had been insufficient, but fortunately, it did not lead to gross negligence as a result.

(c) Relationship with other development projects

The amount of water that can be used for power generation at the Sang'oro Power Station depends on whether the development of Kano Plains Irrigation, which uses the Sondu River, takes place. From the interviews with the National Irrigation Board, it was confirmed that Kano Plains Irrigation had not been developed yet at the time of the ex-post evaluation. However, the evaluator has also received information that the National Irrigation Board has conducted a survey on the Kano Plains Irrigation Project and that future development can be expected depending on the allocation of Kisumu County's project budget. The future direction of this process should be closely observed.

(d) Application of the Clean Development Mechanism (CDM)

The feasibility of the CDM application to this project was to be discussed during the appraisal. Prior to applying for review of the CDM application for this project, the CDM application for the Sondu-Miriu Hydropower Project had been reviewed, where it was concluded that the Sondu-Miriu Hydropower Project was not eligible for CDM application as it developed before the establishment of CDM. Because it was deemed that the same conclusion would apply to this project, which started as a part of the development of the Sondu-Miriu Hydropower Project, applying for review of the CDM application did not take place.

(4) Dialogue with residents

For this project, taking after the experience from the Sondu-Miriu Hydropower Projects (I) and (II), a Technical Committee was established as a vehicle for problem solving and dialogue between the executing agency and residents. The Technical Committee consists of representatives of local residents, NGOs, academics, specialists, politicians, regional administrative officials, the executing agency, etc. JICA also participated in regular meetings. Four sub-committees were established under the Technical Committee: land acquisition and compensation, health safety and security, environment, and employment and economic

[27] The easement acquired by the executing agency for the project was transferred to KETRACO, responsible for the management of power transmission lines, from the executing agency in 2015.

opportunities. The quarterly environmental monitoring report includes a record of the activities of each sub-committee, reporting their recognition of the status of issues and action proposals. The Technical Committee was active from December 2008, which is after the construction of Sang'oro Power Station started, to July 2012, when this power plant construction was completed. According to members of the Technical Committee, no activity took place after the completion of the power plant construction, and the Technical Committee was dissolved upon the establishment of the Stakeholders' Coordination Committee, as explained below.

Based on the experiences from Sondu-Miriu Hydropower Projects (I) and (II) and this project, the executing agency KenGen established the Stakeholders' Coordination Committee in each regional office in order to facilitate dialogue between the executing agency and the residents. According to interviews with the executing agency, it has organized two committees, one for the construction phase of the power plant and the other for the operation and maintenance of the power plant after the completion of the construction. At the Western Region Office, which has jurisdiction over the Sang'oro Power Station, the Stakeholders' Coordination Committee was organized upon selecting members by means of election by residents around November 2018.[28] The Stakeholders' Coordination Committee is expected to solve complaints that were heard during on-site interviews through dialogues: for example, a problem in the access road between the Sang'oro Power Station and the main road is causing flooding in the school building of an elementary school adjacent to the access road during the rainy season.

In light of the above, this project has largely achieved its objectives. Therefore, the effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ②)

Table 7 and Figure 10 show key organizations involved with the electricity sector as of the ex-post evaluation, along with their roles and relationships. The maintenance of the power plant and power transmission lines constructed in this project are undertaken respectively by KenGen, the executing agency for this project, and KPLC. The maintenance of the power transmission lines was originally a role to be undertaken by KETRACO,[29] organized in 2008 after the appraisal of this project. From on-site interviews, it was found that KPLC was actually undertaking maintenance on behalf of KETRACO at the time of the ex-post evaluation. For this reason, the maintenance system, capability, and finance of both KenGen and KPLC were evaluated. Information on KETRACO's maintenance is limited to partial summarization.

