FY2023 Simplified Ex-Post Evaluation Report of Japanese Grant Aid Project

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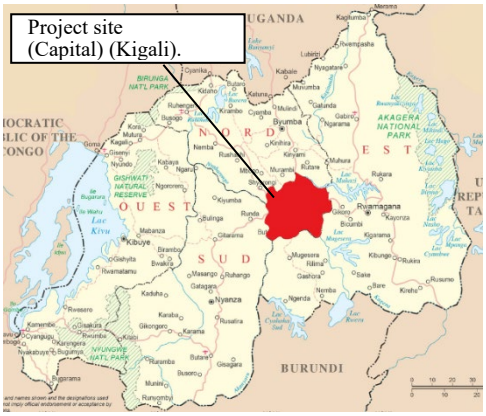
Duration of the Study: October 2023–February 2025
Duration of the Field Study: February 25, 2024 – March 16, 2024

Country Name
Rwanda

The Project for Improvement of Substations and Distribution Network (Phase 2)



Location of the Project Site
(Source: prepared by the external evaluator based on a UN map)

Ndera Substation 110 kV Switchgear
(Source: picture taken by the external evaluator)

I. Project Outline

Background	In Rwanda, following a severe power shortage in 2004, the country's electricity generation capacity had increased and stabilized. However, as of 2015, the installed power generation capacity stood at 160 MW, and the national household electrification rate remained low at 24.5%. Meanwhile, driven by an annual economic growth rate of approximately 8%, electricity demand was increasing at an annual rate of over 10%. Regarding power transmission and distribution facilities, Kigali, the capital city, accounted for 64% of the nation's total electricity consumption. However, investments in transmission and distribution substations to meet this level of consumption were deemed insufficient. Without adequate investment in the power transmission and distribution network, there was a risk of overloading major substations in Kigali, potentially leading to unstable power supply. This instability posed significant challenges to economic activities and efforts to improve people's quality of life.
Objectives of the Project	To improve the stability and efficiency of power supply by strengthening substations, transmission lines and distribution lines, thereby contributing to the economic growth of Kigali.
Contents of the Project	1. Project Site: Kigali 2. Japanese side 1) Facility Construction, Procurement of Equipment, etc. Facilities: Buildings for the Ndera Substation, Murindi and Kabuga Ring Main Unit (RMU) and Switching Station-Foundation for facilities Equipment: 1Ndera Substation: Transformers, gas circuits breaker, etc. 2Murindi and Kabuga RMU Switching Station: Switching station equipment, communication facilities, etc. 3Transmission lines and distribution lines: Overhead transmission lines, distribution lines, etc. 4Existing Gasobi Substation: Installation of the switchgear panel 2) Consulting Service/Soft Component Detailed design, procurement support, construction supervision, etc. (No Soft Component) 3. Rwandan side Securing project lands, site levelling and removal of obstacles in the project site, construction of ancillary facilities for new substations and switchyards, removal of the existing transmission and distribution towers and their foundations, development of a Supervisory Control and Data Acquisition (SCADA) communication network for the new Murindi RMU Switching Station, etc.
Implementation Schedule	E/N Date: 8 March 2016 G/A Date: 8 March 2016 Completion Date: 30 November 2018 (Handover date)
Project Cost	E/N Grant Limit / G/A Grant Limit: 2,219 million yen Actual Grant Amount: 2,143 million yen
Executing Agency	Energy Development Corporation Limited (EDCL)
Contracted Agencies	Main Contractors: Nishizawa Limited/Takaoka Engineering Co., Ltd. (JV) Main Consultant: Yachiyo Engineering Co., Ltd.

II. Results of the Evaluation

Summary

This project aimed to improve the stability and efficiency of power supply by strengthening substations, transmission lines and distribution lines, thereby contributing to the economic growth of Kigali, the capital of Rwanda. The project conformed to Rwanda's development policies and needs. While there were no related JICA projects during the planning and implementation phases, and no synergistic effects with other agencies' support projects had emerged by the time of the ex-post evaluation, the project was consistent with Japan's development cooperation policy at the planning stage. Thus, overall, the project demonstrated high relevance and coherence. Regarding effectiveness, the project's intended outcome—stabilization and efficiency improvement of power supply—was largely achieved as planned. For impact, the project contributed as expected to the promotion of Kigali's economic and social development, demonstrating high effectiveness and impact. Regarding efficiency, the project outputs were almost fully achieved as planned. Although the project period exceeded the initial plan, the project cost remained within the budget. Despite the extended project duration, the overall efficiency was high owing to the achievement of outputs and adherence to the budget. Concerning sustainability, the importance of proper maintenance and continuous investment in the power transmission and distribution network is well recognised in policy and system. For institutional/organisational aspect, the maintenance of facilities and equipment has been conducted as planned by the Energy Utility Corporation Limited (EUCL), the cooperating agency, with established workflows for addressing issues. The required workforce for operation and maintenance has been secured, and there are no technical challenges. In terms of financial aspect, despite deficits caused by rising fuel prices, measures such as increasing hydropower generation and importing electricity from neighbouring countries have been implemented. From an environmental and social aspect, no adverse impacts were observed, and the operation and maintenance of facilities have been conducted satisfactorily. Overall, the sustainability of the project's effects is high.

