Ex-Post Project Evaluation 2011: Package III-3
(Vietnam, Georgia, Kenya)

November 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

WASEDA UNIVERSITY

EV
JR
12-36

Preface

Ex-post evaluation of ODA projects has been in place since 1975 and since then the coverage of evaluation has expanded. Japan's ODA charter revised in 2003 shows Japan's commitment to ODA evaluation, clearly stating under the section "Enhancement of Evaluation" that in order to measure, analyze and objectively evaluate the outcome of ODA, third-party evaluations conducted by experts will be enhanced.

This volume shows the results of the ex-post evaluation of ODA Loan projects that were mainly completed in fiscal year 2009, and Technical Cooperation projects and Grant Aid projects, most of which project cost exceeds 1 billion JPY, that were mainly completed in fiscal year 2008. The ex-post evaluation was entrusted to external evaluators to ensure objective analysis of the projects' effects and to draw lessons and recommendations to be utilized in similar projects.

The lessons and recommendations drawn from these evaluations will be shared with JICA's stakeholders in order to improve the quality of ODA projects.

Lastly, deep appreciation is given to those who have cooperated and supported the creation of this volume of evaluations.

November 2012
Masato Watanabe
Vice President
Japan International Cooperation Agency (JICA)

Disclaimer

This volume of evaluations, the English translation of the original Japanese version, shows the result of objective ex-post evaluations made by external evaluators. The views and recommendations herein do not necessarily reflect the official views and opinions of JICA. JICA is not responsible for the accuracy of English translation, and the Japanese version shall prevail in the event of any inconsistency with the English version.

Minor amendments may be made when the contents of this volume is posted on JICA's website.

JICA's comments may be added at the end of each report when the views held by the operations departments do not match those of the external evaluator.

Vietnam

Ex-Post Evaluation of Japanese ODA Loan
"Power Sector Loan"

External Evaluator: Takeshi Daimon, Waseda University
Miho Kawahatsu, Waseda Research Institute Corporation

0. Summary

The project aimed at (1) establishing an Environment Management System (EMS) in Vietnam Electricity (ENV), (2) installation of environment equipment and (3) facilitation of rural electrification; these measures were intended to contribute to mitigating the environmental impact of the power sector and supporting stable power supply in Vietnam. The relevance of this project is quite high as it is closely related to Vietnam's policies and needs both at the time of the appraisal and ex-post evaluation. However, a lowering of efficiency has resulted from a delay and cancellation of consulting services. Also with regard to effectiveness and impact, it has not fully achieved the intended environmentally positive effects and impacts due to the cancellation of consulting services for establishing EMS at EVN and the Ninh Binh thermal power plant. In light of the original scope of the project, therefore, the effectiveness is considered to be fair. Sustainability, however, is considered to be high. Judging from the current situation of the power sector reform being implemented by the Vietnamese Government, we have confirmed that the direction of restructuring of the EVN group on the whole is in favor of strengthening organizational competitiveness by duly introducing the market mechanism. Also there is a high degree of usage of facilities for distribution of electricity and regular check-ups for operation and maintenance is systematically carried out.

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

1. Project Description

(Project Locations)

(A substation in Bac Ninh)

*In the map on the left, the red circles show the three regions where the subprojects for rural electrification were implemented (5 provinces in t1he North, 4 provinces in the Central, 11 provinces in the South region)

1.1 Background

Since the launch of Doi Moi reform program in 1986, the Vietnamese economy has thrived and this has been accompanied by a sharp increase of electricity demand. During the period from 1996 to 2002, before the project, the annual average rate of electricity consumption increase was 14.6%. ENV estimated that electricity consumption would increase at the annual average rate of about 13% by 2010. In order to satisfy this sharp demand increase, ENV addressed the need for massive electrical power development on the scale of up to 37,600MW in its long-term plan that extended to 2020, and expected that about one-fourth[1] of overall power will be provided by newly built coal-fired thermal power plants since Vietnam is endowed with relatively abundant coal resources. On the other hand, however, the use of coal inevitably brought up the issue of environmental pollution caused by NOx, SOx and particulate matter emitted from ordinary coal-fired thermal power plants. Therefore it was seen as an urgent task to make use of a standardized Environment Management System (EMS) throughout ENV in an organized manner in order to introduce proper guidelines and implement environment measures and programs. Also in order to minimize anticipated as well as ongoing environment burdens through parallel efforts on behalf of rural electrification, the installation of environment-protecting equipment was to be duly made.

1.2 Project Outline

The objective of this project is to establish Environment Management System and to expand distribution services by introducing an Environmental Management System in EVN, installing environmental equipment and facilitating rural electrification; thereby contributing to mitigate environmental impact on power sector and to support stable power supply in Vietnam.

Loan Approved Amount / Disbursed Amount	3,190 million yen / 2,810 million yen
Exchange of Notes Date / Loan Agreement Signing Date	March, 2004 / March, 2004
Terms and Conditions	Interest Rate:0.75% Repayment Period: 40 years (Grace Period: 10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency	The Government of the Socialist Republic of Vietnam / Vietnam Electricity Guarantor: Government of the Socialist Republic of Vietnam
Final Disbursement Date	August 13, 2009
Main Contractor (Over 1 billion yen)	--

[1] At the time of the 2003 evaluation study, it was anticipated that by 2020 of the total of about 37,600MW of installed capacity 9,500MW would be provided by coal-fired thermal generation. It was further anticipated that reform of the power sector would result in the new entry of generation companies primarily as independent power producers (IPP) operating thermal power plants and through private investment through the BOT method.

Main Consultant (Over 100 million yen)	ESBI Engineering and Facility Management (Ireland)
Feasibility Studies, etc.	(1) ”Project Concept Paper for Vietnam: Power Sector Loan” (Maenaam Advisory, August 2003) original version in Japanese (2) “Study on Assisting the Establishment of EMS in EVN, Socialist Republic of Vietnam” (J-Power, January 2004) original version in Japanese (3) “Study on Assisting the Establishment of EMS in EVN, Socialist Republic of Vietnam (Phase II) ” (Chubu Electric Power Co., Inc, April 2004) original version in Japanese
Related Projects	“The Study on National Energy Master Plan in Vietnam”

2. Outline of the Evaluation Study

2.1 External Evaluator

Takeshi Daimon, Waseda University

Miho Kawahatsu, Waseda Research Institute Corporation

2.2 Duration of Evaluation Study

Duration of the Study: December, 2011 – October, 2012

Duration of the Field Study: March 11, 2012 – March 25, 2012, June 30, 2012 – July 8, 2012

2.3 Constraints during the Evaluation Study

With regard to effectiveness and impact, due to data constraints, of all provinces served by two EVN subsidiaries, the Northern Power Corporation (NPC) and Central Power Corporation (CPC), Bac Ninh, Quang Ninh, Quang Nam were selected to be subject to comparison by use of predetermined operation and effect indicators. As Bac Ninh was selected as a pilot province for the project at the time of appraisal,[2] the results of a beneficiary survey conducted as part of the ex-post study was used in the evaluation. Other provinces in the NPC and CPC service areas as well as 12 provinces served by the Southern Power Corporation were not subject to the evaluation as the size of subprojects were deemed too small and limited to represent provincial-wide data; therefore relevant data for the indicators were not collected there.

3. Results of the Evaluation (Overall Rating: B[3])

3.1 Relevance (Rating: ③[4])

3.1.1 Relevance with the Development Plan of Vietnam

With regard to electric power strategy during times relevant to the project, following on the Fifth Power Development Master Plan (2001-2010), in July 2011, the Seventh Power Development Master Plan (2011-2020) was promulgated and according to it within the section on development policy, with regard to reducing the burden on the environment created by the power sector, it referred to "the protection of resources and the environment at the same time that power is developed, and ensuring the sustained development of the nation." At the same time, with regard to the stabilization of electric power supply in provincial areas, it assigned continued high importance to infrastructure improvement in connection with power distribution, stating "It is possible to electrify all villages by 2015, and then 98.6% of all farm households will be able to use electricity, and it is intended that all farm households will be able to use electricity by 2020."

Reform of the electric power sector on the basis of market principles is contained in the Power

[2] A reason of the selection is that Bac Ninh Power Company under NPC implemented subprojects for low voltage power distribution focusing on seven out of the eight districts of the province. That means that they covered almost all of the provincial area and potential beneficiaries were up to 519,000 residents.

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

[4] ③: High, ② Fair, ① Low

Sector Policy Statement issued by the Ministry of Industry in 1997, providing orientation for reform of the sector. Further, at the time of establishment of EVN in 1995, the Vietnamese Government in preparation for joining the WTO,[5] had been examining the legal framework for reform of state enterprises on the basis of the Corporation Law of 2005, after which there was reorganization of state enterprises with the objective of improving their competitiveness, and conversion of some into joint stock companies. It was against this background that the Electric Power Law[6] was passed in 2005, to realize organizational reform in order to promote the introduction of market principles.

The above processes of change denote that the project is highly consistent with both the action plan for implementing the national power strategy and the nature of reform of the power sector.

3.1.2 Relevance with the Development Needs of Vietnam

At the time of the project appraisal, there was perceived need for development of electric power generation capacity on a large scale, in keeping with the rapid increase in power demand that was a result of the country's economic development, and at the time of ex-post evaluation the power sector's priority had been assigned to thermal power development, using coal, petroleum and natural gas which continued to require appropriate environment measures (see Fig. 1).

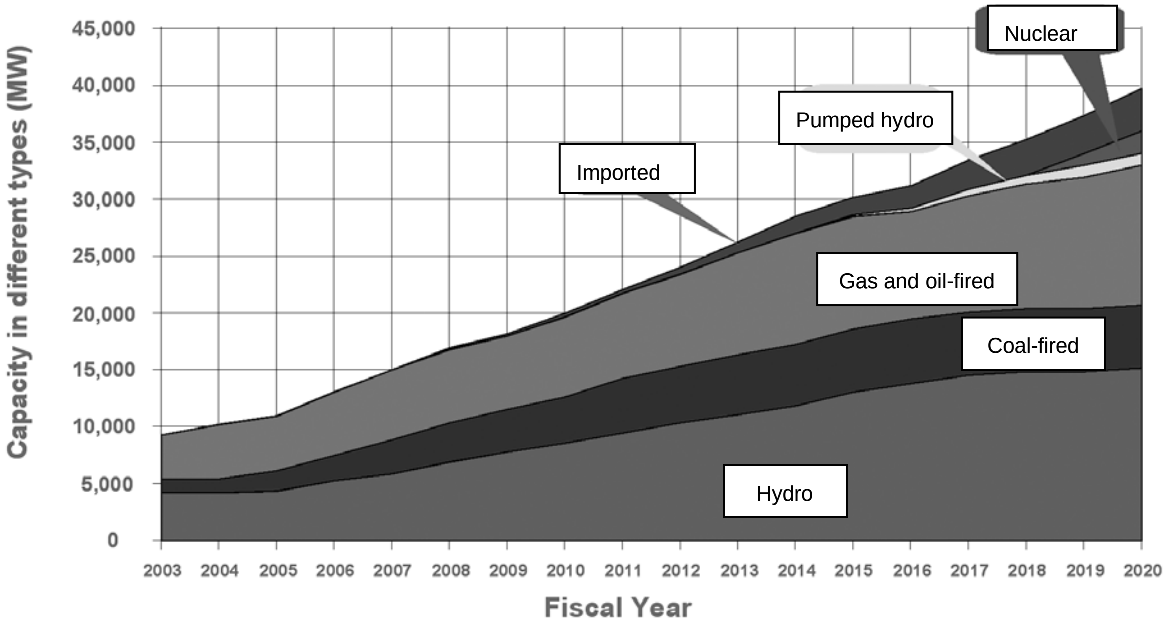


Fig. 1. Power Development Plan of Vietnam (2003-2020)

Source: EVN

At the time of the ex-post evaluation, there had been an increase in the overall national concern over climate change and environment issues[7], making EVN's approach to environment issues all the

[5] After applying for admission to the WTO in January 1995 Vietnam was formally admitted to the organization in January 2007.

[6] The basic principles of the Electric Power Law are (1) formation of a power market operating on the basis of free competition, (2) promotion of investment from within and outside the nation, and (3) protection of the rights of consumers, investors, and employees.

[7] World Bank. Global Facility for Disaster. April 2011. *Reduction and Recovery, Climate Risk and Adaptation Country Profile, Vietnam.*

more important. In 2002 EVN had established at Department of Science, Technology, Environment and Telecommunication[8] and following that there was steady expansion of the organization's structure. Since 2006, the spinning off of companies and organizational change of EVN in keeping with its conversion to a joint stock company resulted in the company's becoming smaller and its operations becoming more narrowly focused. These changes have increased the importance of implementing measures on behalf of the environment. Further, regarding power distribution operations at the regional level, the independent activities and responsibilities of power distribution organizations formed at the level of villages (communes) have been dominant (Fig. 2), as of the time of a nation-wide survey by the Chamber of Commerce and Industry in 2007, less than 40% of all communes were purchasing power from a subsidiary of EVN. Renewal and improvement of power distribution at the commune level thus is lagging – a condition that is hampering the improvement of stable power supply to the rural sector. It is thus evident that operations by distribution subsidiaries of EVN on behalf of effective use of electric power and of ensuring the stable supply of electricity in rural areas continues to be of high importance[9].

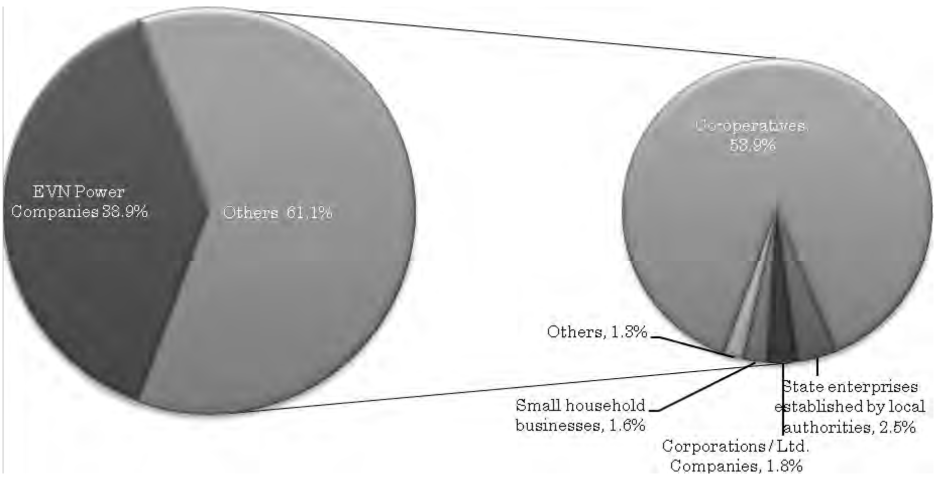


Fig. 2. Shares of Power Distribution by Type of Organization

Source: Vietnam Chamber of Commerce and Industry, 2007.

3.1.3 Relevance with Japan's ODA Policy

At the time of appraisal, improvement of electric power infrastructure was one of the high-priority areas in the country assistance program for Vietnam. It intended to be offering of assistance for operations where development cooperation could be highly effective in improving the use of existing facilities (for power generation, and for energy conservation, etc.), for the stable supply of electric power, and power distribution systems that would contribute to rural electrification, while

[8] It was previously called Center of Environment and Computer.

[9] Eligibility of subprojects was examined by EVN based upon a list submitted by regional power corporations. They had to fulfill the following main conditions: (1) listed in power corporation's investment program in the fiscal years 2003~2006, (2) have never been and not to be financed by the other external resources (e.g., World Bank, Asian Development Bank), (3) Not exceeding 500 million yen per each contract for construction/procurement.

giving attention to improvement of the environment. Another background factor was the policy of assisting ongoing sector reform through implementation of sector loans, particularly through providing advisory support by means of the soft component of the yen loan, to facilitate institutional reform in order to minimize the burden on the environment.

This project has been highly relevant to the country's development plan, development needs, as well as Japan's ODA policy, therefore its overall relevance is high.

3.2 Effectiveness[10] (Rating: ②)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

At the time of appraisal "improvement of the regional power distribution network" were identified as operation and effect indicators and the pilot province for this was Bac Ninh (where the implementing agency was NPC, a subsidiary of the forerunner of the present EVN), and Quang Nam (there, the CPC). Regarding the year to be the target for comparison of actual results to targets this was set at 2008 at the time of appraisal, because implementation had not been delayed.

The results of analysis of indicators for the three provinces are as in the following table.