Table 7: Key Organizations Related to the Electricity Sector

Organization (Note 1)	Major function
Ministry of Energy	Policymaking for the electricity sector
Energy and Petroleum Regulatory Authority (EPRA)	Electricity-related regulations (Note 2)
Kenya Generation Company (KenGen)	Electricity development (Power generation)
Geothermal Development Company (GDC)	Geothermal power generation development
Kenya Transmission Company (KETRACO)	Power transmission (established in 2008)
Kenya Light and Power Company (KPLC)	Power distribution and transmission
Rural Electrification Authority (REA)	Rural electrification

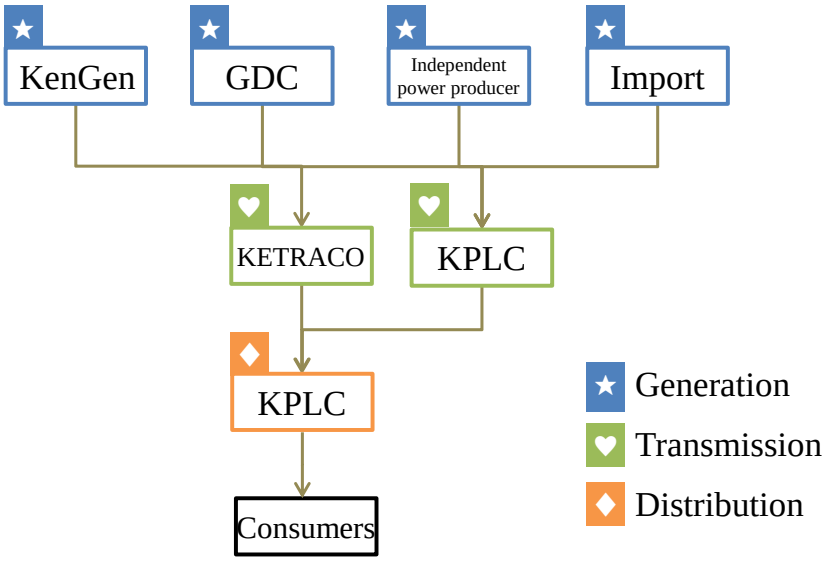
Source: Created based on https://www.ketraco.co.ke/learn/electricity-sub-sector.html (June 24, 2019)

Note 1: The government owns 70% of KenGen's shares, 100% of GDC's shares, approximately 50% of KPLC's shares, and 100% of KETRACO's shares.

Note 2: Organization changed from the Energy Regulatory Commission to EPRA based on the Energy Act 2019.

[28] Information on the members of the Stakeholders' Coordination Committee was not obtained. The number or frequency of meetings held, scope of roles and duties, whether or not there were sub-committees, and other information were undefined as of the time of the ex-post evaluation.

[29] https://www.africa-energy.com/article/ketraco-takes-over-independent-system-operator-kenya (June 9, 2019)



Source: Created based on https://www.ketraco.co.ke/learn/electricity-sub-sector.html (June 24, 2019)

Figure 10: Key Organizations in the Electricity Sector

3.4.1 Institutional / Organizational Aspects of Operation and Maintenance

KenGen undertakes maintenance of power plants and manages power plants by region. The Western Region Office, responsible for the operation and maintenance of the Sang'oro Power Station, was assumed to be in charge of only the Sondu Miriu Power Station and Sang'oro Power Station, but at the time of the ex-post evaluation, it was undertaking operation and maintenance of other nearby power plants[30] in addition to the Sondu Miriu Power Station. The number of staff members for the operation and maintenance of the Sondu Miriu Power Station and Sang'oro Power Station was assumed to be 26 at the time of the appraisal, but 23 staff members were actually assigned as of the ex-post evaluation, which is almost as planned. Figure 11 shows the organizational structure of KenGen as it relates to the Sang'oro Power Station.

KPLC undertakes the maintenance of power plants and manages them by dividing the country into 10 sub-districts/regions.[31] The power transmission lines constructed in this project were assumed to be under the jurisdiction of a sub-region of the Western Region during the appraisal, but as of the ex-post evaluation, they were operated and maintained by the Western Kenya Office. While the number of staff members for the operation and maintenance of the power transmission lines was assumed to be six at the time of the appraisal, 10 staff members were actually assigned as of the ex-post evaluation, which is almost as planned. Figure 12 shows the organizational structure of KPLC as it relates to the Sang'oro Power Station (power transmission lines).

The organizational structure of KETRACO, which will be responsible for the maintenance of power transmission lines of this project in the future, was uncertain while the interviews as of the ex-post evaluation suggested progress in developing a maintenance structure by converting the existing structure for another power transmission line development project.