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

Overall Rating[1]	A	Relevance & Coherence	③[2]	Effectiveness & Impacts	③	Efficiency	③	Sustainability	③

1 Relevance/Coherence

<Relevance>

・Consistency with the Development Policy of Rwanda at the Time of Ex-Ante Evaluation

The Rwandan government identified increasing electricity production, improving electrification rates, reducing power losses, and ensuring a stable power supply as key challenges to support economic growth in its long-term national development plan, *Vision 2020 (2000–2020)*, the medium-term development plan, *Economic Development and Poverty Reduction Strategy II (2013–2018)*, and the sector-specific *Energy Sector Strategic Plan (2013/14–2017/18)*. This project conforms with Rwanda's development policies, as it aims to stabilise and improve the efficiency of power supply in Kigali by developing and expanding substations and associated power transmission and distribution facilities, thereby contributing to the promotion of Kigali's economic and social development.

・Consistency with the Development Needs of Rwanda at the Time of Ex-Ante Evaluation

According to demand projections for Kigali and the central region at the time of this project's planning, the capacity of the existing transformers supplying electricity to the area was expected to reach its limit by 2015 under a high-demand scenario and by 2019 under a low-demand scenario if the capacity was not increased. The Ndera area, where the development of an economic zone was underway, relied on power supply from the neighbouring Birembo and Gikondo Substations. Owing to the high load factors of these substations, frequent power outages caused by unstable supply and equipment failures resulting from voltage instability were occurring. This project addressed these needs by constructing the new Ndera Substation and strengthening the power supply system for the area, thereby aiming to stabilize electricity supply. Thus, the project is deemed to have been well-aligned with the development needs. In conclusion, the project's consistency with development needs is assessed as high.

<Coherence>

・Consistency with Japan's ODA Policy at the Time of Ex-Ante Evaluation

The Government of Japan, in its *Country Assistance Policy for the Republic of Rwanda (April 2012)*, set the promotion of sustainable growth (transition to a middle-income country) as its overarching goal and identified economic infrastructure development as one of its priority areas. Among the specific areas of support for economic infrastructure development, the improvement of power facilities was highlighted. Therefore, the objective of this project conforms with the policy of the Japanese government.

・Internal Coherence

This project was planned with the understanding that EUCL, the cooperating agency, would be responsible for the operation of the facilities after their completion. Through a preceding technical cooperation project, the 'Project for Capacity Building for Efficient Power System Development in Rwanda' (2011–2014), EUCL's technical capacity for facility maintenance had been enhanced. As a result, it was anticipated at the planning stage that EUCL's maintenance of the facilities under this project would contribute to greater effectiveness and sustainability. At the time of the ex-post evaluation, EUCL was maintaining the facilities as planned. However, it could not be confirmed whether the staff who received support under the preceding technical cooperation project were directly involved in the maintenance of equipment provided by this project.

During the ex-post evaluation, Energy Development Corporation Limited (EDCL), EUCL, and the JICA office recognized this project,

[1] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[2] ④: Very High, ③: High, ②: Moderately low, ①: Low

along with the preceding grant aid project, the 'Project for Improvement of Substations and Distribution Network' (Phase 1) (2011–2014), and the subsequent grant aid project, the 'Project for the Improvement of Substations and Distribution Network (Phase 3)' (2018–), as part of an integrated package. Together, these three projects aimed to improve the electrification rate in Kigali and stabilise and enhance the efficiency of the power transmission and distribution network. The target areas of Phase 1, Phase 3, and this project were different regions within Kigali (with Phase 1 also including surrounding areas). While JICA provided continuous support, the lack of coordination among these projects during their implementation means that internal coherence, which evaluates collaboration during project execution, was not achieved. Therefore, it was determined that there was no direct linkage with other JICA projects.