Table 1. Operation and Effect Indicators in Bac Ninh, Quang Ninh, and Quang Nam

Province	Indicator	Base value (2003)	Target value (2008)	Actual value (2008)
Bac Ninh	Electricity consumption per household (MWh/household)	0.62	1.24	1.04
	Annual power outage hours per user household (minutes/year per household)	7200	5400	5133
Quang Ninh	Electricity consumption per household (MWh/household)	0.25	0.35	2.40
	Annual power outage hours per user household (minutes/year per household)	800	600	575
Quang Nam	Electricity consumption per household (MWh/household)	0.74	1.37	n/a[11]
	Annual power outage hours per user household (minutes/year per household)	n/a	n/a	n/a
	Distribution loss (%)	8.5	6.65	7.05
	Distribution loss reduction rate (%)	n/a	22	23

Source: JICA appraisal documents and questionnaire responses from NPC, CPC

From the actual data for Bac Ninh obtained at the time of the ex-post evaluation study, it is seen that the fulfillment rate for electricity consumption per household reached 84% so that it can be said

10 Sub-rating for Effectiveness is to be put with consideration of Impact

11 Regarding data (actual value of 0.007MWh/ household in 2008) obtained from the Quang Nam Province through CPC, we could not confirm detailed data sources and unit to calculate the values of the indicator. Therefore, it was judged that we could not ensure the accuracy comparable to that of data from other provinces.

that in terms of this measure the objective was essentially achieved. Concerning power outages per user household the length of the outages was below the target figure so that in terms of this measure the target was reached. Also, even in Quang Ninh 96% fulfillment was achieved for power outages per user household, indicating improvement of the stability of power supply. Moreover, the data from Qiang Nam shows improvement in the efficiency of power distribution, in the form of reduced distribution loss based on actual longitudinal data, even though the target figure itself was not reached. Data for the annual failure rates of low voltage transformers show that the annual number of failed transformers per 100 transformers were 0.024 in 2007 and 0.016 in 2008, a point of concern in this project, shows almost no failures so that the project accomplished a certain degree of effectiveness.

3.2.2 Qualitative Effects

The following four points were set forth for qualitative effect analysis at the time of appraisal.

- Reduction of the burden on the environment by establishing an EMS in EVN
- Reduction of greenhouse gas effects by acquisition of equipment for protection of the environment
- Stabilization of power supply by rehabilitation and construction of facilities
- Restraint of CO2 production by reducing use of diesel generators

Regarding “reduction of the burden on the environment by establishing an EMS in EVN” and “reduction of greenhouse gas effects by acquisition of equipment for protection of the environment,” the building of an EMS was not completed and acquisition of equipment for protection of the environment was not done through use of the yen loan but by the funds of the Pha Lai thermal power plant itself and although installation of environment protection equipment – only for water treatment – was done, the qualitative effects sought for this project were not attained.

Regarding “stabilization of power supply by rehabilitation and construction of facilities,” in the beneficiary survey[12] in Bac Ninh an inquiry was made into attitudes of residents who can be thought of as being direct recipients of benefits, and analysis of the data obtained was used to supplement our judgment of qualitative effects. They were asked several questions regarding the quality of power supply that were deemed as problematic in Vietnam (multiple answers allowed). Among them, four issues that were particularly relevant to the project were: “power cut without prior notice,” “frequency of rolling blackouts,” “frequency of breakdowns,” and “voltage stability.” 82% of them responded “power cut without prior notice” had been much improved. 81% of them responded “frequency of rolling blackouts” had been much improved. 74% of them responded “frequency of breakdowns” had been much improved. 84% of them responded “voltage stability” had been much improved. Further,

[12] Before conducting the beneficiary survey, we studied basic data (area, population, number of communes, economic growth rate, food production per capita, type of occupation) of the seven targeted districts. Further, we needed to confirm that the 130 respondents should be residents of the districts who had lived before the project (2004). Notable characteristics of the sample are that the size of household is relatively small (3.5 persons) and head of household are mostly male except one. Also more than 90% of them knew that the project was assisted by JICA through an announcement from Bac Ninh people’s committee and the power company.

many of the transformers that were intended to be replaced in this province by means of the project had been purchased by the residents in about 1975 and by dint of being superannuated frequently broke down, causing more than 30% distribution loss prior to project implementation. However, in 2006, after project implementation which covered a wide area of Bac Ninh for upgrading of transformers with optimization and improvement of distribution lines, it was reported that great improvement was attained, so that the loss was currently reduced to 11%.

Regarding "Restraint of CO2 production by reducing use of diesel generators," since the project targeted rural areas in Bac Ninh where there are relatively more poor households, it is not in the case that they did not own diesel generators at all in the first place. Also according to responses from three regional power corporations, there was no report that existing diesel generators were removed. However, if there was no implementation of the project for rural electrification, we can assume that diesel generators might be used so that CO2 might have been increased.

Table 2. Rural electrification in Vietnam

(%)

	2005	2006	2007	2008	2009	2010
Communes	95.9	96.4	97.0	97.8	97.9	98.6
Households	90.4	91.5	96.7	94.5	95.0	97.3

Source：EVN Corporate profile 2009-2010,2010-2011

3.3 Impact

3.3.1 Intended Impacts

The project sought to achieve improvements by the following impacts:

- Reduction of the environmental burden caused by the power sector
- The use of power is to be spread more widely in rural areas

On the matter of the reduction of the environmental burden, as the project component of establishing an EMS has not been completed, the anticipated impact therefore was not realized.

With regard to the rural use of power, we have designed and conducted a survey of villagers in Bac Ninh, specifically to examine on their purchasing of electric appliances, as well as the change in the percentage of power bill payment in household expenses, after the project.

First, we have confirmed that the stable electricity supply realized by the project contributed to their purchases of new electric appliances and use of power. Notably, the bars of "bought after the Project" in Figure 3 indicate the wide range of new purchases of electric appliances. 5% of respondents bought electric pumps, and washing machines which had not been bought before the project. They are useful to improve sanitary and environmental conditions. Air-conditioners (40%), Microwave ovens (50%), water heaters (45%) were purchased to provide comfort and convenience in domestic life. Also, the increase in ownership of PCs and laptops (30%), radios and karaoke sets (30%), and TVs (10%) can serve to provide greater access to information and new ways to spend leisure time. All in all, the villagers have increased purchases of electric appliances which can bring various changes in many aspects of their daily lives.

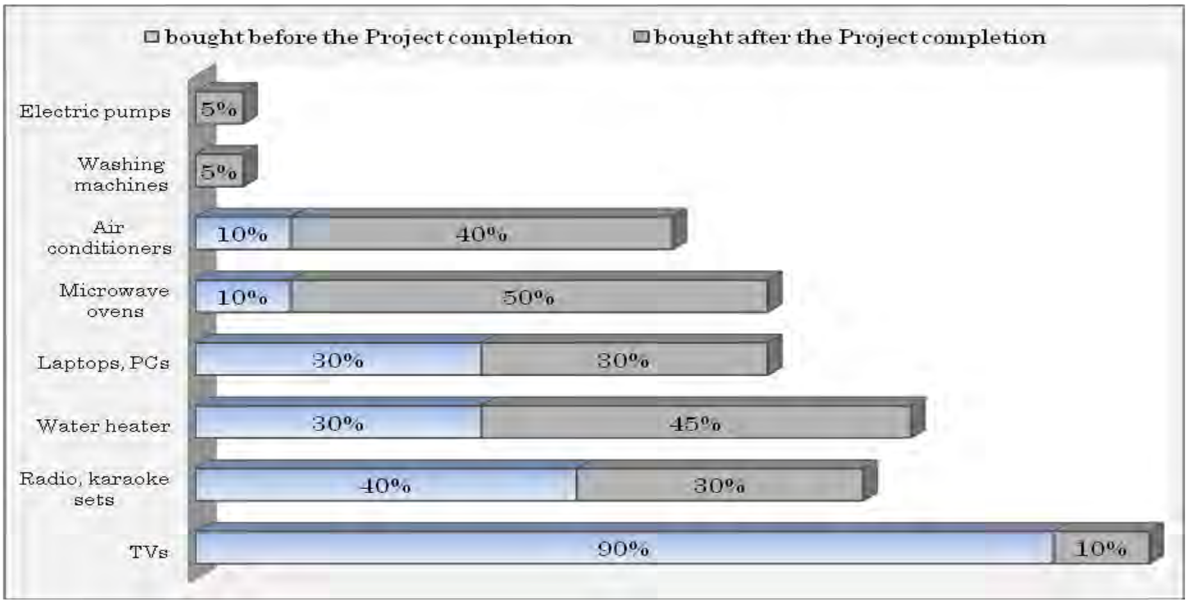
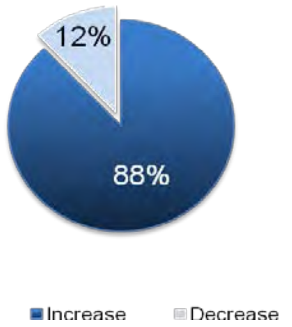


Fig. 3. Change in Possession of Electric Appliances among Residents in the Survey Area

Source: Data compiled from the beneficiary survey

Second, the percentage of the power bill payment in household expenses was increased by 88% after the project. Thus it can be said that they have come to use more electricity after realization of the project. In fact, the electricity tariff per unit had not increased much at the time of the study in May 2012, and was at the same level as the time of project completion in 2006.[13] In addition, responses indicated that as a result of having shifted to becoming customers of Bac Ninh Power Company (an EVN subsidiary) as encouraged by the project, the electricity tariff per unit was rather cheaper than before.

[13] However, the tariff has been uniformly increased by 5% starting from July 2012.



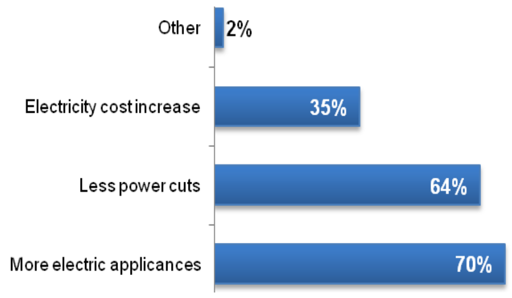
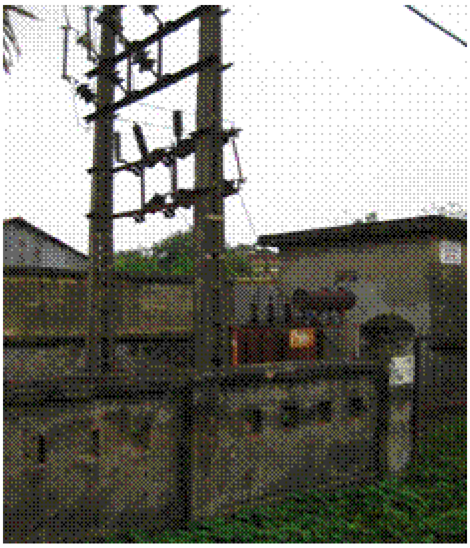


Fig. 4. Change in the Percentage of Power Bill Payment in Household Expenses

Source: Data compiled from the beneficiary survey

3.3.2 Other Impacts

According to Bac Ninh Power Company, as unintended positive impacts, a decrease of electrocution of children and domesticated animals caused by the replacement of the outdated substations scattered in rural villages has been observed. Also, with the additional new substations, they could replace existing outdated distribution equipment without interrupting the electricity supply.



(Outdated substation in a village dating to the 70's)

(Old electric transformer)

➢ Impact on the Natural Environment

The power company reported that in agricultural villages in Bac Ninh, because they started using electric pumps, farmers could easily drain and circulate water in paddy fields and could also efficiently provide oxygen for fish culture in ponds. Thus, the project has some positive impacts on village-based agriculture and fishery in terms of water improvement and production in villages.

➢ Land Acquisition and Resettlement

It has been reported that there were some subprojects under the supervision of NPC that took more time for due procedures for land acquisition and resettlement, notably for legal compensation, than expected. As such, this is not currently deemed to be a social problem of serious magnitude.

BOX 1. Socio-Economic Impacts of the Project

The socio-economic impacts in Bac Ninh brought about by the project are illustrated in the table below.

Table 3. Changes after the Project in Bac Ninh

Listed changes in lives	No Comment	Strongly Agree	Agree	Disagree	Strongly Disagree
My family now has more opportunitites to access information, knowledge from TV, Radio, and Internet	1%	45%	52%	0%	2%
Quality of life was improved, made safer and more comfortable	2%	42%	54%	0%	2%
Our children spend more time for studying, and they can now use a computer to get more access to information for study	1%	49%	47%	1%	2%
We can spend more time for entertaiment and culturally enriched	2%	48%	48%	1%	1%
Healthier and nutritiously improved	1%	39%	58%	1%	1%
It gives support to housewives for housework and child-care	3%	45%	49%	2%	1%
Better quality in public care services and social infrastructure	2%	43%	52%	1%	2%
Local security is increased	2%	41%	54%	1%	2%

Source: Data compiled from the beneficiary survey

Based on the survey result, improving the reliability of electricity supply actually has many positive impacts on their daily lives. Among others, the two notable facts are that children spend more time studying at night and housewives are free from the burden of prolonged domestic work, an improvement that can have direct synergy effects on improvement on education and income generation. Through interviews, we have confirmed that by the new purchases of household appliances women have become able to spend more time on income generation activities as a result of the project. Thus, they can significantly help support their family budget by bringing in additional income from the activities.

Positive impacts of the project are being observed on the whole and no other pending issues for immediate attention have been reported concerning the environment, relocation of inhabitants, or land acquisition.

In light of the above, quantitative effects are being observed. On the other hand, regarding qualitative effects and intended impacts particularly on reduction on the burden of the environment, these were not achieved mainly because of cancellation of consulting services for establishment of EMS. Regarding other impacts, they are mostly positive. Thus, its effectiveness is fair.

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

At the time of the project appraisal, three outputs were assumed as below.

① Establishment of Environmental Management System (EMS) in EVN headquarter and at the Ninh Binh thermal power plant

② Procurement of environmental equipment for the Pha Lai thermal power plant

・System line for manufacturing of mechanical parts of electrostatic precipitators and air heaters for boilers

・Sewage waste water plant

③ Rural electrification

・Substations, distribution lines, cable lines, antennas in 47 provinces

First, with regard to establishment of EMS in EVN, the scope of the target of consulting service includes not only EVN headquarter and the existing Ninh Binh Thermal power plant (Ninh Binh 1) but also a new Ninh Binh thermal power plant (Ninh Binh 2) being planned during the project period for a site adjacent to Ninh Binh 1. This eventually caused the delay and cancellation of the consulting services since the government of Vietnam decided to stop all the projects related to Ninh Binh 2 because of a serious siting problem. Therefore, consulting services started in April 2007 and an inception report was submitted. However, the decision of government of Vietnam mentioned above was issued in July 2007, the consulting service was stopped and postponed, and in September 2008, EVN finally decided to cancel the services. This was duly reported to JICA and explained by EVN through a formal process and JICA agreed with the decision[14].

Regarding the procurement of environmental equipments at Pha Lai thermal power plant, the power plant became a joint stock company in March 2005 (EVN's ratio of stock holding was 67%). The board meeting decided that this should be dealt with by its own funding. Therefore it was decided to make procurement be outside the scope of the project and not implemented by use of the yen loan.

Regarding rural electrification, all subprojects that 3 regional power corporations implemented were completed and placed in operation.

Thus, on the whole, although the soft component was partially cancelled, and the procurement of equipment was outside the scope of the project, the unused budget that occurred due to the change of the scope was allocated to fund additional subprojects[15] for the rural electrification component and

[14] According to the comments by a former official of MPI, as EVN was undergoing cost-cutting and rationalization as state-owned enterprise reforms during the project period, if there was a possible way of introducing EMS by the project, it might have been in the grant form of technical assistance or expert dispatch.

[15] Since the three regional power corporations which are subsidiaries of EVN are in charge of entire management of the subprojects, EVN headquarters did not have a direct responsibility to report JICA in detail. Thus EVN headquarters did not have detailed records for each subproject.

completed during the project period.

Table 4. List of Subprojects for Rural Electrification at the Time of Appraisal

Name of power corporation	Name of province	Distribution lines (km)	Number of Substations	Total capacity (kVA)
NPC	Bac Ninh	96	282	37,015
	Quang Ninh	51	51	7,740
CPC	Quang Nam	166	107	18,380
SPC	Soc Trang	5	40	1,025
	Tra Vinh	3	11	275
	Tien Giang	24	7	503
	Ben Tre	8	33	1,225
	Kien Giang	1	3	300
	Binh Thuan	46	0	--
	Binh Phuoc	4	0	--
	An Giang	7	0	--
	Can Tho	8	0	--
	Ca Mau	1	0	--
	Long An	8	0	--
	Ninh Thuan	16	0	--
	Tay Ninh	23	0	--

Source: JICA appraisal documents

3.4.2 Project Inputs

3.4.2.1 Project Cost

The planned cost at the appraisal was 3,753 million yen in total. Of the planned total, 3,190 million yen was the requested sum for a yen loan. In comparison, the total disbursement was 2,812 million yen, mainly for rural electrification. The environment equipment was procured partially by own funds (The water treatment system investment amount was 260 million VND. It was completed and started to operate in 2006~2007, and the oil-water separator system investment amount was 200 million VND; it was completed and started to operate in 2005.)

The actual cost was a total of 3,176 million yen, consisting of payment of 451,884 million VND in domestic currency for all the completed subprojects for rural electrification and 20 million yen for consulting services paid for in foreign currency. This amount was 85% of the planned cost of 3,753million yen. Even allowing for exclusion of the original cost of consulting services (210 million yen) from the total planned cost due to the cancellation, it is lower than planned (90%).