Although the future structure at KETRACO needs attention, it is deemed that the maintenance structure for the power plants and power transmission lines are established as of the ex-post evaluation.

[30] Hydropower plants GoGo and Sosiani, and gas thermal power plant Muhuorni.
[31] Managed in four districts. The parentheses indicate sub-districts. See footnote 5 for details.

KenGen

Operations Division	➔ **Within Operations Division**		➔ **Within Western Region Department**
Company Secretary & Legal Affairs Division	Western Region Department		Regional Manager
Human Resource & Administration Division	Upper Tana Department		Ass. Operations Manager
Finance & ICT Division	Eastern Region Department		**-Station in-charge Sondu/ Sangoro / Sosiani**
Corporate & Regulatory Services Division	Technical Services Department		**- Shift supt. Sondu/ Sangoro**
Business Development Division	Thermal Department		- Station in-charge Gogo
Geothermal Development Division	Operations Dispatch Department		- Station in-charge Muhoroni Gas Turbine
Strategy & Innovation Division			AG. Chief Engineer
Supply Chain Division			

Source: Created from information in the annual report of the executing agency
Note: The part colored by gray is the offices in charge of operation and maintenance.

Figure 11: KenGen's Organizational Structure for Sang'oro Power Station

KPLC

Business Strategy	**Administrative Regions**	➔ **West Region Office**
Infrastructure Development	Nairobi North	Regional Manager
Network Management	Nairobi South	Chief Engineer／Technical Services Engineer
Street Lighting	Nairobi West	**Transmission Engineer**
Customer Service	Coast	Protection Engineer
Regional Coordination	Central Rift	Electrical Plant Engineer
Company Secretary	West	
Supply Chain	North Rift	
Internal Audit	South Nyanza	
Human Resource and Administration	Mount Kenya	
Finance	North Eastern	
Information and Communication Technology (ICT)		

Source: KPLC Company Profile (2017)
Note: The part colored by gray is the offices in charge of operation and maintenance.

Figure 12: KPLC's Organizational Structure for Sang'oro Power Station (Transmission Lines)

3.4.2 Technical Aspects of Operation and Maintenance

KenGen undertakes maintenance of power plants and clearly defines the competence standards for each position. For example, managerial positions in organizations that undertake operation and maintenance are required to have a bachelor's degree in mechanical engineering and several years of on-site work experience. KenGen conducts personnel evaluations twice a year for each worker and provides training opportunities according to the evaluation result. KenGen develops training programs every year and offers training opportunities to its workers. KenGen has developed and uses a manual for hydropower generation in general and a manual specifically for the operation and maintenance of the Sang'oro Power Station and prepares periodic maintenance reports. As described in "3.4.4 Status of Operation and Maintenance," KenGen swiftly responded to the breakdown of the oil cooler for the power generator that occurred in 2017. Thus, it seems fair to say that KenGen has sufficient technical capacity.

KPLC undertakes the maintenance of power transmission lines and clearly defines the role division and required functions, work experience, and academic background for each office organization. For example, a transmission engineer, which is a managerial position in an organization responsible for the operation and maintenance of power transmission lines, is required to have a bachelor's degree in electrical engineering and five years of work experience. KPLC offers periodic competence training every year and has developed a manual for the operation and maintenance of power transmission lines to manage the technical standards.

According to interviews with the JICA country office, the technical competence of KETRACO, which is to take on the maintenance of power transmission lines of this project in the future, would be sufficient to not cause a serious problem in the maintenance of the five-kilometers of power transmission lines constructed in this project. This can be inferred from its handling of the Olkaria-Lessos-Kisumu Transmission Lines Project, a Japanese ODA Loan Project for which KETRACO is the executing agency. Thus, it seems fair to say that KETRAO has technical capacity to manage the said transmission lines at the time of ex-post evaluation.

Therefore, it seems that KETRACO has the technical capacity for the operation and maintenance of power plants and power transmission lines.