・External Coherence

At the planning stage, collaboration with projects supported by the European Union (EU) and the International Development Association (IDA) was anticipated. However, in practice, no specific coordination or collaboration occurred. Moreover, there is no evidence of unplanned collaboration arising during the project's implementation. Therefore, it is concluded that there was no linkage with projects of other organisations.

<Evaluation Result>

In light of the above, the relevance and coherence of the project are high.[3]

2 Efficiency

[Outputs]

The outputs of this project are as described in 'I Project Outline' above. They were implemented almost as planned.

- Japanese Side

The switchgear panel procured for the existing Gasogi Substation was used in the subsequent project, the 'Project for the Improvement of Substations and Distribution Network (Phase 3)', for the reasons outlined under the 'Rwandan Side'.

-Rwandan Side

There were the following changes in Rwanda's obligations:

1. Owing to difficulties in financing by the executing agency, the renovation of the building for the additional switchgear panel at the existing Gasogi Substation was not conducted. As a result, the switchgear panel procured for the existing Gasogi Substation was used in the 'Project for the Improvement of Substations and Distribution Network (Phase 3)', and the spare switchgear panel originally held by the executing agency was used at the existing Gasogi Substation. This change did not affect the project outcomes, project duration, or project costs. Ultimately, the renovation work at the existing Gasogi Substation was not conducted. The spare switchgear panel was used without issue until the operation of the newly constructed Gasogi Substation (supported by the Phase 3) began in August 2022.[4]
2. After the contractor was selected, the executing agency shared documents indicating the boundary lines of the site. As a result, it was decided to modify the substation design to fit within the existing land rather than purchasing new land. This caused a delay of about five months. However, it seems plausible that this delay could have been prevented if the boundary line documents had been shared by the executing agency at the planning stage.

[Inputs]

-Project Costs

The project cost was 2,496 million yen, which was within the planned budget (100% of the plan). The Rwandan government's share of the costs increased by 125% compared to the plan. The reasons for this increase include the expansion of the compensation targets due to revisions in the land acquisition guidelines, rising land prices, and increased land preparation work owing to the change in the location of the Ndela Substation. The revision of the land acquisition guidelines by the Rwandan government during project implementation expanded the Right of Way (ROW) and the criteria for relocation, resulting in an increase in the number of compensation targets. Table 1 presents the planned and actual project costs.

Table 1: Planned and Actual Project Costs

	Planned (million yen)	Actual (million yen)	Actual vs. Plan (%)
Japanese Side Project Cost	2,219	2,143	97%
Rwandan Side Project Cost	282	353	125%
Total	2,501	2,496	100%

Source: Ex-ante evaluation (planned), interviews with executing agency (actual)

-Project Duration

The planned duration was from March 2016 to February 2018 (24 months), but the actual one was from March 2016 to November 2018 (33 months), exceeding the planned period (138% of the plan). The reasons for the extended duration include delays in securing some of the land for the Ndela Substation (a responsibility of the Rwandan government) and delays in power outages during the construction of

[3] Relevance: ③, Coherence: ②

[4] The existing Gasogi substation was no longer used once the operation of the new Gasogi substation began in August 2022.

transmission lines. Measures taken by the executing agency to address the delays were not confirmed. Table 2 indicates the planned and actual project duration.

Table 2: Planned and Actual Project Duration

	Project Duration	Breakdown
Planned	March 2016– February 2018 (24 months)	-G/A signing to detailed design: 1 month -Detailed design period: 4.5 months (including bidding period) -Construction period: 18 months
Actual	March 2016– November 2018 (33 months)	-G/A signing: March 2016 -Detailed design period: April 2016–August 2016 (5 months) -Construction period: April 2017–November 2018 (20 months) -Completion: November 2018
Actual vs. Plan (%)	138%	

Source: Ex-ante evaluation Sheet (Planned. Although the starting point in the ex-ante evaluation sheet is set to April 2016, following the 2023 external ex-post evaluation reference, the starting point is defined as the month of the G/A (Grant Agreement) signing, which is March 2016. No definition of completion is provided in the ex-ante evaluation sheet), interviews with the executing agency (Actual. The definition of completion is set as the completion of construction).

<Evaluation Result>

Although the project period exceeded the plan, the project cost was within the plan. Therefore, the efficiency of the project is high.