Table 5. Comparison between Planned and Actual Cost

Unit (million yen)

	Planned Cost	Agreed amount of the yen loan	Actual cost
Consulting services	210	90	20
Procurement of environment equipment	530	Out of scope	Self-financed
Rural electrification	2,344	2,994	3,050
Others (IDC, Contingency)	699	106	106
Total	3,753	3,190	3,176

Source: JICA documents

3.4.2.2 Project Period

The project period was extended once, by 24 months, in August 2007. After the extension, the project was duly implemented within the period planned. However, restructuring-related internal procedures accompanying EVN's becoming a joint stock company in June 2006 caused a substantial delay in approving and implementing consulting services. At the beginning, the contract negotiation prior to approval was delayed for about 32 months. Once started, it stopped right away and then was postponed. It was finally cancelled after the government decision on the new Ninh Binh thermal power plant.

Regarding rural electrification, for certain subprojects in Northern Vietnam, the implementing agency needed to revise the bidding plan and this took a longer time for processing. Also, as a small group of villagers needed to be relocated in order to build a substation, this required some time to deal with the legal compensation and land acquisition matters. In Central Vietnam, one case in point is that a subproject required specific equipment for which no local bidder met the technical requirements (for an underground cable of waterproof type) so that they had to change the procurement method to international competitive bidding which took a longer processing time than planned. On the whole, the actual project period duration was 159% of the initial planned project period of 41 months.

In addition, the terms of reference for consulting services originally included monitoring for installation of rural electrification. However it was not contracted for by EVN during the implementation period. Therefore, it was not systematically monitored and reported by the third party that may have caused lowering of the efficiency of management of the subprojects implemented throughout the three regions.

Thus, the time required was longer than planned even considering the decrease of the output

3.4.3 Results of Calculations of Internal Rates of Return (IRR)

Due to the nature of the project, a quantitative analysis of the internal rate of return was not possible.

Although the project cost was within the plan, the project period exceeded the period planned, therefore efficiency of the project is fair.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

As stated in the section of "Relevance to the Development Plan of Vietnam," power sector restructuring is under way as a matter of major national policy. Even before the project implementation and after becoming a holding company since 2006, EVN continued to undergo extensive organizational restructuring. From the perspective of the EVN group as a whole as well, it is in a very fluid situation that is more or less unpredictable. However, regarding operation and maintenance of the facilities constructed for rural electrification in the project, provincial power companies grouped under the three regional power corporations are in charge in the field. These power companies and power corporations continue to be subsidiaries of EVN and comprise the essential components of the EVN group. Thus, it is hard to foresee that major organizational problems at the power companies arose from the current restructuring. In addition, according to the Prime Minister's Decision on the "Roadmap for Power Sector Reform" adopted in January 2006, plans call for further change in the structure of the power sector and its time schedule so that power corporations under EVN will be spun off and be financially independent from 2015. Thereupon they will be able to purchase electricity from not only EVN but also power sources other than EVN, in the wholesale electricity market. Inevitably competition will increase and will make power companies irreversibly adjust to achieve greater economic efficiency and to strengthen organizational management. In addition, even though the organizational restructuring based on electricity as a business was ongoing, the Department of Science, Technology and Environment which is the core organization for dealing with all environment issues of EVN including the establishment of EMS[16], was steadily expanded from just a few persons to a staff of 10 with relevant expertise. This reflects the increase in recognition of its importance since 2002.

Regarding the renovation of the communication network, it has been reported that EVN Telecom has been liquidated[17] and Viettel which is another state-owned company specialized in telecommunication has taken over is assets since last November. Therefore these facilities are no longer under the control of EVN. We also confirmed that they settled that all liabilities of EVN Telecom including those related to the project will be borne by Viettel in February 2012.

[16] According to the master plan made in 2011, the main tasks of the Environment Department are (1) promotion of energy-saving measures, (2) environmental impact evaluation, (3) development of alternative energies that reduce the environmental burden, (4) promotion of investment in environment protection, and (5) promotion of use of LED for public facilities.

[17] EVN Telecom, an affiliate of EVN, was in charge of operation and maintenance of the facilities. However, it was revealed to be business failures, due to lax management and insufficient screening of credit applications. The chairman of EVN was fired by the Prime Minister in November 2011, to take responsibility for the business failure. Through this, the government demonstrated that EVN should focus only on electricity business. In fact, it was reported that EVN Telecom was recently in a battle for market share with other companies and failed to bring in new customers. As such Viettel which is under the defense ministry has been in charge of operation and maintenance.

3.5.2 Technical Aspects of Operation and Maintenance

Regarding local electricity distribution, no major problems have been reported since provincial power companies under EVN have been put exclusively in charge, even before the project, as cooperatives had been operating in many communes in rural areas. Introduction of new facilities and their operation and maintenance did not require unfamiliar foreign technology and technical knowledge. In fact, the conventional low voltage transformers are manufactured domestically. In any event, a point that should be kept in mind is that it is necessary to provide regular training regarding new distribution lines that connect to the old ones require grid network optimization technique. We have confirmed that there is a training course at EVN for technicians of power companies according to the rule of EVN on a regular basis.

Pole mounted transformer made in Vietnam

Further, as awareness of environment issues has increased in EVN[18], it continues to assign importance to the establishment of EMS and other measures on behalf of reduction of the burden placed on the environment.

As recognition of this has become well established within EVN, once EMS is established, it is quite likely that the effect will be achieved and sustained in the future.

3.5.3 Financial Aspects of Operation and Maintenance

According to the response from power corporations, the profit from the project is slightly lower than the cost of operation and maintenance. In NPC's projection, the profit level will exceed the cost after 2013. In principle, it is very important to set price levels that can cover actual costs of electricity, however, it is known that Vietnam's price level is far lower than those of its neighboring countries. As such, the World Bank and the ADB have asked the Government of Vietnam to ensure an adequate tariff increase as a performance indicator of the sector reform.[19] Therefore a future tariff increase is inevitable for both resource development and the electricity business and to attract a considerable amount of investment from inside and outside the nation. With this background of the pressure for higher prices and for increased competition, it is getting even more essential for all power companies to upgrade the level of their distribution services to justify price increases and to ensure transparency of cost of operation and maintenance for customers.

Regional power corporations which supervise and manage all the provincial power companies

[18] As one example of their effort with regard to EMS, Thac Ba hydro power plant which is the oldest hydro power plant of EVN and has already become a joint holding company, achieved ISO14001 certification in 2004 as a result of its installation of an EMS.

[19] ADB (Asian Development Bank, Operations Evaluation Department).2004. *Technical Assistance Performance Audit Report on Advisory Technical Assistance for Power Sector Institutional Strengthening in Viet Nam.*

and facilities need to prepare for upgrading hands-on management to become financially independent. Among others, to introduce systems to ensure uniform collection of operation and maintenance costs is indispensable as a basis of management. However, all in all, as shown in Table 6, judging from the financial issues and direction of the EVN group on the whole as well as the three-way progress of state-owned-enterprises, the power sector and price reform all of which have accelerated from this year, no major problems have been observed in this aspect.

Table 6. Solvency of the EVN Group

Indicators	2008	2009	2010	Remarks
Liquidity ratio	165	143	117	Being over 100%, not too much of a problem regarding cash-flow
Long term debt-equity ratio	87	91	74	Being less than 100%, its long-term fund management is not too much done by short-term funding
Equity ratio	32	28	23	There has been somewhat of a downturn

Source : Calculated from the balance sheets in the Corporate Profile of EVN

Note: Assets and liabilities of the three regional power corporations (NPC, CPC, SPC) are currently included in the balance sheet in the profile in consolidated accounting.

3.5.4 Current Status of Operation and Maintenance

Through the field survey, we have observed that the facilities constructed by the project have been fully utilized based on regular check-ups following the EVN manual of operation and maintenance. Also it was informed to us from the power company that having new transformers obtained by the project, they were able to replace the outdated transformers without interruption of supply, so that the overall condition of distributing electricity has been improved.

No major problems have been observed in the operation and maintenance system, therefore sustainability of the project is judged to be high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project aimed at establishing an Environment Management System in EVN, and installation of environment equipment and facilitation of rural electrification; these measures to contribute to mitigating the environmental impact on the power sector and supporting stable power supply in Vietnam. The relevance of this project is quite high as it is relevant to the policies and needs both at the time of the appraisal and ex-post evaluation. However, a lowering of efficiency has resulted from a delay and cancellation of consulting services. Also with regard to effectiveness and impact, it has not fully achieved intended environmentally positive effects and impacts due to the cancellation of consulting services for establishing EMS at EVN and the Ninh Binh thermal power plant. In light of the original scope of the project, therefore, the effectiveness is considered to be fair. Regarding sustainability, it is considered to be high. Judging from the current situation of the power sector reform being implemented by the Vietnamese Government, we have confirmed that the direction of restructuring of the EVN group on the whole is in favor of strengthening organizational competitiveness by duly introducing the market mechanism. Also there is a high degree of usage of facilities for distribution of electricity and regular check-up for operation and maintenance is systematically carried out.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

In light of power sector reform by which the market mechanism has to come into play, EVN and EVN affiliated group companies inevitably have to face the issue of making fair and reasonable increases in prices hand-in-hand with improvement of services. Especially, as the government decision to transfer rural electricity management from local authorities to EVN and EVN now has to deal with end-users on a daily basis, business management of EVN power companies at the provincial level becomes substantially more important. Also, the fixed and variable costs of distribution and fair profit must be reflected in the price of electricity and that will ultimately lead to stable management and competitiveness. The first specific measure necessary to realize the above is that all power companies should introduce uniform software to swiftly collect, compute and integrate O&M cost related data which are the basis of business management.

4.2.2 Recommendations to JICA

None in particular.

4.3 Lessons Learned

To assist the sector on the whole may generally involve many organizations and legal entities, so that sufficient attention should be paid to relationships among them as well as each function that shapes the nature and quality of the sector. Also it is important take note of the status of progress within the roadmap for sector reform.

Also, as in the case in point wherein reform is to be driven by introducing the market mechanism through means such as privatization, it is necessary to keep in mind the anticipation of other potential competitors in the private sector. That means that it is important to be flexible regarding the scope of changes as they must be properly responsive to market signals ranging from what types of service improvement are sought or what the specific needs of consumers/buyers are, as well as awareness-raising to enable fair pricing and costs from a hands-on managerial perspective.

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1.Project Outputs	(1) Consulting services ・Establishment of Environmental Management System (EMS) in EVN (32M/M) ・Monitoring for installation of environment equipment and rural electrification subprojects (17M/M) (2) Procurement of environmental equipment ・System line for manufacturing of mechanical parts of electrostatic precipitators and air heaters for boilers ・Sewage waste water plant (3) Rural electrification ・ Substations, distribution lines, cable lines, antennas	(1) Consulting services Cancellation (2) Procurement of environmental equipment Out of the scope of the Yen loan (3) Rural electrification Completed as planned and some additional subprojects during the project period. There were some revisions of scope of subprojects.
2.Project Period	March 2004 – August 2007 (41months)	March 2004 – August 2009 (65 months)
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 240 million yen 3,513 million yen (457,389 million VND) 3,753 million yen 3,190 million yen VND1 = 0.00768 yen (As of October 2003)	 126 million yen 3,050 million yen (451,884 million VND) 3,176 million yen 2,812 million yen VND1 = 0.00713 yen (Average between October, 2003 and March, 2009)

Georgia

Ex-Post Evaluation of Japanese ODA Loan

"Power Rehabilitation Project"

External Evaluator: Juichi Inada, Senshu University

0. Summary

This project was intended to restore electricity generation and enable stable electricity supply, by rehabilitating existing power stations and modernizing control centers and telecommunication systems, thereby contributing to restoration and growth of the economy in Georgia. These objectives are consistent with development policy and development needs at the time of appraisal and ex-post evaluation, therefore the relevance of the project is high.

The scope of the project planned to be assisted by JICA at the time of appraisal was reduced, but the original scope as a whole was rehabilitated almost effectively, because other funds from the managing companies were used for rehabilitation of the remaining portions of two hydropower stations, and a World Bank loan was offered to cover the renewal of the Tbilisi Control Center. Thus, the effectiveness and impacts of the project are considered to be is high.

The project cost was almost the same as planned, although the necessary costs to complete the full intended scope at the time of appraisal were much higher than planned and the project period was extended, taking more than twice as long as originally planned; therefore, the efficiency of the project is considered to be low.

The facilities and equipment involved in the project are maintained by two managing privatized companies, and there have been no major problems with the structure, technique, or finance of the project; therefore, the sustainability of the project is considered to be high.

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

1. Project Description

Location Map of the Project

Renewed Water Valve of Khrami II Power Station

1.1 Background

The steep downturn in Georgia's industrial output, combined with severe energy supply shortages, resulted in a steady decline of gross electricity consumption from the breakdown of the former Soviet Union in 1989 and Georgian independence in 1991. However, since Georgia had been experiencing a positive economic trend since 1995 and electricity demand was expected to grow in the near future, existing power plants and power system facilities were in urgent need of repair to meet increasing electricity demand. Therefore, the government set rehabilitation of the electricity sector as one of the top national priorities in its public expenditure plan.

The total installed capacity of Georgia's domestic power plants was about 4,673 MW, of which hydropower accounted for around 58% h/ 1996. Since the breakup of the Soviet Union, general deterioration of hydropower plants and power system facilities due to lack of proper operation and maintenance led to a decline in domestic generation capacity to 1,884 MW; annual hydropower generation declined to 44% of that of 1989. Thus, Georgia was dependent on imported electricity from neighboring countries, with imports meeting between 10% and 20% of total electricity demand. Rehabilitation of hydropower generation facilities was particularly important in Georgia, a country rich in water resources but dependent on imported gas and oil for the resources necessary for thermal power generation. Similarly, urgent measures were required to renovate electricity control systems to ensure an adequate level of system integrity and reliability.

1.2 Project Outline

This project was intended to restore electricity generation and enable stable electricity supply by rehabilitating existing power stations and modernizing control centers and telecommunication systems, thereby contributing to restoration and growth of the economy in Georgia.

Approved Amount/ Disbursed Amount	5,332 million yen/ 5,327 million yen
Exchange of Notes Date/ Loan agreement Signing Date	January 1998/ January 1998
Terms and Conditions	Interest Rate 2.3%, Repayment Period 30 years (Grace Period 10 years) General Untied
Borrower/ Execution agency	Department of Finance, Republic of Georgia/ Energogeneratsia
Final Disbursement Date	August 2008
Main Contractor （Over 1 billion yen）	Khrami II Power Station: Ansaldo Energia SpA (Italy)/ Mitsui Bussan (Japan), Lajanuri Power Station: ALSTOM (France)
Main Consultant （Over 100 million yen）	Management: FEPPIA (Georgia), Engineering: ELC (Italy)/EPDC (Japan)
Feasibility Study, etc.	F/S conducted by the fund of USAID and KfW (Harza Engineering Company/Energy Services, September, 1996)
Related Projects	Georgia Power Rehabilitation Project (WB-IDA) (1997–2000) (52.3 million USD) Energy Sector Emergency Program III (KfW) (1997–2000)

	(40 million DM) Electricity Market Support Project (WB-IDA) (2001–2010) (27.4 million USD)

2. Outline of the Evaluation Study

2.1 External Evaluator

Juichi Inada, Senshu University

2.2 Duration of Evaluation Study

Duration of the Study: November 2011–October 2012

Duration of the Field Study: March 12–March 24, 2012; July 14–July 22, 2012

2.3 Constraints During the Evaluation Study

Two hydropower stations owned by Energogeneratsia, the execution agency at the time of signing Loan Agreement (L/A), were later privatized: Khrami II hydropower station is currently managed and operated by RAOUES (a Russian company) and Lajanuri hydropower station by EnergoPro (a Czech company). Although both companies take the stance that they have no direct responsibility for repaying JICA's Japanese ODA loan, both were cooperative and offered the information necessary to evaluate the project. However, it was difficult to obtain data for the period prior to their acquisition of the power plants (i.e., before 2003 in the case of Khrami II and before 2007 in the case of Lajanuri); this prevented the acquisition of continuous data and ruled out a detailed comparison of the data from the time of appraisal with that from the time of evaluation.

The portions assisted by JICA in the scope of the project ware reduced; other funds were provided by the managing companies for rehabilitation of the remaining portions of two hydropower stations, and a World Bank loan was offered to cover the costs of the renewal of the Tbilisi Control Center, although those portions were not conducted exactly according to the original plan. It was necessary to obtain relevant information related to the original scope of the project to evaluate the project as a whole.

3. Results of the Evaluation (Overall Rating: B[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance with the Development Plan of Georgia

At the time of appraisal in 1996, the existing power plants and power system facilities were in urgent need of repair, as Georgia faced severe energy shortage and electricity demand was expected to grow in the near future. The government conducted rehabilitation of the existing power plants and

1 A: highly satisfactory, B: satisfactory, C: moderate, D: unsatisfactory

2 ③: High, ② Fair, ① Low

invested in incomplete projects, making this one of the top national priorities in its sector development policy at the time.

Additionally, the government promoted privatization as part of electricity sector reform and both the Khrami II and Lajanuri hydropower plants were privatized after the beginning of the project. The privatization process rapidly progressed during 2003–2004 and construction works were delayed, partly because it took time to clarify the responsibilities of the executing agency and the new managing companies during the privatization process. In spite of these difficult issues, JICA continued its assistance to the project because JICA made much of the significance and necessity of the project.

The government created and approved a document entitled "Main Directions of State Policy in the Power Sector of Georgia" in June 2006; this document discussed diversification of supply sources, achievement of economic independence, sustainability of the sector, and provision of security. The rehabilitation of two hydropower stations and management of those stations by private companies corresponds to the state policy.