3.4.3 Financial Aspects of Operation and Maintenance

The financial status of KenGen, which maintains the power plants, is shown below. Table 8 shows KenGen's financial statements and financial indicators, KenGen's overall sales, expenditures, and maintenance cost, as well as KenGen's sales, maintenance cost budget and actual cost related to KenGen Sang'oro Power Station. The income from the Sang'oro Power Station is enough to cover the necessary expenses for maintenance. Cost distribution is such that the actual cost exceeds the budget. According to interviews with KenGen, the company prioritizes the allocation of budget to maintenance cost as a general management policy of KenGen. Looking at KenGen overall, a certain level of expenditures is maintained for maintenance cost. KenGen's financial status based on past financial statements is sustained at a sound level in terms of equity ratio, debt ratio, and current ratio. KenGen used a debt equity swap in fiscal 2015, and KenGen guarantee project that started in 2018 with the support of the World Bank is predicted to undergo difficulty in paying short-term debts after fiscal 2018 because of the accumulated previous borrowings; therefore it must be noted that the KenGen guarantee project has refinanced existing debt to improve KenGen's financial soundness.

Table 8: KenGen's Financial Statements and Balance

(Unit: million Shs, financial indicators present actual figures)

	2014	2015	2016	2017
Total assets	342,520	366,738	376,730	379,353
Fixed assets	321,151	344,822	347,090	347,941
Current assets	21,369	21,916	29,639	31,412
Combined total of liabilities and net assets	342,520	366,738	376,730	379,353
Net assets (Capital and reserves)	141,594	172,385	182,836	190,104
Fixed liabilities	178,446	176,163	173,800	168,370
Current liabilities	22,480	18,190	20,093	20,879
(1) Financial indicator: Equity ratio	0.41	0.47	0.49	0.50
(1) Financial indicator: Debt ratio	0.47	0.43	0.42	0.52
(1) Financial indicator: Current ratio	0.95	1.20	1.48	1.50
(2) Income	36,611	39,301	43,432	45,290
(2) Pre-tax profit	8,690	11,171	11,461	11,745
(2) Expenditure (Operating expenses)	4,285	4,559	4,778	-*
(2) Expenditure (Maintenance cost)	1,386	1,624	1,554	1,669
(3) Income (Sales)	818	924	597	856
(3) Expenditure (Maintenance cost/budget)	24	28	30	27

	2014	2015	2016	2017
(3) Expenditure (Maintenance cost/actual)	31	37	39	44

Source: Financial statements and (1) KenGen's annual report (basically the financial statements from fiscal 2017), (2) Documents provided by KenGen and KenGen's annual report, and (3) KenGen's offerings (received data from 2014)
* Expense account has been changed.
(1) Financial indicators: The figures of financial indicators are the results of the following calculations: Equity ratio = Equity / Total assets, Debt ratio = Debt / Equity (Net assets), Current ratio = Current assets / Current liabilities, (2) KenGen's overall income, expenditures, and maintenance cost. (3) Income and maintenance cost of the Sang'oro Power Station.

The financial status of KPLC, which maintains the power transmission lines of this project, is shown below. Table 9 shows KPLC's financial statements and financial indicators, as well as KPLC's overall sales, expenditures, and maintenance cost. KPLC underwent higher depreciation and lower profit in 2017 compared to other years. The maintenance cost also went down. The debt ratio has stayed high for the last few years. The current ratio is dropping, increasing the risk of short-term fund shortage. As of the ex-post evaluation, KPLC is preparing to refinance short-term debts with long-term debts.[32]

Table 9: KPLC's Financial Statements and Balance

(Unit: million Shs, financial indicators present actual figures)

	2014	2015	2016	2017
Total assets	272,286	289,583	331,236	336,655
Fixed assets	206,224	242,265	269,943	282,035
Current assets	66,062	47,318	61,293	54,620
Combined total of liabilities and net assets	272,286	289,583	331,236	336,655
Net assets (Capital and reserves)	57,970	59,379	63,334	64,207
Fixed liabilities	168,717	180,091	189,074	166,190
Current liabilities	45,599	50,112	78,829	106,258
Financial indicator: Equity ratio	0.21	0.21	0.19	0.19
Financial indicator: Debt ratio	1.40	1.69	1.94	1.88
Financial indicator: Current ratio	1.45	0.94	0.78	0.51
Income	106,764	108,375	120,742	125,854
Pre-tax profit	12,254	12,082	7,657	3,089
Net income	7,432	7,197	5,280	1,918
Expenditure (Administration)	11,851	14,830	18,679	15,910
Expenditure (Maintenance cost)	1,114	1,040	1,287	854