3 Effectiveness/Impacts[5]

<Effectiveness>

[Quantitative effect]

Table 3 outlines the quantitative effect indicators for this project. At the planning stage, the following indicators were established: (Indicator 1) Annual electric energy at sending end of Ndera Substation (GWh); (Indicator 2) Load factor of transformer in Gikondo Substation (%); and (Indicator 3) Power loss of transmission system in Kigali area (kW). These indicators aimed to evaluate the expansion of transmission and substation capacity in Kigali and the reduction of the load factor at the adjacent Gikondo Substation. To assess whether the project contributed to avoiding large-scale blackout risks and stabilizing power supply, two additional indicators were set at the ex-post evaluation stage: (Indicator 4) System Average Interruption Duration Index (SAIDI); and (Indicator 5) System Average Interruption Frequency Index (SAIFI).

-Indicator 1: Annual electric energy at sending end of Ndera Substation

Although the target for this indicator was not achieved three years after project completion (2021), it was met five years after project completion (2023). Therefore, this indicator is considered achieved. Electric energy at sending end is influenced by factors such as generation capacity and electricity demand[6]. In the power system, electricity supply (generation) must match demand, meaning that an increase in demand necessitates an increase in generation, which, in turn, raises electricity transmission levels. The increase in electricity transmitted at the Ndera substation after its commissioning is attributed to growing electricity demand.

-Indicator 2: Load factor of transformer in Gikondo Substation

The target for this indicator was achieved. Before the project, power supply to the Ndera area depended on the neighbouring Gikondo and Birembo Substations, resulting in high load rates at both substations and concerns about unstable power supply. Following the project's completion, the transformer load rate at the Gikondo Substation gradually decreased, demonstrating the project's contribution to reducing its load rate.

-Indicator 3: Power loss of transmission system in Kigali area

Owing to differences in calculation methods, actual values comparable to those used during the project planning stage could not be obtained.

-Indicator 4 (SAIDI) and Indicator 5 (SAIFI)

These indicators measure power supply reliability, with SAIDI calculated as the total duration of outages per customer divided by the total number of customers, and SAIFI as the total number of outages per customer divided by the total number of customers. Available data show a declining trend in both indicators, indicating reduced outage durations and frequencies. This suggests that the project contributed to mitigating blackout risks and stabilising power supply in Kigali.

Among the three original indicators set during planning, Indicators 1 and 2 achieved their targets. Additionally, contributions to Indicators 4 and 5, which measure power supply stability, were observed. Based on these results, the project is assessed to have mostly achieved its objectives.

[5] When providing the sub-rating, Effectiveness and Impacts are to be considered together.

[6] Electric energy at sending end is calculated by subtracting the internal power consumption of the power plant from the gross power generated at the generator terminal. It can also be defined as the sum of the power demand, transmission and distribution losses, and the internal power consumption of substations.

Table 3: Target and Actual Values of Quantitative Effect Indicators for This Project

Indicators	Baseline	Target	Actual					
	2015 Baseline Year	2021 3 Years after Completion	2018 Completion Year	2019	2020	2021 3 Years after Completion	2022	2023
1. Annual electric energy at sending end of Ndera Substation (GWh)	Not applicable*1	58	2.90	21.44	41.66	46.85	48.80	70.24
2. Load factor of transformer in Gikondo Substation (%)*2	59	53–76	60	60	53	44	*3	*3
3. Power loss of transmission system in Kigali area (kW)*4	467	3,225	*3					
4. [Supplementary Indicator]SAIDI	*3	Not applicable	2.80	1.80	1.401	1.22	*3	*3
5. [Supplementary Indicator]SAIFI	*3	Not applicable	8.10	2.802	2.40	2.16	*3	*3

Source: Data provided by JICA (baseline and target values), responses to questionnaires and interviews with the executing agency (actual values)

*1 The Ndera Substation was newly constructed as part of this project, so there were no pre-project values.

*2 Without the project, the transformer load factor at the Gikondo Substation was predicted to reach 63–90% in 2022 owing to increased electricity demand in the target area. The project was expected to reduce the load rate to the target value.

*3 Data were not provided by the executing agency.

*4 Without the project, power losses in Central Kigali were expected to reach 3,937 kW in 2022 due to increased electricity demand in the target area. The project was expected to reduce losses to the target value (3,225 kW).

[Qualitative effect]

The qualitative effect set at the planning stage, 'Promotion of economic and social development in Kigali', corresponds to the project's impact. Therefore, it will be addressed under the impact section below.

<Impacts>

The impact of 'contributing to economic growth of Kigali' was confirmed through both quantitative and qualitative effect indicators.

-Quantitative Effect Indicator 1:

The electricity sales in Kigali were examined. Sales volume is influenced by factors such as generation capacity, power distribution infrastructure capacity, and power losses. This project aimed to increase the supply capacity of power distribution facilities and reduce power losses through the construction of the Ndera Substation and associated power distribution network. The accelerated increase in electricity sales from 2018 to 2022 can be attributed to the increased supply capacity of the power distribution facilities and the reduction of power losses resulting from this project.