The government produced a document entitled "Strategic Plan of Development of Georgia: Ten Point Plan of Modernization and Development 2011–2015" in October 2010. The fifth point in this document referred to improved infrastructure, stating that "Georgia is one of the most energy secure countries in the region, with a bulk of renewable energy, and it is also an export country with major hydro energy potential."

3.1.2 Relevance with the Development Needs of Georgia

The project is co-financed by the World Bank's Power Rehabilitation Project for Georgia (1997–2000, 52.3 million USD) and KfW's Energy Sector Emergency Program III (1997–2000, 40 million DM).

A feasibility study (F/S) of major power plants and facilities, including the Gardabani thermal power plant, Khrami II and Lajanuri hydropower plants, and Tbilisi/Kutaisi control centers was conducted in 1996 using funds from USAID and KfW. The Georgian government verified the benefits of rehabilitation of those power plants and facilities in its economic analysis in 1997, and the World Bank decided to offer loans for the rehabilitation of Gardabani thermal power plant. Furthermore, JICA offered a Japanese ODA loan for the Khrami II and Lajanuri hydropower plants and Tbilisi/Kutaisi control centers. As the government had prioritized the rehabilitation of existing power stations and not the construction of new ones at the time of appraisal in 1996, a project focusing on rehabilitation was appropriate.

Although the power generation capacity of the two hydropower stations supported by Japanese ODA loan was only about 10% of total hydropower generation (and about 4–5% of total power generation, including thermal power), hydropower generation facilities were particularly important in Georgia, a country rich in water resources but dependent on imported gas and oil for thermal power generation[3]. Of the existing hydropower plants in Georgia, Khrami II was the largest in the vicinity of Tbilisi (the largest and capital city, located in the east of the country) and Lajanuri was the largest in the vicinity of Kutaisi (the second largest city and located in the west of the country). Therefore, the choice of these two hydropower stations for the project was considered appropriate, even though the largest hydropower plant in Georgia was Enguri hydropower station, very close to the border with Abkhazia. The benefits of power generated by these power stations are being disseminated nationwide through the national electricity transmission and distribution network.

Although Georgia became a net electricity exporter after 2007, electricity demand has continued to increase owing to the steady economic growth of the Georgian economy in recent years, and an expansion of energy supply capacity is still required at present. Based on the report of GSE (a state-owned transmission company), electricity demand will continue to increase by 300 million KWh each year until 2020, and the Georgian government has in place a plan to increase its hydropower generation capacity at a rate greater than that of the increase in demand[4].

3.1.3 Relevance with Japan's ODA Policy

Georgia is a newborn liberal democratic country, formed after the collapse of the former Soviet Union, and assistance in its democratization and transition to a market economy was considered important for the stability of the Caucasian region. For instance, the Japanese government advocated "Diplomacy toward Eurasia from the Pacific Region" in July 1997 and announced its emphasis on offering assistance for state-building in Central Asian and Caucasian countries. In "Annual Report of Implementation of Japanese ODA" in 1997, the rehabilitation and improvement of economic infrastructure (energy, transportation, and telecommunications) in order to promote democratization and the transition to a market economy in Central Asian and Caucasian countries were highlighted as priorities. Furthermore, in a 1999 JICA policy document entitled "Operational Policy of Foreign Economic Cooperation," priority was given to assisting in the rehabilitation of old economic and social infrastructure and improving the socioeconomic infrastructure necessary for sustainable economic development in the Central Asian and Caucasian countries. On this basis, the project was consistent with the priority areas of Japanese ODA policy at the time. Therefore, this project has been highly relevant with the Georgia's development plan and needs, as well as Japan's ODA policy; thus, its relevance is high.

3.2 Effectiveness[5] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

At the time of appraisal, the increase of operating revenue was employed as a quantitative

---

3 Gardabani thermal power station, supported by the World Bank loan, is the largest thermal power station located near the eastern boundary, and its power generation capacity is approximately 30–45% of the total power generation of Georgia. However, the World Bank assisted with the rehabilitation works of Unit 10 only, and the power generation capacity of Unit 10 is only about 4–5% of total power generation in Georgia.

4 GSE (Georgia State Electrosystem), *2010 Annual Report*, p. 9.

5 The rating of effectiveness includes impacts of the project.

indicator. The increase of electricity supply was not included as a quantitative indicator at the time of appraisal, but should be considered as an operation and effect indicator because the increase in electricity supply (power generation) has led to an increase in operating revenue. The capacity factor (or hydro utilization factor) of both hydropower plants should also be considered as an operation and effect indicator.

(1) Increase of Electricity Supply

The annual power generation of the Khrami II and Lajanuri hydropower stations are shown in Table 1 and Table 2, including power generated by the existing facilities. The data from before 2003 are regarded as power generation by the facilities that existed before rehabilitation.

Comparing the levels of power generation in 2000–2002 (i.e., before the completion of the rehabilitation works assisted by the Japanese ODA loan) with those in 2009–2011 (i.e., after the completion of the renewal of the portion supported by the Japanese ODA loan), it is clear that the average annual power generation of the Khrami II hydropower plant increased from 223 million KWh to 373 million KWh (1.68 times increase), and that the average power generation of the Lajanuri hydropower station increased from 171 million KWh to 396 million KWh (2.23 times increase).

The objective of the project was not an increase in power generation capacity (maximum output) but an increase in power supply as a result of rehabilitation of decrepit facilities and equipment, although there was no target indicator (such as a capacity factor) related to the rate of operation. In fact, annual power generation decreased during the rehabilitation works, especially in 2004[6].

Table 1 Annual Power Generation (Unit: Million KWh)

	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11
Krami II	165	n.a.	n.a.	n.a.	n.a.	220	240	210	105	38	128	120	186	347	326	385	410
Lajanuri	347	296	329	164	344	194	186	134	219	90	129	289	279	342	418	421	349

(Note) Data after 2002 were obtained from RAOUES and EnergoPro.
Data before 2001 were obtained from the World Bank documents (PAR, etc.)

(2) Increase of Operating Revenue

As both RAOUES (managing company of the Khrami II hydropower station) and EnergoPro (managing company of the Lajanuri hydropower station) have several hydropower stations in addition to the two for which rehabilitation works were supported by a Japanese ODA loan, the operating revenues of these companies did not coincide with the operating revenues of individual power stations in this study.

Table 2 indicates that the operating revenue of the Khrami II hydropower station increased after 2008, when its rehabilitation was completed. The operating revenue data for the Lajanuri hydropower station prior to 2007 could not be obtained because the acquisition of the plant occurred in 2007; the operating revenue after 2008 coincides with the annual power generation of the plant.

6 Both Khrami II and Lajanuri hydropower stations were originally constructed in 1960.

Table 2 Operating Revenue (million lari)

	00	01	02	03	04	05	06	07	08	09	10	11
Khrami II	2.56	3.35	3.13	1.41	0.01	1.91	1.78	2.77	5.17	8.92	13.31	14.16
Lajanuri	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	12.92	15.77	15.97	13.18

Source: Data from RAOUES and EnergoPro.

(3) Capacity Factor Per Unit for Both Hydropower Stations

The rehabilitation works supported by the Japanese ODA loan did not cover all units of the power plants; therefore, it was necessary to check the capacity factor data for each unit of the plants. RAOUES and EnergoPro offered us the following data.

① Khrami II Hydropower Station

Although data relating to power generation and capacity factor per unit could not be obtained, we obtained capacity factor of total units and outage hours per year per unit (Table 3).

Table 3 Capacity factor and outage hours per unit for Khrami II hydropower station

	02	03	04	05	06	07	08	09	10	11
Net electricity energy production（million KWh）	210	105	38	128	120	186	347	326	385	410
Maximum output（MW）	110	110	110	110	110	114	114	114	114	114
Capacity factor（%）	21.8	10.9	4.0	13.3	12.5	18.6	34.8	32.6	38.6	41.0
Unit 1・Outage hours (days/year)	444	69	1510	3984	4237	6967	8760	8760	6473	0
Unit 2・Outage hours (days/year)	8760	8760	8760	8760	8760	6118	224	780	1332	3477

Source: Data from RAOUES.

Note: Capacity factor = (net electric energy)/(maximum output × hours per year) × 100 (%)

Outage hours: annual maximum 8760 h (= 24 h × 365 days)

Table 3 shows that Unit 2 was completely suspended during 2002–2006 because of its rehabilitation works and began operating in the middle of 2007, reaching full operation after 2008. Unit 1, which was rehabilitated using RAOUES's own funds, was operational during 2002–2004 but operated to a lesser extent during 2005–2010 because of rehabilitation works (completely suspended during 2008–2009), and began full operation after 2011. The operating hours of Unit 2 decreased after 2009 because Khrami II has the capacity to generate more than enough power to meet demand, and the renewed Unit 1 was used the most of all units in 2011, which was considered more effective. In addition, the maximum total output of both Units was expanded from 110 MW to 114 MW after 2007.

② Lajanuri Hydropower Station

Lajanuri hydropower station has three units and a Japanese ODA loan was offered to cover rehabilitation of Unit 2 and Unit 3; Unit 1 (and part of Unit 3) was rehabilitated using EnergoPro's own funds. Net electric energy production and capacity factor for each unit of Lajanuri hydropower station are presented in Table 4.

Table 4 Net Electric Energy Production of Lajanuri Hydropower Station (Million KWh/year)

	02	03	04	05	06	07	08	09	10	11
Unit 1	134	219	90	129	185	150	187	138	135	124
Unit 2	0	0	0	0	0	0	23	125	170	110
Unit 3	0	0	0	0	103	129	130	155	118	114
Total	134	219	90	129	289	279	342	418	421	349

Source: Data from EnergoPro.

Table 5 Capacity Factor of each Unit of Lajanuri Hydropower Station (%)

	02	03	04	05	06	07	08	09	10	11
Unit 1	41	67	27	39	56	46	57	42	41	38
Unit 2	0	0	0	0	0	0	7	38	52	34
Unit 3	0	0	0	0	31	39	40	47	36	35
Total	14	22	9	13	29	28	35	42	43	35

Source: Data from EnergoPro.
Note: Capacity factor = (net electric energy)/(maximum output × hours per year) × 100 (%)

Table 4 shows that Unit 2 and Unit 3 were completely suspended and generated no power during the period of rehabilitation works (2002–2007) in the case of Unit 2 and 2002–2005 in the case of Unit 3), but increased their electricity power generation after the completion of the rehabilitation works (after 2008 in the case of Unit 2 and after 2006 in the case of Unit 3). Table 5 illustrates the capacity factor of each unit, highlighting the increase in total capacity factor after 2008.

Electricity energy production of hydropower stations depends on the level of water, which normally increases in summer and decreases in winter, and the capacity factor of hydropower stations never reaches 100%. The decrease in total power generation from 2010 to 2011 was caused by the low water level in 2011, which occurred because of the weather and not because of failure or the rehabilitation works or facilities. Furthermore, the decrease in power generation and capacity factor for Unit 2 in 2011 was the result of a balancing operation between all three units in response to the electricity demand during that year.

When the evaluation team conducted a site visit in March 2012, only Unit 2 and Unit 3 were operational; Unit 1 was undergoing rehabilitation work that was divided into 2 phases. The first phase is planned to be completed by April 2013; the second phase is planned to be conducted between August 2013 and April 2014, during which time power generation at the Lajanuri hydropower station will depend entirely on Unit 2 and Unit 3.

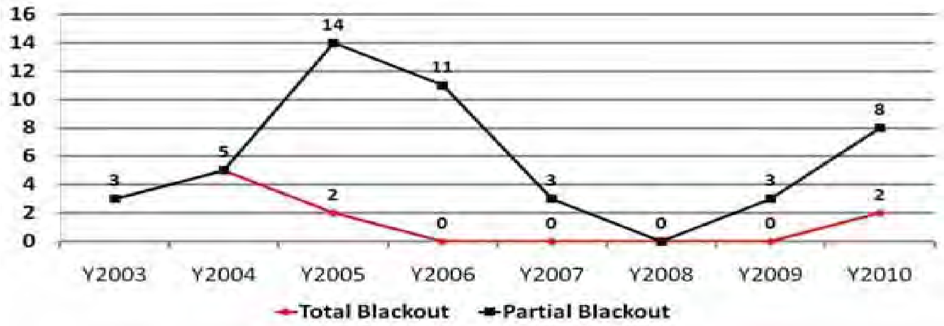
3.2.2 Qualitative Effects

Frequency of blackouts and technical loss rate can be considered indicators of stable supply of electricity. As both indicators are calculated from nationwide data, and the capacity for power generation of the two hydropower stations is about 5% of the capacity for power generation for Georgia as a whole, those indicators are not linked directly to the effects of the project. However, they are useful as related indicators.

① Frequency of Blackout

Blackouts occurred frequently before 2006 as a result of electricity shortage in Georgia as a whole, but almost no blackouts occurred after 2007, when Georgia became a net exporter of electricity. Table 6 illustrates the frequency of blackouts in Georgia after 2003.

Table 6 Frequency of Blackout (frequency/year)



Source: Data from *Annual Report of GSE*, 2010.

No blackouts occurred in 2008. Two total blackouts throughout the country occurred in 2010, although each lasted only 1 hour, and no total blackouts occurred after 2011. Partial blackouts that occurred after 2009 were a result of electricity demand exceeding supply in summer, highlighting the increase of electricity consumption in recent years.

② Technical Loss Rate

Technical loss rate (transmission loss) was around 5–10% before 2003 (before privatization of managing companies) and improved to an average of 1.8% after 2007, as shown in Table 7. The renewal of the control center and transmission facilities of GSE in 2001–2010, supported by the World Bank, is regarded as a major cause of the dramatic decrease of technical loss rate in Georgia.

Table 7 Technical Loss Rate (Annual average: %)

Before 2003	2004	2005	2006	2007	2008	2009	2010	2011
5–10%	6.6	3.8	2.7	1.9	1.9	1.7	1.8	1.9

Source: Based on the EMSP document of the World Bank and interview with the Ministry of Energy and Natural Resources.

The rehabilitation of control centers and communication systems became out of the scope of the Japanese ODA loan, because of the cost overrun for some portions of the rehabilitation works. As part of the Electricity Market Support Project (EMSP), supported by the World Bank (IDA), a new supervisory control and data acquisition (SCADA) system was introduced and Tbilisi Control Center was renewed and began operating in October 2009; these factors allowed electricity supply in Georgia to become stable and effective. The rehabilitation of Kutaisi Control Center, which was included in the original Japanese ODA loan portion, became unnecessary because of the introduction of the new control system, and the center is now used as part of the distribution network in western

Georgia.

The Tbilisi Control Center was excluded from the scope assisted by the Japanese ODA loan and was renewed, not using the funds of the Georgian government but using those of the World Bank as part of another project. As a result, a stable supply of electricity, which was the objective of JICA's Japanese ODA loan project, was realized as part of the EMSP project of the World Bank. This allowed better management as a result of the process of privatization of the companies, as shown by the decrease in frequency of blackouts and the improvements in technical loss rate.

［BOX ］ Progress of the Electricity Sector Reforms in Georgia

Privatization process has been rapidly progressed in electricity sector in Georgia with the assistance of the World Bank and USAID, and advanced institutional arrangements are introduced and implemented in comparison with other developed countries as Japan. At the time of operation by state-owned company, supply of electricity was unstable and the electricity company faced continuous financial deficit in its operation. After the privatization of operation and rapid reforms in power sector, electricity supply is stable and the tariff of electricity is relatively modest and collected effectively.

At this moment, there are 3 different electricity markets in Georgia. The first is the large scale power generation (mainly 500kv) operated by 2 state-owned companies, and the tariff is set by GNERC (Georgian National Energy Regulatory Commission), which is an independent organ newly established in 1997. The second is the middle range of power generation market (mainly 110-220kv), in which Khrami II and Lajanuri hydropower plants locate, where the tariff of electricity is regulated by GNERC, but it regulates only the upper limit of the tariff and the real price is decided in the market. The third is the free electricity market generated and operated by small and medium sized companies (less than 100kv), where users and suppliers can make their own agreements directly as to the price of electricity.

To promote the balance between stable electricity supply and stable price in electricity market, ESCO (Energy Sector Commercial Operator) was established on August 2006. ESCO is 100% state-owned company and its major role is to stabilize the electricity supply and its price, by purchasing electricity from small and medium sized power generation companies and selling the electricity to distribution companies and/or exporting to foreign market. ESCO is also operated as an independent non-profit company, for the purpose of keeping transparency of its operation and effective management.

These reforms and privatization process in electricity sector is an important factor for stable and effective supply of electricity in Georgia. It can be said that the project for rehabilitation of power generation in Georgia could have been effective in parallel with the efforts of establishing these new institutional framework.

3.3 Impact

3.3.1 Intended Impacts

At the time of appraisal, a decrease in imported energy resources (oil/gas) and improvement of the current account balance were expected as a result of the decreased dependence on thermal plants. As both indicators represent Georgia as a whole, and the power generation capacity of the two hydropower stations is about 5% of that of Georgia as a whole, these indicators are not directly linked to the effects of the project; however, they were investigated as impacts of the project.