Source: KPLC annual report (financial statements from fiscal 2017, fiscal 2016, and fiscal 2015)
Note: The figures of financial indicators are the results of the following calculations: Equity ratio = Equity / Total assets, Debt ratio = Debt / Equity (Net assets), Current ratio = Current assets / Current liabilities

The financial status of KETRACO, which originally had the responsibility of maintaining the power transmission lines of this project, is shown below. Table 10 shows KETRACO's financial statements and financial indicators, as well as KETRACO's overall sales, expenditures, and maintenance cost. KETRACO is a relatively new organization, founded in 2008, and receives and operates wheeling charge from KPLC, which sells electricity. This wheeling charge is determined by government policy and includes maintenance cost. KETRACO's equity ratio and current ratio are both low while its debt ratio is high. Attention must be given to KETRACO's short and medium-to-long term fund management capacity.

[32] https://www.businessdailyafrica.com/news/Short-term-Sh16bn-debt-takes-toll-on-Kenya-Power/539546-4868866-idjjfz/index.html (June 9, 2019)

Table 10: KETRACO's Financial Statements

(Unit: million Shs, financial indicators present actual figures)

	2013 (Note 1)	2014	2015	2016
Total assets	50,128	71,344	109,421	134,860
Fixed assets	45,592	68,685	103,342	126,020
Current assets	4,536	2,659	6,079	8,840
Combined total of liabilities and net assets	50,128	71,344	109,421	134,860
Net assets (Capital and reserves)	1,184	1,002	1,661	2,091
Fixed liabilities	43,250	61,739	97,962	117,985
Current liabilities	5,694	8,603	9,798	14,785
Financial indicator: Equity ratio (Note 2)	0.02	0.01	0.02	0.02
Financial indicator: Debt ratio (Note 2, Note 3)	-	2.98	1.87	1.34
Financial indicator: Current ratio (Note 2)	0.80	0.31	0.62	0.60
Income from wheeling charge	50	735	2,011	2,011
Pre-tax profit	64	371	654	566
Expenditure (Maintenance cost)	No data	239	659	430

Source: KETRACO annual report (basically financial statements from fiscal 2016)

Note 1: Financial statements from fiscal 2014 and fiscal 2015 have been corrected in the financial report for fiscal 2016.

Note 2: The figures of financial indicators are the results of the following calculations: Equity ratio = Equity / Total assets, Debt ratio = Debt / Equity (Net assets), Current ratio = Current assets / Current liabilities

Note 3: Debt ratio was not published in the annual report. The result of the calculation by the evaluator was used.

Therefore, the finances for the operation and maintenance of power plants and power transmission lines have a room for improvement. It is necessary to keep paying attention to fund operation by KenGen, KPLC, and KETRACO.

3.4.4 Status of Operation and Maintenance

KenGen, which maintains the power plants, has been conducting half-term and annual inspections on the Sang'oro Power Station. During the appraisal, it was assumed that KenGen would conduct quarterly and annual inspections, as well as a full inspection every six years. According to interview, full inspection is no longer planned, by reason of a change in KenGen's maintenance policy to use a combination of time-based maintenance, where maintenance is conducted at fixed intervals, and condition-based maintenance, where maintenance is only conducted when deem necessary, and there is an alarm or malfunction.

As of the ex-post evaluation, the following issues and KenGen's responses have been observed: (1) A problem in the main inlet valve has caused a failure to completely stop the water flowing into the power generator's turbine. Water leakage has been resolved by replacement of the valve seal with one from the valve manufacture which was determined not to be robust for the operating conditions hence premature failures. KenGen is planning to redesign and replace with a more suitable seal material. (2) Peeling off of power plant wall tiles and cracks in walls inside the power plant were found, but it has been confirmed that they do not reduce the efficiency or effectiveness of power generation. (3) A problem was found in the IT system designed to enable operation and management of the Sang'oro Power Station from the control room of Sondu Miriu Power Station, which prevented sufficient remote control and management. KenGen plans to replace this IT system by 2020. (4) The oil cooler of the power generator broke down in January 2017. Because importing it from the supplier in China would be costly and time-consuming due to export and customs procedures, KenGen used redesigning techniques to manufacture and procure parts from the domestic market and repaired it in short time to make it in time for the annual inspection.