-Quantitative Effect Indicator 2:

The electrification rate in Kigali was examined. The electrification rate is influenced by factors such as generation capacity, expansion of the power grid network, and the supply capacity of power distribution facilities. Although the project did not directly aim to improve the electrification rate, it contributed to the expansion of the power grid network and the increase in supply capacity of power distribution facilities through the construction of substations, switchgear, and the power distribution network. Consequently, the project likely contributed to the improvement of the electrification rate. While data prior to January 2024 could not be obtained, information from the executing agency indicated that, due to the continuous expansion of the power grid network since 2018, the electrification rate in Kigali has steadily improved and is nearly 100% at the time of the ex-post evaluation.

Table 4: Actual Values of Quantitative Effect Indicators 1 and 2

	Indicators	Actual						
		2018	2019	2020	2021	2022	2023	As of January 2024
1	Electricity sales to prepaid users in Kigali (kWh)	155,735,899	156,296,380	158,671,457	177,574,385	204,947,078	*1	*1
	(Reference: Year-on-Year Growth Rate)		0.36% increase	1.52% increase	11.93% increase	15.40% increase		
	Electricity sales to postpaid users in Kigali (kWh)	193,243,399	200,538,634	213,321,112	236,088,242	270,210,128	*1	*1
	(Reference: Year-on-Year Growth Rate)		3.77% increase	6.38% increase	10.66% increase	14.45% increase		
2	Electrification rate in Kigali (Gasabo) (%)	*1						88.7%
	Electrification rate in Kigali (Kicukiro) (%)							93.4%
	Electrification rate in Kigali (Nyarugenge) (%)							92.7%

Source: Information obtained from the executing agency and EUCL through interviews.

*1 Data not provided by the executing agency.

[Qualitative effect indicator]

The beneficiaries of the power supply from the newly developed distribution network, including one resident, one factory, and two schools, were interviewed regarding the changes in power supply duration (Qualitative Effect Indicator 1), the frequency and duration of power outages (Qualitative Effect Indicator 2), and the impact on health, economy, and society (Qualitative Effect Indicator 3). All beneficiaries reported an increase in power supply duration and a decrease in the frequency of power outages compared to before the project. The schools reported that students could now study at night. The factory reported that the stability of voltage eliminated machine breakdowns, and the provision of 24-hour electricity led to increased productivity. The residents reported that stable voltage allowed them to use household appliances such as television sets and that children's study time had increased. The stabilisation of the power supply resulted in improvements in education, economy, and social aspects for the beneficiaries, and it can be considered that the project contributed to the promotion of economic and social development in Kigali City.

Table 5: Results of Interviews on Qualitative Effect Indicator 1 (Increase/Decrease in Power Supply Duration)

Beneficiaries	Power supply duration (per day)	
	Before implementation	After implementation
Resident	A few hours	24 hours
Factory	8–10 hours	24 hours
School 1 (Boarding)	Varies by day	24 hours
School 2 (Boarding)	Varies by day	24 hours

Source: Information obtained through interviews with beneficiaries

Table 6: Results of Interviews on Qualitative Effect Indicator 2 (Frequency and Duration of Power Outages)

Beneficiaries	Frequency of power outages (per week)		Duration of power outages (per occurrence)	
	Before implementation	After implementation	Before implementation	After implementation
Resident	2–3 times	Almost none*1	A few hours (sometimes half a day)	A few minutes*2
Factory	4 times	Almost none*1	3 hours or more	Within 10 minutes *2
School 1 (Boarding)	4 times	Almost none*1	1 hour or more	Within 20 minutes *2 (sometimes 2–5 minutes)
School 2 (Boarding)	3 times	Almost none*1	1 hour or more	Within 20 minutes *2 (sometimes 2–5 minutes)

Source: Information obtained through interviews with beneficiaries

*1 Power outages occur for a few minutes during maintenance conducted by EUCL, but no other outages are reported. Scheduled power outages are communicated in advance by EUCL.

*2 The power outages are due to maintenance mentioned above by EUCL.

Table 7: Results of Interviews on Qualitative Effect Indicator 3 (Impact on Health, Economy, and Society)

Beneficiary	Impact on health, economy, and society
Resident (Women Interviewed on Qualitative Effect Indicators 1 and 2)	Owing to the reduction in power outages from this project, children are now able to continue studying at home after school, and they can use electronic appliances such as television. Before the project, the unstable voltage made it impossible to purchase a television set owing to the risk of it breaking; but now that the risk is gone, and they can use television. Prior to the project, due to the unstable electricity supply to the home, it was necessary to go to a nearby shop to charge mobile phones, but now this is no longer required, which was also mentioned as a positive impact.