(1) Conversion to Net Electricity Export

Georgia was a net electricity importer prior to 2006 because of electricity shortages but became a net exporter after 2007 as a result of the increase in its electricity power generation. In particular, the expansion of net export of electricity after 2008 is remarkable. Tables 8, 9, and 10 illustrate the drastic change from electricity importer to net electricity exporter, although there are no exact figures that would make possible a comparison between data before 2006 and after 2007 using the same statistical method.

Table 8 Demand and Supply of Electricity before the Project (1990–1995) (GWh)

	1990	1991	1992	1993	1994	1995
Power generation by Energogeneratsia	13,614	12,822	11,076	9,811	6,852	6,910
(thermal power)	(6,019)	(5,781)	(4,578)	(2,835)	(1,940)	(703)
(hydro power)	(7,595)	(7,041)	(6,498)	(6,976)	(4,912)	(6,207)
Other power generation	625	538	445	258	176	1,632
Net electricity import	3,205	2,252	1,016	713	917	754

Source: Based on the JICA Appraisal Document.

Table 9 Demand and Supply of Electricity after the Project (2007–2011) (GWh)

	2007	2008	2009	2010	2011
Domestic electricity production	8,547	8,471	8,897	11,349	10,566
(thermal power)	(1,515)	1,279)	(991)	(678)	(2,216)
(hydro power)	(6,832)	(7,162)	(7,412)	(9,368)	(7,890)
Electricity import	434	649	255	222	471
Electricity export	634	679	794	1,524	931

Source: Based on the data of HP of the Ministry of Energy and Natural Resources.

As the power generation capacity of both hydropower stations (including all units) is about 5% of the power generation capacity of Georgia as a whole (including thermal power), the impact of the rehabilitation of the two hydropower stations on the improvement of the supply–demand situation for electricity in Georgia is regarded as limited, although it does contribute some improvement.

Electricity power generation fluctuates depending on the level of water, which increases from April to August in summer and decreases from November to February in winter. Therefore, Georgia can export its electricity in summer and import it in winter; hydropower stations are considered an important component of electricity exports in summer.

(2) Improvement of International Balance of Payment

Georgia became a net electricity exporter after 2007, when it became less dependent on thermal power generation thanks to the increase of hydropower generation. This led to reductions in the import of oil and gas, the largest portion of current account deficit, and helped prevent worsening of the current account balance of Georgia. Thermal power generation contributed 44% of total power, on average, from 1990–1992; this decreased to about 10% on average during 2008–2010, although the percentage of thermal power generation increased again in 2011 because of the low level of water available.

Table 10 International Balance of Payment (million US$)

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Current Account	-231	-384	-421	-763	-1259	-2122	-3238	-1319	-1465
Capital Account	18	20	41	59	169	128	112	183	206
Oil/Gas Import	-140	-171	-266	-427	-656	-850	-967	-747	-856
Net Export of Electricity	-10.5	-19.8	-30.7	-34.4	-18.9	5.2	10.0	23.5	8.3

Source: Data from HP of National Statistics Office of Georgia

The evaluation team conducted trial calculations to assess the effect of the increase of hydropower generation on the current account balance of Georgia, based on the percentage of the operational cost of thermal power plants that could be attributed to fuel cost. If fuel cost is assumed to represent 82% of operational revenue as shown in the case of Gardabani thermal power plant[7], 23.2 million lari (14.6 million US dollars at the current lari–dollar exchange rate) would have been saved: the average annual operational revenue of the Khrami II and Lajanuri hydropower stations in 2010–2011 was 28.3 million lari. This coincides with 1.7% of the total amount spent on oil and gas imports in 2010.

(3) Improvements in Living Standards

Georgian GDP has been increasing since the early 2000s. It is believed that the increase in electricity generation and the stabilizing of supply have contributed to increasing GDP and improvements in quality of life through stable supply of energy to major industries in Georgia. Table 11 illustrates the share of the energy (electricity, gas, and water) sector in the total GDP of Georgia.

7 Based on economic analysis of fuel purchases of the Gardabani thermal power station (Unit 10, maximum capacity 285MW) written in ICR (Implementation Completion Report) of Power Rehabilitation Project supported by the World Bank, pp.38-39.

Table 11 GDP and its Growth Rate (million lari)

	2002	2003	2004	2005	2006	2007	2008	2009	2010
GDP	6,961	8,042	8,990	10,285	12,047	14,611	16,522	15,546	18,014
Growth Rate (%)		15.5	11.8	14.4	17.1	21.3	13.1	-5.9	15.9
Electricity/Gas/Water	312	324	304	326	375	411	434	491	534
GDP share (%)	4.5%	4.0%	3.4%	3.2%	3.1%	2.8%	2.6%	3.2%	3.0%

Source: Data from HP of National Statistics Office of Georgia

As the transmission and distribution network of electricity is nationwide, increasing electricity generation and stability of supply has been of benefit to the country as a whole; however, there is no clear evidence that it has made a significant impact on the local economy or the industrial structure of Georgia. The Khrami II hydropower station, located near Tbilisi, is an important plant because much of the population lives in the eastern part surrounding Tbilisi; however, there are few hydropower stations in the eastern part of Georgia.

It was difficult to obtain detailed information about electricity users because electricity generation companies and distribution companies vary within Georgia. For instance, the largest distribution company in Tbilisi and its surrounding areas is JSC Telasi. Based on the data obtained from EnergoPro (which distributes electricity in the west), the distribution of electricity users is as follows: 28.1% large companies, 15.3% small and medium companies, 34.1% households, and 22.5% others (based on the data for 2009–2010.

3.3.2 Other Positive or Negative Impacts

As the project is focused mainly on the rehabilitation of existing facilities, there are no significant negative impacts on the natural environment and no specific problems relating to land acquisition or resettlement.

Thus, this project has largely achieved its objectives, therefore its effectiveness is considered to be high.

3.4 Efficiency (Rating: ①)

3.4.1 Project Outputs

There have been several modifications to the original plan in terms of the scope of this project. Major deviations of actual output from planned output are summarized in Table 12.

Table 12: Major Changes in Output (Planned and Actual)

Planned	Actual (major changes of scope and their reasons)
Rehabilitation of Khrami II Hydropower Station and Substation: Units 1 & 2	・Because of price escalation and in order to cover the unexpected additional cost for rehabilitation, the Japanese ODA loan was used mainly for rehabilitation of Unit 2 and part of Unit 1 (purchasing of equipment), excluding all civil works, and the Georgian side decided to finance all remaining works on Unit 1. ・.The new management company, RAOUES, implemented the rehabilitation

	works of Unit 1.
Rehabilitation of Lajanuri Hydropower Station and Substation: Units 1, 2, & 3	・Because of price escalation and cost overrun, the Japanese ODA loan was mainly used for rehabilitation of Unit 2 and Unit 3, and Unit 1 was excluded from the Japanese ODA loan portion. The rehabilitation of Unit 1 was conducted using funds from the new managing company, EnergoPro. ・Additional rehabilitation for the completion of Unit 3 was implemented using funds from EnergoPro.
Rehabilitation of Tbilisi & Kutaisi Control Centers, Rehabilitation of Communication System	・Because of a cost overrun for two hydropower plants, the Japanese ODA loan was used for rehabilitation of two hydropower stations, which were considered prioritized, and excluded the rehabilitation of control centers and communication system from the Japanese ODA loan portion. ・Tbilisi Control Center and communication system were renewed by the Electricity Market Support Project of the World Bank (2001–2010) and completed in August 2009.
Consulting Services: foreign portion 45 M/M, domestic portion 345 M/M	・Consulting services for construction supervision of two hydropower stations was extended until July 2007 in response to the extension of project period (foreign portion of consulting services increased from 45 M/M to 103 M/M).

3.4.2 Project Inputs

3.4.2.1 Project Cost

(1) Change of Project Cost

The project was planned to cost 5,332 million yen (foreign currency: 4,678 million yen, local currency: 1,213 million yen); however, the actual cost was 5,327 million yen (foreign currency: 4,942 million yen, local currency: 2,559 million Yen), which is 99.9% of the planned cost. Thus, the project cost almost the same as planned, but this is because it became impossible to implement all components of the original project scope and the portion of the project scope assisted by Japanese ODA loan was reduced to correspond to the planned amount of Japanese ODA loan.

(2) The Project Cost Necessary to Implement All Components of Original Scope

JICA supported the rehabilitation of Unit 2 of the Khrami II hydropower station, while Unit 1 was rehabilitated using primarily the funds of RAOUES after 2004. JICA also supported the rehabilitation of Unit 2 and part of Unit 3 of the Lajanuri hydropower station, while the rehabilitation of Unit 1 and part of Unit 3 was implemented using the funds of EnergoPro after 2007.

The cost overrun for the project was caused not by miscalculation of the cost at the time of F/S but by the delay in starting construction works, which in turn caused the price of equipment to escalate and resulted in expansion of additional repair works.

It was difficult to obtain exact data regarding the cost of rehabilitation for all five units of the two hydropower stations because the rehabilitation of some units was implemented continuously by two private companies using their own funds[8].

[8] For instance, the amount of investment of RAOUES for the additional rehabilitation works of the Khrami II hydropower station was 13 million lari (approximately 780 million yen) in total between 2003 and 2011. EnergoPro invested about 6 million lari for the additional rehabilitation of the Lajanuri hydropower station, including an investment of 5.475 million lari in 2010 for the total repair of Unit 1 and replacement of the spherical valve of Unit 3.

In addition, the cost of the Electricity Market Support Project conducted by the World Bank between 2001 and

3.4.2.2 Project Period

(1) Extension of Project Period

At the time of appraisal, the project was planned to run from January 1998 to December 2002 (60 months). However, the project actually ran from January 1998 to July 2008 (126 months), representing a delay of 5 years and 7 months (210% delay).

Table 13 shows a more detailed comparison of the planned and actual timescales.

Table 13 Comparison of Project Schedule (Planned and Actual)

	Planned	Actual
Procurement, tender, and contract	March 1998–March 2000	March 1998–January 2002 Khrami II: March 1998–November 1999 Lajanuri: March 1998–January 2002
Construction works	March 1998–July 2002	April 2000–July 2008 Khrami II: April 2000–December 2007 Lajanuri: October 2001–December 2008
Consulting Services	March 1998–December 2002	December 1999–July 2008 ELC-EPDC: January 2000–July 2008 FEPPIA: December 1999–July 2008

(2) Reasons for the Delay

Relative to the original plan, the delay in the start of construction work was 25 months in the case of the Khrami II hydropower station and 43 months in the case of the Lajanuri hydropower station. The construction works were planned to last 53 months. However, in reality, construction lasted 81 months for Khrami II and 87 months for Lajanuri.

The main reasons for the delays in the implementation schedule were as follows.

A. Delay in the procurement phase

The executing agency was unaccustomed to the procurement process involved in the Japanese ODA loan and took a long time to check the appropriateness of the results of the bid.

The cost overrun of the two main construction works highlighted the necessity of adjusting the portions of rehabilitation to be supported by the Japanese ODA loan and those to be implemented using funds from the Georgian side; this adjustment took a considerable time to resolve.

B. Delay of the construction works

Necessity of additional works: After the dismantling of the units and diagnostic inspections, it was deemed necessary to carry out additional works for both the Khrami II and Lajanuri

2010, which assisted in the rehabilitation and renewal of Tbilisi Control Center and transmission facilities, was 58.97 million US$ (total actual expenditure). Of this, the component involving SCADA/EMS/ Telecommunications, which focused on the renewal of Tbilisi Control Center and the introduction of the SCADA system, cost 17.7 million US$, excluding consultant services.

hydropower stations. This led to a need for additional funds from the Georgian side for rehabilitation, and time was required to alter the contracts to reduce the funds required.

Change of managing company of Khrami II hydropower station: The Georgian government concluded the contract transferring the management of the Khrami II hydropower station to a US-based private company (AES, which was later purchased by RAOUES) in December 1999. AES rejected the suspension of operations of the power units during rehabilitation in order to continue to collect revenue, which made it difficult for contractors to conduct rehabilitation works, leading to inevitable delays[9].

3.4.3 Financial Internal Rate of Return (FIRR) (for reference)

At the time of appraisal, the internal rate of return (IRR) for the project was calculated to be 37%.

The project period is deemed as 1998-2008, the financial internal rate of return (FIRR) for the project was recalculated based on the longer project period, taking into account additional rehabilitation costs including Japanese ODA loan investment and Georgian funds (from government and managing companies). Average annual operation and maintenance costs of the two companies were taken as costs, while sales of electricity generated (current 2011 figures of the two companies) were considered benefits and project life was 25 years. This recaluculation generates new figures of 18.5% in the case of the Khrami II hydropower station and 16.2% in the case of the Lajanuri hydropower station, values which are lower than the original calculations[10]. The figures include all power units of both hydropower stations and do not focus solely on the units supported by the Japanese ODA loan.

The project cost was almost the same as planned, although the increased cost overall meant that the Japanese ODA loan covered a lower proportion of the project than intended. The cost of completing the whole scope at the time of appraisal was much higher than planned, and the project period was extended more than twice; therefore, the efficiency of the project is low.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

(1) Privatization of Executing Agencies

The executing agency of the project at the time of appraisal was Energogeneratsia, a state-owned power generation company; however, the hydropower stations were later transferred to two private companies as follows.

---

9 In comparison with the World Bank's Power Rehabilitation Project (PRP), conducted for almost the same period between 1997 and 2000, the project was much less influenced by the privatization process. Conversely, the World Bank's Electricity Market Support Project (EMSP), conducted between 2001 and 2010, was strongly influenced by unexpected events such as rapid privatization, drastic fluctuations of exchange rate, and the war against Russia during the period after 2003.

10 The FIRR figures presented in PCR were 3.66% in the case of the Khrami II HPP and 7.64% in the case of the Lajanuri HPP, but none of the Georgian counterpart could clarify the basis for calculation of these figures.

A. Khrami II hydropower station:

The Georgian government promoted privatization of the electricity sector, concluding a contract by transferring the management of the Khrami II hydropower station to AES (a US-based company) in 1999[11]. The management contract was transferred again to RAOUES (a Russian-based company) in September 2003.

B. Lajanuri hydropower station:

The Georgian government conducted an international open bid for the management of several hydropower stations, including Lajanuri, and the distribution network in the area surrounding Kutaisi in the western part of Georgia in June 2006. EnergoPro (a Czech company) obtained the contract, and the Lajanuri hydropower station was sold to the company in February 2007.

(2) Organizational Structure

The Khrami II hydropower station has been operated and managed by RAOUES since 2003 and the Lajanuri hydropower station by EnergoPro since 2007. Both companies bought the assets of these hydropower stations from the Georgian government and have been managing the power stations by running those facilities and earning operating revenue. At the time of purchasing the assets, all previous debt was included in the purchase price and the companies were not responsible for repaying the Japanese ODA loan used for the rehabilitation of the hydropower stations to JICA (the Georgian government still has a duty to repay the Japanese ODA loan to JICA).

Transmission of electricity is managed by GSE (Georgian State Electrosystem, a state-owned company of Georgia) and distribution of electricity by five private companies. Telasi, a sister company of RAOUES, is the largest distribution company in eastern Georgia, while EnergoPro is the largest in western Georgia. RAOUES, the company managing the Khrami II hydropower station, was established in 1997 and its head office is located in Moscow in Russia. The company is a huge conglomerate, with total group assets of 3,854 million euros at the end of 2010, and engages in electricity operations in Armenia, Finland, Kazakhstan, Tajikistan, Turkey, and Lithuania in addition to Georgia. EnergoPro, the company managing the Lajanuri hydropower station, was established in 1994 and its head office is located in the Czech Republic. It is the largest hydropower generation company, with 11 hydropower stations in the Czeck Republic, and had total assets of 300 million euros at the end of 2011, extending its investments in the eastern European and Caucasian region to include countries such as Bulgaria and Georgia. Both companies are regarded as possessing sufficient management capacity in terms of finance, technical skills, and human resources.

Therefore, the privatization of the electricity sector in Georgia can be regarded as having exerted positive effects on the effective and sustainable operation and management of hydropower generation.

---

[11] JICA didn't get any information about the contract of transfer of management of Khrami II from the executing agency in advance, a part of the duties and responsibility of the loan contract became unclear and it took time to check and clarify those issues at that moment.

3.5.2 Technical Aspects of Operation and Maintenance

At the time of evaluation in March 2012, there were 58 members of staff at the Khrami II hydropower station, including 51 engineers/technicians. There were 10 chief engineers, all of whom were engineering graduates. One or two young graduate engineers are hired almost every year.

Similarly, there were 41 members of staff at the Lajanuri hydropower station: 2 managers, 11 engineers, and other technical support staff. The number of staff decreased from 115 at the time of Energogeneratsia in the 1990s to less than half that number as a result of restructuring and the privatization process; however, its management has become more efficient as a result.

Capable engineers have continued to work since the era of Energogeneratsia, both for RAOUES (Khrami II) and EnergoPro (Lajanuri), and engineers and experts are occasionally sent from the headquarters of those companies as needed. Training of technical staff is often implemented, and no major problems were found in either company in terms of technical skills.

3.5.3 Financial Aspects of Operation and Maintenance

The project scope for which the Japanese ODA loan was offered was reduced; however, rehabilitation of the portion excluded from Japanese ODA loan assistance was implemented and those facilities are maintained by the funds of the privatized companies.