KPLC, responsible for the maintenance of power transmission lines, has been inspecting the power transmission lines between Sang'oro and Sondu every three to four months. No major problem was found in the power transmission lines or transmission towers during the site visit.

Therefore, it is fair to say that the operation and maintenance of power plants and power transmission lines are in an appropriate state.

In light of the above, a room of improvement has been observed in terms of the financial aspect. Therefore sustainability of the project effects is fair. The power transmission lines, for which the maintenance responsibility is to be transferred from KPLC to KETRACO, need attention in terms of future change in maintenance structure.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was carried sout for the purpose of expanding power supply by constructing a hydropower station with an installed capacity of 21.2 MW in the Kisumu District of Nyanza Province in Western Kenya, thereby contributing to the improvement of the living standards of Kenyans and the sustainable economic growth of the country.

As this project was in accord with Kenya's power development policy and development needs at the time of the appraisal and the ex-post evaluation and Japan's ODA policy at the time of the appraisal, the relevance of this project is high. As there was no change in the general outputs and the project costs and duration were within the plan, the efficiency of this project is high. The target values set as indicators of effectiveness were largely achieved. Additionally, as impacts from this project, this project has contributed to the alleviation of the tight power supply and demand as well as stable power supply. At the time of project implementation and the ex-post evaluation, while some issues were detected concerning the impacts on the natural environment, resettlement, land acquisition, employment, and work environment, no serious negative impact was observed. Therefore, effectiveness and impacts of this project are high. The sustainability of effects generated by this project has no major problem overall despite a room for improvement with respect to finances. Therefore, the sustainability of this project is fair.

In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

As a vehicle for dialogue with residents, the Stakeholders' Coordination Committee was organized in place of the Technical Committee. As the basis of bilateral communication, when defining the scope of works of the Stakeholders' Coordination Committee in the future, it is important to clarify the commitments between KenGen and the residents, such as those concerning the term of members and frequency of meetings, and to mutually abide by these commitments.

4.2.2 Recommendations to JICA

The maintenance of the power transmission lines and transmission towers constructed in this project will be substantively undertaken by KETRACO in the near future. Compared to KPLC, which is currently undertaking maintenance, KETRACO is a young organization and may experience issues with respect to the maintenance structure or technical aspects. Information should be collected as necessary, and assistance should be considered as needed.

4.3 Lessons Learned

<u>Ensuring means for dialogue with residents for large-scale projects and the maintenance thereof</u>

In this project and its predecessor, the Sondu-Miriu Hydropower Project, a committee was organized as a system for consultation and solving issues related to the execution of the project

through periodic dialogues with residents. This system was adopted by the executing agency, and a rule was established in the organization to set up a similar committee in the execution phase of other projects and in the maintenance phase of constructed facilities. For development projects, especially projects that involve land acquisition and compensation, health and safety, natural environment, and employment, it is desirable that the executing agency ensures a means of dialogue with residents, such as the above committee, and alleviate any major negative impacts on the residents through dialogue throughout the entire project management cycle, including project planning, execution, and maintenance.

END of Document

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	1. Construction of connecting channels, a head tank, and a penstock 2. Construction of power plant 3. Installation of power generators (10.6 MW x 2 units) and transformers 4. Installation of power transmission lines	As planned
2. Project Period	January 2007 to December 2013 (84 months)	January 2007 to July 2013 (79 months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	 4,575 million yen 2,037 million yen (1,397 million Kenyan shillings) 6,612 million yen 5,620 million yen (1 Kenyan shilling = 1.46 yen) (As of September 2005)	 3,769 million yen 1,691 million yen (Unknown) 5,499 million yen 4,318 million yen (1 Kenyan shilling = 1.20 yen) (Average between 2007 and 2016)
4. Final Disbursement	August 2016	