Source: Information obtained through interviews with beneficiaries

[Other Positive and Negative Impacts]

1. Environmental Impact

This project was classified as Category B under the *JICA Guidelines for Environmental and Social Considerations* (April 2010). It was determined that the project did not fall under large-scale power transmission and distribution lines sectors, and the adverse environmental impacts were not significant. Moreover, it was not located in areas that are particularly susceptible to the impacts listed in the guidelines. Interviews with the executing agency confirmed that environmental monitoring during construction and after operation, as well as measures to mitigate undesirable environmental impacts, were conducted as outlined in the *Environmental Impact Assessment (EIA) report*. No unexpected negative environmental impacts were observed.

2. Relocation and land acquisition

Interviews with the executing agency and sector[7] land and infrastructure management officials confirmed the following:

- Relocation of residents and compensation were conducted based on the *Abbreviated Resettlement Action Plan (ARAP)*.
- All affected individuals, including eight people who had not reached compensation agreements and four people who had not been contacted during the planning stage, eventually reached agreements.
- The number of households requiring relocation increased from the three initially planned to 15. Additionally, the number of households whose crops and trees are eligible for compensation, though relocation is not required, increased from the initially planned 10 to 152[8]. These are owing to changes in the Rwandan government's land acquisition guidelines, which expanded the Right of Way (ROW) and altered the relocation criteria.
- Some affected individuals initially disagreed with the compensation price, but agreements were reached based on the amount assessed by a real estate appraisal agency.
- The majority of workers involved in unskilled labour for the construction were affected people. This was because the local government of the project site and the executing agency agreed to prioritize the employment of affected people over outsiders. The exact number of affected people employed was not provided by the executing agency.

Regarding livelihood restoration, it was found that no specific monitoring was conducted for relocated residents under this project. The reason was inquired with the cell office, but no response was received. However, it was confirmed that if residents had any concerns, dissatisfaction, or requests, they would be able to consult during weekly meetings organized by the cell office. To date, no complaints or issues related to the project have been raised by involuntary relocated residents. Table 8 presents the number of affected individuals by type and the status of agreements.

Table 8: Number of Affected People by Type and Agreement Status

Affected people	Affected Households (Planned)	Affected Households (Actual)	Agreement Status
Relocation Required			
Households (Buildings and Land)	3 households	15 households	Agreement, relocation, and compensation completed (except for 1 household[*1])
No Relocation Required			
Landowners	46 households	46 households	Agreement and compensation completed
Owners of Crops and Trees (without land ownership)	10 households	152 households	Agreement and compensation completed
Total	59 households	213 households	Agreement and compensation completed (except for 1 household[*1])

Source: Information obtained from the executing agency

[*1] At the time of the ex-post evaluation, there was one household for which compensation had not yet been completed. This resident owned two houses on the land, and compensation for the land and one house had been completed. The delay in compensating for the second house was due to the time required to obtain the land title deed, which is one of the necessary documents for compensation. A few days before the ex-post evaluation interviews, the required documents had been submitted to the executing agency, and the resident was awaiting payment.

[7] In Rwanda's administrative structure, sectors and cells are organized below provinces and districts. Sectors provide administrative services such as education, healthcare, and economic development. Cells, which are smaller administrative units within sectors, serve as the primary point of contact with residents, offering more localized and community-based administrative services. The grievance and complaint resolution procedure for this project is as follows: 1. Consultation with community leaders, 2. If unresolved, consultation with the cell office, 3. If still unresolved, consultation with the sector office and district office, 4. As a final step, legal action may be pursued. It has been reported that all grievances and complaints related to this project have been resolved at the sector office level.

[8] The final scale, including the area of land acquired and the number of affected individuals, was not provided by the executing agency.

3. Gender

At the planning stage, no specific initiatives from a gender perspective were anticipated. However, during the implementation phase, initiatives from a gender perspective were confirmed by the executing agency, including efforts related to short-term employment for construction work (gender equality in employment opportunities and consideration for female workers) and attention to gender balance among participants in operational training for the facilities and equipment established by the project. No information regarding the impact of these initiatives was provided by the executing agency.

4. People whose social participation is hindered

At the planning stage, no initiatives were included to address people whose social participation is hindered. No unexpected positive or negative impacts on people whose social participation is hindered were observed as a result of the project. It was confirmed that, as part of efforts for the impoverished population who find it difficult to pay electricity bills, free electricity connections and discounted electricity rates are available[9].