In Georgia, operation and management of electricity generation has been privatized in principle; the electricity generated by these private companies is sold to a state-owned electricity transmission company, GSE (Georgian State Electrosystem), and the electricity is then sold to private distribution companies operating in different areas of the country. The tariffs are regulated by Georgia National Energy Regulatory Commission (GNERC), which was established in 1997. The tariff system is arranged such that the power generation companies can cover their maintenance costs and generate profit through the system.

The collection rate of electricity charges, both at the stage of selling to transmission companies and at the stage of selling to distribution companies, was around 35–50% in 2002; this was drastically improved to 95–97% in 2011[12]. Several factors are considered to have contributed to the improvement. First, the electricity market has been reformed: during operation by the state-owned company, Energogeneratsia were less stringent regarding collection of electricity charges from users, but the companies distributing electricity after privatization were much more strict in their collection of charges, stopping supply to users who did not pay. Second, a new system was established for the electricity demand and supply network. The World Bank and USAID supported construction of a new information network system in which all sales and purchases were collated.

Although the companies managing both the Khrami II and Lajanuri hydropower stations are private companies and do not release their financial data, the following financial information was offered[13].

12 Based on data offered by EnergoPro.

13 After 2008, GNERC (Georgia National Energy Regulatory Commission) requested all relevant power companies

A. Operation and Maintenance Costs of Khrami II Hydropower Station

The financial situation of the Khrami II hydropower station after the takeover by RAOUES in 2003 is illustrated in Table 14. RAOUES plans to invest 1.9 million lari for additional rehabilitation of Unit 1 and Unit 2 between 2013 and 2017.

Table 14 Financial Situation of Khrami II Hydropower Station (million lari)

	03	04	05	06	07	08	09	10	11
Operating Cost	1.61	1.36	0.51	0.58	0.82	1.23	1.33	1.88	3.66
Maintenance Cost	0.14	0.10	0.16	0.16	0.18	0.20	0.36	1.02	0.63

Source: Data from RAOUES though the Ministry of Energy and Natural Resources.

B. Operation and Maintenance Costs of Lajanuri Hydropower Station

The annual investment and maintenance costs of the Lajanuri power station after the takeover by EnergoPro in 2007 are shown in Table 15.

Table 15 Financial Situation of Lajanuri Hydropower Station (million lari)

	07	08	09	10	11
Investment		0.143	0.275	5.475	0.140
Maintenance Cost	0.35	1.07	0.65	0.06	0.29

Source: Data from EnergoPro.

A large investment (5.475 million lari, or about 346 million yen) was made in 2010 and was put toward rehabilitation of Unit 1 and replacement of the spherical valve of Unit 3, among other things. EnergoPro is investing 4.143 million lari in 2012; most of this money will be used for replacement of the water valve and generator of Unit 1.

3.5.4 Current Status of Operation and Maintenance

The evaluation team visited both the Khrami II and Lajanuri hydropower stations in March 2012.

(1) Khrami II Hydropower Station

There are two power units. It is said that the facilities were poorly maintained when the management of the power plant was transferred to RAOUES in 2003, but both power units are now operational and most facilities are maintained properly at this time. Major equipment in Unit 2 was replaced with JICA support, and the unit has been fully operational since 2008. Unit 1 has also been fully operational since the end of 2010.

The new facilities supported by JICA are basically in good condition. However, it takes time to obtain spare parts for some special equipment, such as the turbine of Unit 1. During the next five

to present financial and technical reports, but our evaluation team could not obtain these reports from the commission.

years (2013–2017), additional repair works will be conducted in Unit 1 and Unit 2. Work will also be conducted on, for example, the warehouses and storage buildings, the shield seals and concrete layers of the regulation pool, and the overhead and gantry cranes. The inclined pipe and derivation tunnels will also be examined.

Renewed transformer

Renewed distributor

(2) Lajanuri Hydropower Station

There are three power units. The management of the power plant was transferred to EnergoPro in March 2007. Unit 2 and part of Unit 3 were rehabilitated with JICA's support and began operating with new equipment from 2008; these facilities are maintained almost completely by EnergoPro. At the time of site visit in March 2012, Unit 2 and Unit 3 were fully operational but Unit 1 was undergoing repair.

The new facilities supported by JICA are in basically good condition and there are no obvious problems. The power plant was originally constructed in 1960, and many old equipment and facilities, such as computers in central control systems and parts of the distribution network, are yet to be replaced.

In 2012, EnergoPro is conducting replacement and repair works on the following: the valve and generator of Unit 1; the transfer tunnel; the derivation channel from dam to tunnel; the surge chamber; and the administration building.

Water valves of all three units

Renewed distributor

No major problems have been observed in the operation and maintenance of the stations with regard to their organization, technical skills, or finance; therefore, sustainability of the project is considered is high.

4. Conclusion, Lessons Learned, and Recommendations

4.1 Conclusions

This project was intended to restore electricity generation and enable stable electricity supply by rehabilitating existing power stations and modernizing control centers and telecommunication systems, thereby contributing to restoration and growth of the economy in Georgia. The objectives are consistent with development policy and development needs at the time of appraisal and ex-post evaluation, indicating the high relevance of the project.

The scope of the project planned to be assisted at the time of appraisal was reduced, but the remaining portions of the two plants were rehabilitated effectively as a result of provision of funds by the managing companies; additionally, a World Bank loan was offered to cover the renewal of the Tbilisi Control Center. Thus, the effectiveness and impacts of the project are considered to be high.

The project cost almost the same as planned, but significantly more investment would have been required to complete the project according to the original scope, and the project timescale was extended to more than twice the planned timescale. Therefore, the efficiency of the project is considered to be low.

The facilities and equipment attached to the project have been properly maintained by the companies managing the plants without major problems in terms of structure, technique, or finance. Therefore, the sustainability of the project is considered to be high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agencies

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

(1) Assistance with hardware components, such as those involved in the construction of facilities and supply of equipment, could be realized more effectively if offered in parallel with the software components of institutional reforms. For example, these components could be offered during the privatization process or market reform in the electricity sector, especially when the counterpart government has limited capacity for policymaking and/or the executing agency has limited capacity for management. It could be said that JICA has already been involved in policy issues through its co-finance with the World Bank, which offered software components of policy advice to the counterparts. However, it is desirable for JICA to become more engaged with policy issues and institutional reforms using its technical assistance in offering Japanese ODA loans, in coordination with the policy assistance of other donors.

(2) Two major factors caused cost overrun for the realization of the original scope of the project: prices escalated compared to those estimated in the F/S, and the necessity to conduct additional work was identified only after diagnostic inspections were conducted by the construction contractors. The price escalation was caused by the delay in procurement after the conclusion of L/A and the delay of the Georgian government in responding to the change of contracts. To reduce risks such as these, it would be useful to incorporate assistance, such as the assistance to speed up procurement by the counterpart executing agency at the start of the project and allowing more flexibility in the setting of reserve budgets and formulation of operating plans.

Comparison of the Original and Actual Scope of the Project

Items	Planned	Actual
1.Project Outputs	(1) Khrami II Hydropower Station (Maximum Output: 2 × 55 MW = 110 MW): Rehabilitation of Units 1 and 2 and substation (2) Lajanuri Hydropower Station (Maximum Output: 3 × 37 MW = 111 MW): Rehabilitation of Units 1, 2, and 3 and substation (3) Tbilisi/Kutaisi Control Center, Communication System (4) Consulting services (foreign portion 45 M/M, local portion 345 M/M)	(1) Khrami II Hydropower Station: Unit 2 and part of Unit 1 The new management company conducted rehabilitation of Unit 1. (2) Lajanuri Hydropower Station: Unit 2 only and part of Unit 3, excluded Unit 1 Remaining works of Units 1 and 3 were financed by Georgian side. (3) Tbilisi/Kutaisi Control Center, Communication System: Excluded from Japanese ODA loan portion. (4) Consulting services: Construction supervision was extended and foreign portion expanded to 103 M/M.
2.Project Period	January 1998–December 2002 (60 months)	January 1998–July 2008 (126 months)
3. Project Cost Foreign currency Local Currency Total JICA loan portion Exchange rate	4,678 million yen 1,213 million yen (12.42 million lari) 5,891 million yen 5,332 million yen 1 lari = 96.7 yen (as of January 1996)	4,942 million yen 2,559 million yen (41.19 million lari) 7,502 million yen 5,327 million yen Khrami II: 1 lari = 60.14 yen Lajanuri: 1 lari = 63.25 yen (Average between January 1998 and July 2008)

Kenya

Ex-Post Evaluation of Japanese ODA Loan

"Sondu-Miriu Hydropower Project I, II"

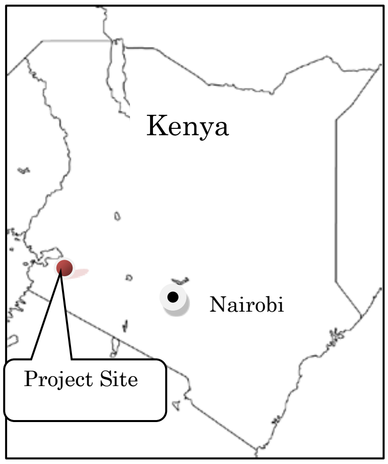
External Evaluator: Takeshi Daimon, Waseda University

0. Summary

This project is consistent with Kenya's policy of promoting efficient and sustainable supply and demand of energy, local and national needs for electricity supply, and Japanese aid policy at that time, so the relevance is high. There is no major operational problem with the constructed power plant, and in general, the target goals for annual power generation, operational ratio, etc. have been achieved; thus, the effectiveness is also high. There is no serious negative impact on the natural environment; further, there are no severe problems involving relocation and pollution and related effects on health. The project cost slightly exceeded the plan, and the project period significantly exceeded the plan—there was a delay of more than five years in the signing of Loan Agreement (L/A)—owing to which the efficiency is low. There is no major problem in the structure, finance, technique, or current status of operation and maintenance; hence, the sustainability of the project is high.

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

1. Project Description



Project Location

Sondu-Miriu Hydropower Plant

1.1 Background

Under the long Moi Presidency (1978–2002), Kenya's policy base became unstable in the early 1990s, when the country was faced with an anti-corruption and pro-democracy movement. Further, the delay in implementation of the structural adjustment programs since the 1980s worsened its relations with the World Bank and IMF. In November 1991, at the Paris Conference for Aid for Africa, Kenya was criticized for the delay in democratization and structural adjustment, and the decision to stop new assistance for Kenya was made; subsequently, there was a substantive decrease in aid for the country until the late 1990s when there was improvement in governance and stabilization of the macro economy. During this period, there was an increase in demand for electricity; however, no new power stations were constructed. Hence, the supply gap increased, and there were frequent planned outages of electricity, which were obstacles for the country's economic activities.

Hydropower (tapping roughly from the central and western river systems) contributes to nearly half of Kenya's electricity supply. The power stations in the country are connected to a single grid, extending from the northwest (facing Uganda) to Mombasa (the second largest commercial city) via Nairobi, the capital city. Kenya Electricity Generating Company Limited (KenGen) deals with power generation, and Kenya Power and Lighting Company Limited (KPLC) deals with transmission and distribution. The grid is also connected to the adjacent nations Uganda and Tanzania.

Western Kenya, includes Kisumu where this project is located, is known to be a major agricultural area; about 30% of the national population resides in Western Kenya. However, there is a shortage of electricity infrastructure, and this is a major obstacle for economic activities in the region. The area is also known to be very poor, with 54% of people living under the poverty line (1994 survey), much higher than the national average of 40% (1994) or the corresponding value of 26% for Nairobi (1994). Addressing the issues of electricity shortage and the creation of employment in western Kenya was expected to provide a solid basis for activating economic activities.

1.2 Project Outline

To meet the growing demand for electricity in western Kenya and the whole country by installing 60MW (30MW×2) hydroelectric power plant in the Nyando and Rachuonyo Districts, thereby contributing to the sustainable economic growth of the country.

Loan Approved Amount/ Disbursed Amount	Phase I: 6,933 /6,933million yen Phase II: 10,554 /10,554 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	Phase I: March 1997/July 2004 Phase II: February 2004/July 2009
Terms and Conditions	Phase I:2.3%, 30 (10) years, General Untied Phase II: 0.75%, 40(10) years, Bilateral Tied
Borrower/Executing Agency	KenGen / KenGen
Final Disbursement Date	Phase I: July 3, 2007 Phase II: July 15, 2009 (II)
Main Contractors (Over 1 billion yen)	[Civil Works] Konoike (Japan) /VEIDE KKE ASA (Norway) / MURRAY AND ROBERTS (South Africa) (Phase I)

	Taiesi (Japan) / Konoike (Japan) (Phase II) [Turbine] IHI (Japan) [Power Generator] Mitsui-Toshiba Consortium (Japan) [Transmission & Substation] Kinden (Japan)
Main Consultant (Over 100 million yen)	Nippon Koei (Japan)
Feasibility Studies etc.	F/S (JICA 1983, "Pre-Study on Sondu River Multipurpose Development Plan" for the power plant and irrigation plan along the Sondu River; JICA 1983–1985 "Sondu River Hydropwer Plan" for the power and irrigation plan including this project.)
Related Projects (if any)	Yen Loan "Sondu-Miriu Hydropower Project (E/S)" (L/A signed in October 1989), World Bank "Energy Sector Reform and Power Development Project" (C/A signed in April 1998).

2. Outline of the Evaluation Study

2.1 External Evaluator

Takeshi Daimon, Waseda University

2.2 Duration of the Evaluation Study

Duration of the Study: December 2011–October 2012

Duration of the Field Study: March 24, 2012–April 4, 2012; June 16, 2012–June 22, 2012

2.3 Constraints during the Evaluation Study (if any)

None

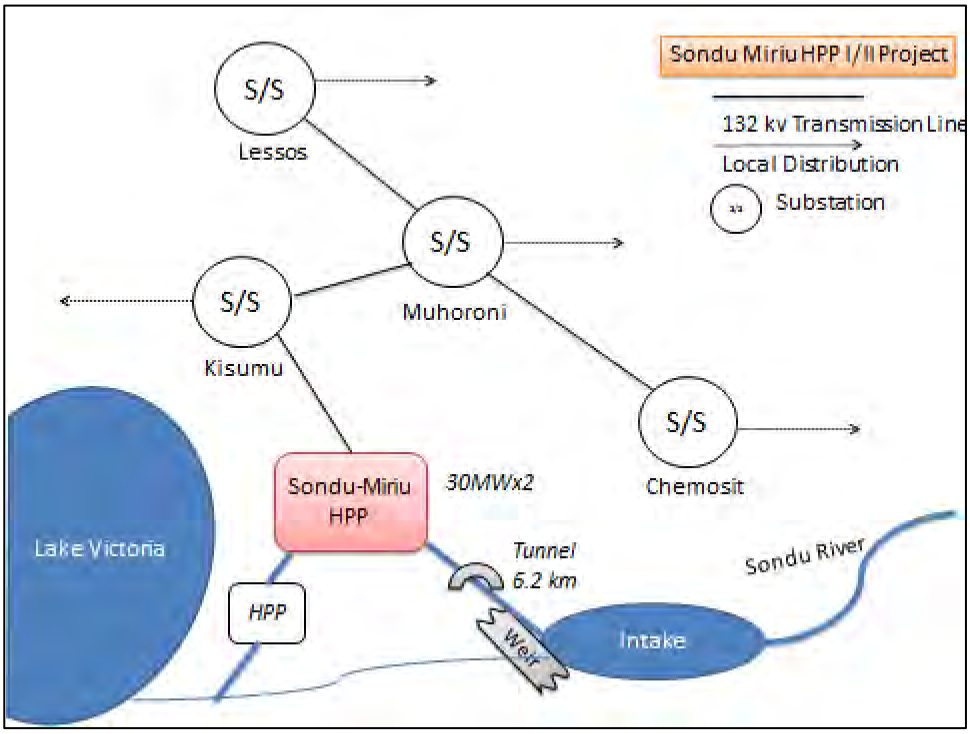


Figure 1 Project Overview

Source: Evaluator

Notes: 1) Local distribution, except for systems for supplying electricity for the weir, is outside the scope of the project.

2) Water used for electricity generation flows back into the Sondu River through a hydropower plant, to be constructed (separate from this project.)

3. Results of the Evaluation (Overall Rating: B[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance with the Development Plan of Kenya

At the time when this project was extended, Kenya's "National Development Plan" (1994–1996) listed the electricity sector as an important sector. The National Power Development Plan (NPDP) (1994–2013), which was part of the national plan, envisioned a 10-year program of expanding power generating facilities, and the 5 Year Least Cost Development Program (LCDP) (1994–1998, 1999–2019) listed this project as a priority investment. Further, the Economic Recovery Project (2003), published after the extension of Phase I of this project, continued to recognize this project as having the highest priority. When Phase II was extended, Kenya drafted a Poverty Reduction Strategy Paper (PRSP) (2001–2004) recognizing this project as a high priority project because it was expected to deliver a "secure supply of energy in order to promote economic growth."

Vision 2030, a long-term national plan drafted in 2007, continues to emphasize the necessity of establishing a system of efficient and sustainable supply and consumption of energy in order to realize

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

[2] ③: High, ② Fair, ① Low

the long-term economic development of Kenya. In addition, the National Energy Policy, drafted in May 2012, continues to emphasize the necessity of investing in expanding power generating capacity to secure a stable supply of electricity. The policy presents a plan to decrease the dependence on hydropower from 47.8% as of 2011 to 5% by 2030 because it is difficult to increase the hydropower contribution in the future because of relocation and environmental issues.

3.1.2 Relevance with the Development Needs of Kenya

As of the appraisal of this project, western Kenya—where Kisumu, the project site is located—is home to about one third of the national population. It is endowed with fertile land and a favorable climate, and is a major agricultural area that produces consumption products such as maize and rice as well as cash crops such as tea, coffee, and sugar. However, the inadequate electricity infrastructure was a major obstacle for further economic activities. In addition, the electricity demand in Kenya grew more than 5% annually, and supply was not able to meet the demand, resulting in planned blackouts and purchases of electricity from Uganda. Because the excess demand was not met by the outdated power stations existing in the country, the construction of new power plants became inevitable.

This project was expected to contribute to narrowing the gap in electricity supply and facilitate the supply of electricity in western Kenya by aiding the construction of a power plant in Kisumu, and thus contribute to the economic activities in the region.

Table 1 Forecast and Actual Electricity Demand

Unit：MW

	Nairobi		Western Kenya		Kenya
	Original Forecast	Actual/Re-forecast	Original Forecast	Actual/Re-forecast	Actual/Re-forecast
1997	392	n/a	76	n/a	n/a
2000	441	n/a	84	n/a	n/a
2005	593	481	114	178	920
2010	804	623	156	233	1,194
2015	1,085	1,241*	211	476*	2,386*
2020	n/a	2,214*	n/a	904*	4,519*
2025	n/a	3,726*	n/a	1,753*	8,102*
2030	n/a	5,996*	n/a	3,283*	14,273*

Source：KPLC Annual Report (Actual), LCDP (1998, 2011)

Note：* Re-forecast at the post-evaluation

As of 2010, the peak demand in the country is 1,194 MW, while the effective capacity[3] is 1,412 MW; hydropower contributes 735 MW (including this project of 60 MW); thermal power, 182 MW; geothermal power, is 143 MW; wind, 5 MW; and others, 347 MW to the effective capacity)[4]. The supply gap is solved for now. However, Kenya showed an annual economic growth of more than 5%[5] from 2005 to 2010, and if this trend continues, the demand in the period 2015–2030 would range

[3]The effective capacity refers to all installed and operational capacity except for non-operational facilities.

[4]According to KPLC data (2010).

[5]5.8%(2005), 6.4%（2006）, 7.1%（2007）, 1.7%（2008）, 2.6%（2009）, 5.6%（2010）, 4.6%（2011）, Statistics Office

from 2 to 10 times the 2010 level (Table1). This demand cannot be met with existing power-generation facilities. In order to mitigate the current gap, Kenya purchases about 30 GWh annually from Uganda (and 1 GWh from Tanzania).

Table 2 Trade of Electricity with Uganda and Tanzania

Unit：GWh

		2004	2005	2006	2007	2008	2009	2010
Uganda	Import	105.6	14.6	12.7	24.7	28.6	37.1	29.9
	Export	19.9	23.9	73.5	46.4	26.6	26.3	30.3
Tanzania	Import	0.3	0.4	0.4	1.0	1.2	1.1	0.9
	Export	n/a	n/a	n/a	n/a	n/a	0.5	0.8

Source：Kenya National Energy Policy (2012) (Fiscal Year)

Therefore, the development needs for electricity in Kenya, particularly the needs for power generation and infrastructure expansion in western Kenya, remain high.

3.1.3 Relevance with Japan's ODA Policy

The Country Assistance Policy for Kenya[6] (Ministry of Foreign Affairs, 1998) states that as Kenya "fills in the shortage of electricity supply from neighboring countries, which is important in industrial activities," it is important "to support the development of energy resources." The Country Assistance Plan (drafted in August 2000) also recognizes "the development of energy resources" as a pivotal assistance area "to alleviate shortage of supply in electricity, indispensable for industrial activities, as far as it pays considerations for coexistence with environment and relationship with community members." In addition, Kenya's Overseas Economic Cooperation Implementation Policies (2002–2004) emphasize the need to support the development of "infrastructure for economic growth" and recognize the importance of support for the economic and social infrastructures.

Originally, the appraisal of Phase II of this project started in October 1998, and was expected to be extended within the same fiscal year. However, the possibility emerged that Kenya would be a candidate country eligible for the enhanced debt reduction scheme, which prevented the Government of Japan from extending the loan for this phase; however, finally, since the Government of Kenya expressed its intention to not take the benefit of the debt relief program, the Government of Japan made a pledge in September 1999. Nevertheless, as the Phase I work started, local parliamentarians, NGOs, and local people raised environmental concerns about this project, which was also taken up by the Japanese Diet, and the extension of Phase II was postponed until February 2004.

Therefore, this project has been highly relevant with the country's development plan and its development needs, as well as Japan's ODA policy; therefore, its relevance is high.

---

of Kenya.

[6] "Country Assistance Policy for Major Countries" (Annual Report on Implementation of Japanese Official Development Assistance for Major Countries.)

3.2 Effectiveness[7] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

The operation and effect indicators for this project overall meet the targets for the maximum output (30 MW × 2), total electricity generated and operating rate, as well as planned outage hours (Table 3).[8] Further, the inflow into the reservoir is stable. KPLC does not measure the end-users' electricity generated.

Table 3 Operation and Effect Indicators

	Target (2012)	Actual			
		2008	2009	2010	2011
Net Electric Energy Production (GWh)	330.6	333.15	340.46	364.31	290.43
Maximum Output (MW)	60	60	60	60	60
Planned Outage Hours (Days/Year)	14	14.84	12.50	33.75	7.19
Unplanned Outage Hours (Days/Year)	2	46.08	23.54	2.71	4.88
Capacity Factor (%)	59.1	63.38	64.78	69.31	82.66
Hydro Utilization Factor (%)[9]	n/a	69.01	67.94	72.67	84.08
Annual Total Volume of Inflow to the Reservoir (mil. m^3)	n/a	957	1,140	1,103	980

Source: KenGen

Note: Fiscal year runs from July till June, but FY 2011 includes data from July 2011 until February 2012.

The inflow and maximum output with seasonality is described in Chart 2 below. In the dry season (January to April), there is little inflow and low output, while during the 8 months of the rainy season, the monthly generation is about 40 GWh (or about 320 GWh in 8 months), which is 97% of the annual generation (about 330 GWh).

KenGen purchases about 360 GWh (July 2011 to May 2012) annually from a UK generator rental company (Aggreko)[10] in order to cope with the seasonally unstable supply of electricity and to meet emergency electricity demand.

There are various hydroelectric power stations at different water systems in the country, which make

[7]Sub-rating for effectiveness is to be decided after considering the impact
[8]Unplanned Outage Hours have been decreasing since 2008 but have not achieved the target as of the ex-post evaluation.
[9]Hydro Utilization Factor = (net electric energy)/ (possible power generation in a given year) × 100(%)
[10]Aggreko installs emergency power plants in Kenya with generating capacities of 30MW and 60MW.

it possible for other plants to fill in the electricity supply gaps, should there be a shortage of water in the Sondu River and a resulting outage of the Sondu-Miriu power plant. Similarly, the Sondu-Miriu plant could fill in the gaps of other power plants if they happen to experience supply shortage.

These measures could rectify the seasonality of electricity generation, which is a challenge for hydroelectric power stations.

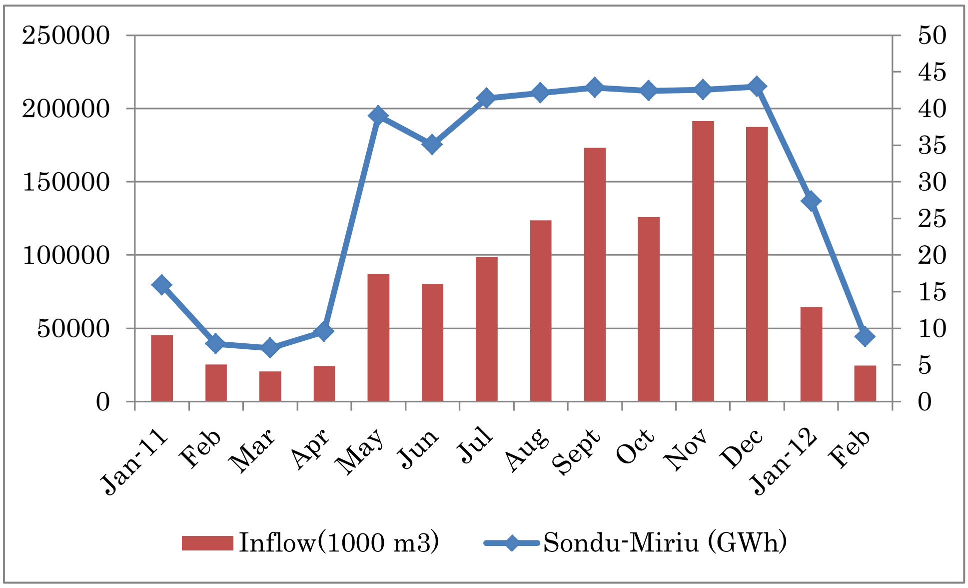


Figure 2 Inflow of water to the reservoir (monthly average) and power generation (monthly)

Source：KenGen

3.2.2 Qualitative Effects

None.

3.3 Impact

3.3.1 Intended Impacts

This project was expected “to alleviate supply gap of electricity,” “to provide stable supply of electricity in western Kenya,” and “to save foreign currency for oil imports by using alternative water resources.”

Considering the supply-demand gap, as shown in Table 1, the peak demand in the whole country as of 2010 was 1,194 MW, while the effective power generated was 1,412 MW; thus, it can be said that the project has contributed to narrowing the gap. The project has indeed contributed to the supply of electricity in western Kenya, where the electrification rate[11] was reduced from 18% in 2005 to 15% in

[11] Number of KPLC subscribers/number of households.

2011[12], and there remains a significant gap between this region and other big cities such as Nairobi.

Table 4 Electrification Rate

Unit: %

	2005	2006	2007	2008	2009	2010	2011
Western Kenya	18	18	17	17	16	15	15
Nairobi	51	52	51	52	53	54	53
Kenya	7.1	4.6	10.6	5.1	2.1	3.5	8.9

Source：KPLC Annual Reports
Note: in fiscal years

Regarding the “saving of foreign currency for oil imports by using alternative water resources,” a thermal power plant[13] of the same capacity costs two billion Kenyan Shilling (about two billion Yen)[14]annually for fule, which is equivalent to the savings by this project, suggesting that it would recover the project cost (about 28.7 billion Yen) in about 15 years by a back-of-the-envelope calculation.

Therefore, the intended overall impact is realized.

3.3.2 Other Impacts

3.3.2.1 Beneficiary Survey

This post-evaluation study includes a beneficiary survey. The target areas include those affected by the project, including the inlet, Sondu River downstream maintenance areas’ left and right banks, the outlet channel, power station, transmission line, and base camp (facilities for staff), along with 200 sample households that have been randomly selected.

The electrification data show that out of 200 sample households, 23 (11.5%) have contracts with KPLC, which serve them with electricity, and the non-contractors replied that they have not signed the contracte with KPLC because of the lack of electricity supply to their community (50 households), high electricity bills (where the community is served) (111 households), and other reasons (5 households).

Further, many of the households recognized the employment and business during construction, and the new infrastructure (power station and related facilities) as major positive impacts; the noise and pollution during construction, and the loss of employment[15] after the construction was completed were recognized as major negative impacts. Overall the rate of satisfaction with the project shows that 140 households (70%) are “very much satisfied” or “satisfied,” far exceeding 55 households (27.5%) who replied “unsatisfied” or “very much unsatisfied.”

[12]However, the population in western Kenya increased by 16% from 4.13 million (in 2000) to 4.8 million (in 2010); hence, the number of people with access to electricity itself has increased.
[13]Calculated (by KenGen) by comparing Kipevu Thermal Power Plant of 73.5 MW, adjusted to the 60 MW capacity.
[14]Exchange Rate (1 Ksh = ~1 JPY) as of March 2012.
[15]Strictly speaking, from an evaluation point of view, this is not defined as “negative impact from the project” because the situation has simply returned to the pre-project status (of no employment).

Table 5 Positive or negative impact from this project

Unit: households

Nature of Impact (Positive/Negative)	During Construction	After Completion
Positive：Employment & Business	177	0
Positive：Infrastructure	1	176
Positive：Other Social Benefits	1	3
Positive：None	20	21
Negative ： Loss of Employment Opportunity	1	171
Negative : Pollution（Noise & Dust）	176	0
Negative：Other Social Costs	9	17
Negative：None	14	12

Source: Beneficiary Survey

Table 6 Level of satisfaction with this project

Unit: households

Very much satisfied	42
Satisfied	98
Unsatisfied	45
Very much unsatisfied	10

Source: Beneficiary Survey

A major reason for satisfaction is the economic benefits such as employment creation (132 households), while a major reason for dissatisfaction is the non-economic costs such as worsening of the environment during construction (45 households).

Box 1 Technical Committee

(1) Background

After Phase I of the project had begun, local people and NGOs had raised concerns regarding for socioenvironmental issues; these concerns were also taken into consideration by the Japanese Diet, which resulted in the delaying of the decision to start Phase II. Faced with the situation, a “stakeholder meeting” (in which 300 people participated) was held in order to assess the current situation of the project and to hear opinions from local people and NGOs; the outcome was an agreement to establish a Technical Committee in order to discuss their daily requests. The committee was in place until 2008, when this project was completed.

(2) Mechanism

The Technical Committee consisted of 31 members, including members of parliament (4), members of local councils (6), professionals (6), community representatives (6, elected by voting), Non-Governmental Organizations (NGOs) (6) (Nyakach Community Development Association, Climate Network Africa, local NGOs), Government of Kenya (2), KenGen (1) (chair), and observers from KenGen (6), JICA (2), and consultants (2).

As a rule, the committee meetings were held quarterly, reporting its activities at the “stakeholder meeting” that were conducted annually in principle. Sub-committee meetings were held monthly in principle with the following themes: “land compensation and relocation,” “employment and economic opportunity,” "environment," and "health, safety, and security." Any issues raised between the executing agency and the stakeholders were coordinated, solved, and monitored through these sub-committees.

However, the committee "is not an enforcing agency that can enforce decisions, but can only study, monitor and make recommendations about the concerns and problems raised by stakeholders" (Technical Committee Guideline); hence, the limitation is that the decisions made by the committee are not legally binding for KenGen.

(3) Contributions of the Technical Committee （From the Beneficiary Survey）

The beneficiary survey reveals the relatively low level of recognition of the committee[16] where people are nearly equally "aware of" (105 households) and "unaware of" (91 households) it. Among those who recognized the committee, 86 households (81.9%) replied that they were either "unsatisfied" or "very much unsatisfied," far exceeding the 18 households (16.6%) who replied that they were either "satisfied" or "very much satisfied." The reasons for satisfaction included "opinions and interests were reflected" (9 households), "problems were solved" (10 households), while the reasons for dissatisfaction included "opinions and interests were not reflected" (17 households), "problems were not solved" (49 households), and "participatory, democratic and transparent process was not available" (27 households).

These results suggest that overall people are satisfied with the project, while they are not aware of the Technical Committee, and unfavorable opinions dominated even among those who recognized the committee because the problems raised were not solved (49 households)[17] etc. However, it is also true that based on requests from local people and NGOs, additional surveys (on fishery and livery standards, etc.) were recommended and conducted by the committee. This suggests that the committee's monitoring of the impacts on fishery and health damages caused by dust, etc. have decreased public concerns. However, it is most likely that these actual contributions by the committee were not fully shared with the local people in general.

3.3.2.2 Impacts on the natural environment（Delegated Issue 1 for the Technical Committee）

（1） Amount and Quality of Water in the Sondu River (maintenance section)

At the appraisal, the water outflow into the Sondu River was planned to be 0.5 m^3/s (constant), but by request from the Technical Committee, a consultant conducted a survey and recommended a modification of the outflow rate to 3.0 m^3/s (constant). The recommendation is not a legally binding target of effort, but post-project monitoring data of the water level shows that the water outflow can be below the target of effort depending on rainfall, and the monthly average remains more than 3.0 m^3/s[18] throughout the dry and rainy seasons.

[16]Households with land compensation (implemented in 1999, 2005, and 2007) replied that they were "aware of" (43 households) and "unaware of" (64 households) the committee.

[17]Those "problems raised but not solved" are too many to be generalized, but as pointed out in section "3.3.2.1 Beneficiary Survey", high electricity rates and loss in employment after the projects are considered among them.

[18]As shown in the chart, the monthly average water outflow is 5.1 m^3/s (March 2009), 6.3 m^3/s (February 2011), 9.9 m^3/s(February 2012). During the site visit (March 2012), outflow was at a rate of 1.4 m^3/s, but this could be indicative of an instantaneous data point during the dry season.