5. Social systems, norms, people's well-being, and human rights

It was confirmed through qualitative effect indicators that children in beneficiary households and students at boarding schools are now able to study at night. This can be considered a positive impact on the right to education for the residents. No specific positive or negative impacts were observed on the existing policies, systems, culture, social inclusion, or empowerment due to the project.

<Evaluation Result>

Therefore, the effectiveness and impacts of the project are high.

4 Sustainability

・Policy and System

The Rwandan government, in its sector development plan *Energy Sector Strategy Plan* (2018–2024), highlights the need for regular and planned maintenance to maintain the efficient performance of the transmission network. It is noted that, without proper maintenance, power losses could occur, leading to significant losses or disruptions in the network, which may result in power supply interruptions to households and industries. The Rwanda Energy Group (REG)[10] has developed the *Rwanda: Transmission Master Plan* and *Rwanda Electricity Distribution Master Plan* for the development of the power system by 2030. These master plans are comprehensive investment plans for the development of the power system, considering future power demand forecasts, the service life of equipment, and the condition of facilities and equipment. They include the renovation and upgrading of existing facilities. As noted in the sector development plan and the master plans, there is an acknowledgement of the need for proper maintenance of the transmission and distribution network and continuous investment for this purpose. Therefore, the sustainability of policies and systems is secured.

・Institutional/Organisational Aspect

The maintenance and management of the facilities and equipment developed under this project are being conducted by EUCL as planned. Daily operations and maintenance are managed by the Transmission Department for substations and transmission lines and the Distribution Department for switchgear and distribution lines. In the event of a malfunction at the Ndera Substation, the alarm system is activated, notifying the on-site operator. If the operator is unable to address the issue, engineers or senior engineers from the Transmission Department take over. The Murindi and Kabuga RMU Switching Stations are operated remotely from the Gikondo Substation's National Control Centre (NCC). In case of a malfunction, the NCC is notified and manages the issue remotely. It has been confirmed that no problems have occurred with this system up until the time of the post-evaluation. Both the Ndera Substation and the Murindi and Kabuga RMU Switching Stations undergo regular inspections. The staffing level for EUCL's Transmission and Distribution Departments, responsible for maintenance, is approximately 90% of the planned staffing (the number of staff for which budget has been secured). While this is less than 100%, it has been confirmed with EUCL that there are no practical issues. Given the clear division of roles between departments and the well-established response flow in case of malfunctions, along with the fact that the necessary number of staff is secured, it is concluded that there are no issues in institutional/organisational aspect.

・Technical Aspect

EUCL, responsible for the operation and maintenance of the facilities and equipment developed under this project, requires relevant academic qualifications, certifications, and experience for the recruitment of engineers. Moreover, EUCL updates its capacity development plan annually and conducts internal training to acquire the latest knowledge and skills. While it is possible that the manuals created for the operation, maintenance, and storage of the facilities and equipment developed under this project have not been used at the time of the ex-post evaluation, EUCL has not reported any specific issues regarding the operation, maintenance, or storage of these facilities and equipment. During the defect inspection about a year after the construction’s completion, the project management consultant confirmed that EUCL was performing appropriate operation and maintenance. Upon re-confirmation with the same consultant during the ex-post evaluation, no concerns about EUCL's technical capabilities were raised. At the time of the ex-post evaluation, EUCL was operating and maintaining a total of eight substations (including the Ndera Substation developed under this project) and the associated transmission and distribution lines within Kigali City. According to EUCL, no technical failures due to a lack of expertise have occurred in the operation and maintenance of any of these substations or lines. Thus, it is concluded that there are no significant technical issues.

[9] It was confirmed that for low-income households struggling to pay electricity bills, connection to the electricity grid, which is typically charged, is provided free of charge, along with discounted electricity tariffs. Information regarding which households qualify as low-income is shared by sector or cell offices, and the determination is made by either EDCL or EUCL. (When new electricity supply is introduced to an area as part of a power development project, EDCL is responsible for identifying low-income households. In areas where electricity is already supplied, EUCL identifies low-income households in cases of new occurrences or influxes of such households.)

[10] REG is the oversight body for EDCL, the executing agency for this project, and EUCL, cooperating agency.

・Financial Aspect

From 2022 to 2023, the gross profit deficit expanded owing to the surge in fuel prices. In response, the Rwandan government increased hydroelectric power generation, electricity imports from Uganda, and methane gas power generation from Lake Kivu. As a result, fuel purchasing costs are expected to decrease in 2024. The operating and maintenance costs are covered by electricity revenue and government subsidies. Although the proportion of government subsidies relative to electricity revenue has been decreasing, subsidies will continue in the future owing to the public nature of the project. Rwanda Utility Regulatory Authority (RURA) sets electricity tariffs, and prepaid payments help prevent arrears. REG has developed a master plan for power system development until 2030 and plans to make investments in infrastructure accordingly. As the necessary financial resources for maintenance have been secured and there has been no negative financial impact from arrears, the financial situation regarding the sustainability of project outcomes is stable.

Table 9: Changes in EUCL's Electricity Revenue, Fuel Purchase Costs, Government Subsidies, and Operating/Maintenance Costs (Unit: Rwandan franc [RWF])

Item	2021	2022	2023
Electricity Revenue	127,948,878,814	144,282,955,741	164,857,798,475
Fuel Purchase and Power Purchase Costs	-96,470,048,808	-150,571,483,028	-185,240,114,017
Gross Profit	31,478,830,006	-6,288,527,287	-20,382,315,542
Government Subsidies	42,745,884,377	39,352,863,859	37,159,669,427
Distribution Costs (Including Operating/Maintenance Costs)	-14,681,549,627	-14,897,720,233	-19,363,537,222

Source: Interviews with EUCL

・Environmental and Social Aspect

Through interviews with the executing agency, it was confirmed that environmental monitoring during construction and after commissioning was conducted according to the monitoring plan outlined in the EIA report. Measures to mitigate undesirable environmental impacts were implemented as described in the EIA, and no unforeseen negative environmental impacts were identified.

・Preventative Measures to Risks

No risks that could negatively affect the sustainability of the outcomes were observed.

・Current Status of Operation and Maintenance

EUCL has been operating and maintaining the equipment and facilities established under this project as planned. Site visits to the Ndera Substation, and the Murindi and Kabuga RMU Switching Stations confirmed that the equipment, transmission lines, and distribution lines within these facilities are operating without any issues. Regular maintenance, including dust removal from equipment, is being conducted, and no problems related to operation and maintenance have occurred thus far. The response procedures in case of trouble are well-established, and no issues have arisen from the responses taken. Therefore, no problems were observed regarding the operation and maintenance status.

<Evaluation Result>

Therefore, the sustainability of the project effects is high.

III. Recommendations &Lessons Learned

・Recommendations to Executing Agency

None

・Recommendations to JICA

None

・Lessons Learned

<u>To avoid delays, the construction site should be thoroughly examined during the preparatory survey stage, and the need for land acquisition should be reviewed at an early stage.</u>

The executing agency and JICA need to confirm the current land boundaries during the preparatory survey and agree on whether additional land acquisition is required. One of the factors contributing to the delay in this project was the relocation of the Ndera substation. The need to change the construction site arose because, just before the start of construction, it was discovered that part of the detailed plans for the substation encroached on land that had not yet been acquired. This issue could have been avoided if the land boundary documents had been shared earlier by the executing agency.

Additionally, the executing agency must ensure proper record-keeping and smooth information transfer, especially when staff changes occur. The lack of communication regarding the necessity to share land boundary documents may have been due to a failure in information sharing or handover within the agency.

<u>To calculate the baseline and actual values of the quantitative effect indicators using the same method, the executing agency needs to understand the calculation method for the baseline values.</u>

At the planning stage, JICA needs to calculate the baseline values for the quantitative effect indicators by adopting the definitions and calculation methods of the indicators typically used by the executing agency. Moreover, JICA must share the original data and the formulas used for the calculation of the baseline values with the executing agency at the planning stage. One of the effectiveness indicators, power

loss of transmission system in the Kigali area, was verified during the ex-post evaluation and it was found that the executing agency did not know the calculation method used at the planning stage.

IV. Non-Score Criteria

・Performance
・Objective Perspective
None

・Subjective Perspectives (retrospective)
None

・Additionality
None

Picture 1: Ndear Substation 15kV Switchgear panel
(Source: picture taken by the external evaluator)

Picture 2: Ndera Substation Control Room
(Source: picture taken by the external evaluator)

Picture 3: Kabuga RMU Switching Station Power Supply Equipment
(Source: picture taken by the external evaluator)

Picture 4: Kabuga RMU Switching Station
(Source: picture taken by the external evaluator)

Picture 5: 15 kV Distribution Line
(Source: picture taken by the external evaluator)

Picture 6: Kabuga RMU Switching Station 15 kV Switchgear Panel
(Source: picture taken by the external evaluator)

(End)