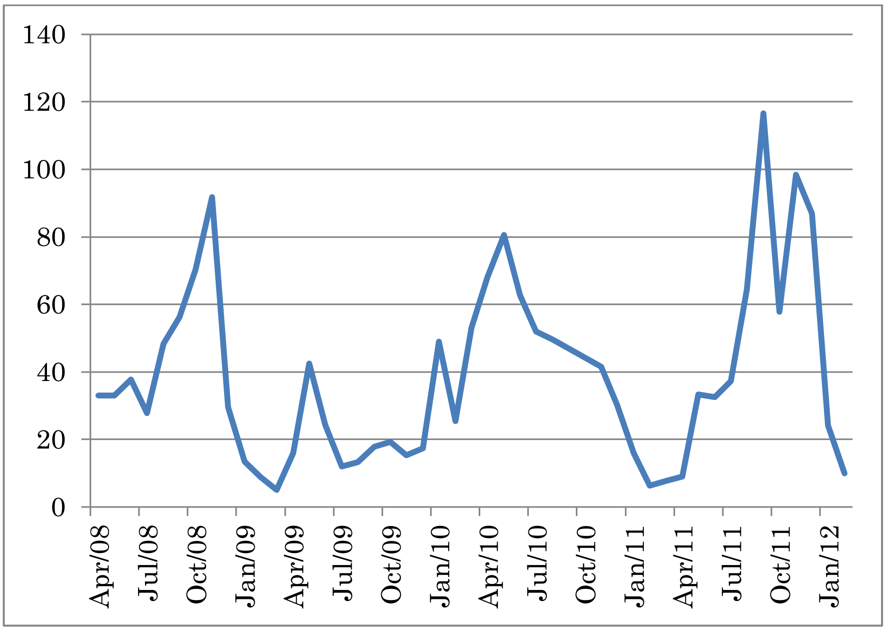


Figure 3 Water Outflow at Sondu River Maintenance Section（m3/s)

Source：KenGen

Water quality is measured at upstream and downstream sections, and indicates a high level of coliform[19], as described by the WHO standards for drinking water[20]. However, there is a seasonal fluctuation in water flow as well as the power required for purification, and there is seasonality in coliform levels, so it is impossible to identify causality between this project and the quality of water. Further, as part of its Corporate Social Responsibility (CSR) activities (Box2), KenGen installed public wells and a treated water system at the downstream area, and there is no report that untreated river water has been used for drinking.

（2）Impact on the Ecosystem

According to a survey on Sondu-Miriu River Fishes[21] conducted in 2010 by request from the Technical Committee, the number of fishes has increased from 2003 to 2010 as measured by “electrofishing”[22]above reservoir, down reservoir (maintenance section), and downstream sections. The diversity has increased from 19 species in 2003 to 25 in 2010.

[19]Measured by Total Coliform (TC) and Fecal Coliform (FC).
[20]WHO standards require the zero level of TC/FC for drinking water. The Sondu River shows a significantly high level of TC/FC exceeding 10,000 c.f.u./100 ml depending upon the timing of measurement.
[21]Owiti, Kapyio, and Bosire (2010), “The Sondu-Miriu River Fishes & Fisheries, Species Diversity, Abundance and Distribution by 2010”
[22]A widely used scientific way to determine the abundance and diversity of fishes, by stunning fishes with electricity.

Table 7 Abundance of Fish

Unit：g

	Above reservoir	Down reservoir	Downstream
2003	1,831	2,392	19,878
2010	4,583	10,666	22,004

Source：Owiti et al (2010)
Note：Total number of fishes (per measure)

The fact that the abundance and diversity of fishes have increased from 2003 to 2007, while the actual decrease of catch by local fishermen can be attributed to causes other than the reservoir (such as illegal fishing), suggests that the project has no significant negative impact on the ecosystem.

3.3.2.3 Impact on Affected Areas （Delegated Issue 2 for the Technical Committee）

(1) Land Acquisition and Resettlement

From January to May 1999, before the Technical Committee was established, land compensation[23] was made for 649 households of 213.2 ha, and about 91 million KSh was paid. The value of land was assessed at the market rate. Those who lost land at the base camp area were paid an additional 22.5%, while for others, 15% was added to the market rate.

In addition, the schools and church near the power station were provided “land for land” and “building for building” compensation, and by January 2001, they were newly constructed near their original locations (Box2). In March 2003, a boat owner above the reservoir intake was given cash for compensation. These compensation amounts were finally agreed upon among stakeholders, based on a hearing of their wishes and claims by the Technical Committee.

Compensation for the 1,714 landowning households[24] affected by the installation of the transmission line[25] was made in 2005 and 2007, totaling 137 million KSh.

(2) Pollution and Health Effects During Construction

Since 2001, KenGen annually conducts a “socioeconomic survey” in order to compare and assess the impacts of the project in the affected and non-affected areas. The 11th survey was completed in August 2011, when 2,773 people were interviewed.

The results showed that 30–50% of the local people have experienced effects of the dust,[26] but more than 70% of them responded that they suffered no health impacts in both the affected and non-affected areas; less than 20–30% of the local residents replied that they suffered from eye and respiratory diseases. During the same period, 40% of the respondents in the non-affected area replied that they suffered from eye diseases, implying that the rate of disease does not depend on whether the location is affected or non-affected by the project. Further, 30–50% of the local people experienced the

[23]The number of actual relocations among those who received land compensation is not recorded. KenGen reports that most of the residents remained in their terrain as the area is not densely populated or at best relocated to the nearest neighborhood.
[24]No data about the area (in ha) of land compensated for the transmission line are not available because the compensation was made for the violation of superficies without any land confiscation.
[25]Transmission line from the power station and a distribution line from the power station to the intake weir.
[26]Measures such as water sprinkling were taken.

effects of noise, but about 60% of the people living in the affected areas replied that they suffered no health impact; only about 40% of the residents of the affected areas experienced health problems such as insomnia. Moreover, 40% of the people in the non-affected area reported having the same problem, suggesting that the rate of the health impact does not depend on whether the location is affected or non-affected by the project.

This project has largely achieved its objectives; therefore, its effectiveness is high.

Box2 CSR Activities by KenGen

CSR activities by KenGen include efforts related to water supply, education, and environment. Water supply is provided to about 20,000 people in the downstream area of the Sondu River[27] through standpipes or as treated water and by establishing a rural water supply association, thus contributing to the supply of safe water. Initially, KenGen assumed the stand that water should be provided by self-help efforts by local communities, but following discussions and a recommendation by the Technical Committee, the water supply was funded entirely by KenGen. Water provided through water kiosks and standpipes is used for drinking or agricultural purposes, contributing to improving their standards of living by reducing the labor involved in fetching water and by providing safe water.[28] Water is provided for communities living downstream Sondu River (31 water kiosks and 3 standpipes) (photo, below left), and also for communities near the outlet channel (5 standpipes) (photo, below right). In addition, water is provided freely for local people within the base camp, which is open to the local community.

A Water Kiosk (Treated Water)

A Manual Standpipe Near the Outlet Channel

[27]KenGen web site.

[28]Before CSR, local people obtained water from rainwater and springs, fetched water from the Sondu River, or diverted water from the outlet channel from the power station; thus, obtaining water involved heavy labor, and unhealthy water was obtained.

As written in the main section, KenGen has constructed elementary and secondary schools as compensation in the affected areas (near the power station), and many local pupils attend these schools; as part of its CSR effort, KenGen provides scholarships for especially bright but economically disadvantaged children wishing to go to secondary schools and university.

In addition, KenGen nurses 50 varieties of trees and freely distributes them (annually about 50,000)[29], and landowners who received them planted them in collaboration with local people, making efforts to reduce the project-related negative impacts on the landscape. KenGen monitors the condition of the planted trees once or twice annually.

3.4 Efficiency (Rating: ①)

3.4.1 Project Outputs

The project has an increase or decrease of output if it is divided into phase I and II according to the loan agreement, but it has overall resulted in the intended power station as well as related facilities (sub-stations and transmission line) as an integrated project.

Table 8 Output Comparison

Item	Original	Actual	Difference
Phase（I） Civil Works (Lot I-1)			
1-1. River Works (Sondu River)	One set	One set	None
1-2. Intake Weir	One set	None	Carried over to Phase II
1-3. Tunnel	4.2-m dia. 6,194.5-m long	4.2-m dia. 6,194.5-m long	None
1-4. Serge Tank	14-m dia. × 36.8-m H	14-m dia. × 36.8-m H	None
1-5.Penstock	3.9-m dia. × 53ml long	None	Carried over to Phase II
1-6. Access Road	10.4-km long	10.4-km long	None
1-7. Staff Accommodation (base camp)	16 ha	25.4 ha	Expanded (+9.4 ha)
Phase（II） 1. Civil Works (Lot I-2)			
1-1.Tunnel（Added）	1,214.3-m long	1,214.3-m long	None
1-2.Power Station（Inside）	Engine room, outlet channel, switchyard	Engine room, outlet channel, switchyard	None
1-3.Outlet Channel	4,408 m + 711 m	3,954 m + 741m	Change in length
1-4.Power Station（Building）	24.5 m × 40 m × 2.2 m	24.5 m × 40 m × 32.2 m	None
1-5. Distribution Line（For Intake Weir）	11 kv	11 kv	None
1-6. Intake Weir	（None）	One set	Carried over from Phase I
2. **Civil Works** Lot II:			
2-1. Water Gates	Gates for intake, outlet, and tunnel	Gates for intake, outlet, and tunnel	None
2-2. Penstock	（None）	3.9-m dia. × 53-m long	Carried over from Phase I
3. **Civil Works** Lot III:			
3-1. Turbine Generator and related facilities	Generator (30 MW ×2)、132kv substation switchgear and related facilities Step-up transformer 11/132kV (33.7MVA x2)	Generator (30 MW ×2)、132 kv substation switchgear and related facilities Step-up transformer 11/132kV (33.7MVA x2)	None

29 About 150,000 plants were nursed and distributed between 2008 and 2010.

Item	Original	Actual	Difference
4. **Civil Works** Lot IV:			
4-1. Installation of Transmission Line	132 kv-49 km	132 kv-49 km	None
4-2. Rehabilitation of sub-stations	132 kv switchgear and related facilities （Chemosit, Kisumu, Lessos, Muhoroni） 132/33kV transformer (Muhoroni)	132 kv switchgear and related facilities （Chemosit, Kisumu, Lessos, Muhoroni） 132/33kV transformer (Muhoroni)	None
（Common to two phases） Consulting Services			
2-1. E/S	D/D, Assistance for bidding, etc.	Additional services for assisitng the management activities of Technical Committee and additional (socioeconomic) studies	

Source：KenGen

As shown above, the intake weir and penstock were not completed in Phase I, and were carried over to Phase II. This is because unexpected geological conditions at the raceway raised the construction cost, which increased to beyond the permitted limit within Phase I. The base camp had to be expanded (+9.4 ha) since there were more staff than expected who needed accommodation, and this change was appropriate. Additional outputs for consulting services occurred because of the establishment of the Technical Committee and the resulting assistance for management work, as well as additional socioeconomic and fishery services, as recommended by the committee, and for implementing the project, these outputs were inevitable.

The Phase II included carry-over work from Phase I, and a slight increase of length of the outlet channel, but these changes are appropriate.

3.4.2 Project Inputs

3.4.2.1 Project Cost

The projected cost of Phase I was planned to be 8,156 million JPY (of which the loan was 6,933 million JPY), but the actual cost was 9,088 million JPY, which is 111% of the planned cost. The projected cost of Phase II was planned to be 12,416 million JPY (of which the loan was 10,554 million JPY), but the actual cost was 15,179 million JPY, which is 122% of the plan cost. The overall cost was 21,504million JPY, which was 104% of the original cost of 20,572 million JPY, and thus, slightly higher than the original.

The difference in Phase I is attributable to the increased construction cost (about 1 billion JPY) attributed to the unexpected geological conditions, while in Phase II it is attributed to (a) price escalation (about 1.3 billion JPY), (b) carry over work from Phase I (about 0.9 billion JPY), (c) changes in design, (d) additional costs (about 0.6 billion JPY) to accelerate the Phase II work, and (e) additional work for Phase II contractors (about 0.2 billion JPY).

Table 9 Project Cost (Plan and Actual) Comparison

Phase I

	Original			Actual		
	Foreign Currency (Mil. JPY)	Local Currency (Mil. KSh)	Total (Mil. JPY)	Foreign Currency (Mil. JPY)	Local Currency (Mil. KSh)	Total (Mil. JPY)
Civil Works	3,415	941	5,202	3,582	1,677	6,194
Contingency	342	98	526	0	0	0
Consulting Services	1,826	179	2,166	2,057	281	2,501
Land Appropriation Fee	0	64	122	0	232	339
Administrative Fee	0	74	140	0	33	54
Total	5,583	1,356	8,156	5,639	2,223	9,088

Source：KenGen
Note：Exchange Rate 1 KSh = 1.90JPY（Appraisal）; ＝1.55 JPY（Post-Evaluation）（1996–2007 average）

Phase II

	Original			Actual		
	Foreign Currency (Mil. JPY)	Local Currency[30] (Mil. KSh)	Total (Mil. JPY)	Foreign Currency (Mil. JPY)	Local Currency (Mil. KSh)	Total (Mil. JPY)
Civil Works	3,005	669	4,368	2,947	3,463	8,362
Hydromechanical Works	1,465	496	2,476	1,299	500	2,165
Generating Equipment	2,329	153	2,641	2,301	110	2,486
Transmission Line & Sub-Stations	1,178	104	1,390	957	254	1,379
Land Appropriation Fee	0	99	202	0	136	217
Administrative Fee	0	89	181	0	69	110
Consulting Services	0	0	0	318	90	449
Contingencies	864	144	1,158	11	0	11
Total	8,841	1,752	12,416	7,833	4,622	15,179

Source：KenGen
Note：Exchange Rate1 KSh ＝ 2.04 JPY（Appraisal）; ＝1.59 JPY（Post-Evaluation）（2004–2007 average）

3.4.2.2 Project Period

The original planned period was January 1997 to July 2002 (67 months) for Phase I, and January 1999 to December 2001 (36 months) for Phase II; the period for Phase II was revised to October 2000

[30]JICA Internal documents (appraisal documents) estimated local currency but it was expressed in KSh using the exchange rate at that time in order to be consistent in units of currency.

to June 2003 (33 months) at the time of appraisal for Phase II. The actual period was March 1997 to April 2004 (97 months) for Phase I with a 145% delay, while it was February 2004 to March 2010 (74 months)[31], with a 224% delay for Phase II. With the two phases combined, the original plan (100 months) and actual (171 months) differed by 171% with the delays. In brief, the actual period significantly exceeded the original plan.

Reasons for delays included the facts that (a) with the delay in the extension of Phase II[32], the executing agency had to stop work until the signing of the Phase II Loan Agreement because it was not possible to fund the project on their own; and (b) part of the civil work in Phase I was carried over to Phase II, requiring additional time. Other reasons included the additional time required for digging the raceway, as well as a delayed hand-over due to mechanical trouble with the turbine.

3.4.3 Results of Calculations of Internal Rates of Return (IRR) (for Reference)

The Financial Internal Rate of Return (FIRR) for the project was re-calculated to be 7.2%[33], which was lower than the original; the calculation was based on the same assumptions as the appraisal, with construction cost, operation and maintenance costs, and transmission cost taken as costs, while sales of electricity generated the benefits, with 50 years of project life.

The Economic Internal Rate of Return (EIRR) was also calculated as 9.2%, lower than the original; this calculation too was carried out under the same assumptions as the appraisal, with construction cost, operations and maintenance costs taken as costs, while the costs of construction and operations and maintenance of an alternative thermal power station, as well as fuel costs for the same power station were considered as benefits.

The decreases are attributable to the significant increase in construction costs from the original values.

Table 10 Internal Rates of Return

Unit：%

	Original (Phase I)	Original (Phase II)	Actual
FIRR	10.1	11.4	7.2
EIRR	14.1	13.4	9.2

The project cost slightly exceeded the planned value, while the project period significantly exceeded the planned duration; therefore, the efficiency of the project is low.

3.5 Sustainability (Rating: ③)

3.5.1 Structural Aspects of Operation and Maintenance

The Sondu-Miriu Hydroelectric Power Plant as completed by this project is operated and maintained

[31]As planned, the end of the project period is defined as the end of experimental operation and the OJT, and the completion of the consulting services.
[32]Loan Agreement was signed with 5 years of delay in the end.
[33]Re-calculated by KenGen staff, adjusted by the evaluator.

by KenGen, while the transmission lines and sub-stations are operated and maintained by KPLC. According to the original plan, Kenya Power Company (KPC), a subsidiary company of KPLC, was to assume the function of KPLC; however, as part of the World Bank-led reform of the electricity sector, the management of KPC was separated from KPLC and incorporated as a part of KenGen, to be specialized in power generation.

(1) KenGen

This is a publicly listed company, with a government-held share of 70%. This project (the Sondu-Miriu Power Plant and related facilities) does not outsource any operations and maintenance (O&M) activities, and is run and supported by full-time staff (8 employees from the engineer level with 15 years' experience); 20 employees from the skilled labor level with 20 years' experience).

(2) KPLC

This is a limited liability company, with a government-held share of 50.08%. The transmission line project is operated under the supervision of KPLC's transmission division, and does not outsource any O&M activities, but the construction of the transmission line was outsourced. The staffing for O&M for the transmission lines is run and supported by 8 engineers, 16 skilled workers, and 5 daily workers (all full-time except for the daily workers).

After the privatization of KPLC and the separation of electricity generation and transmission, KenGen and KPLC (whose head offices are adjacent to each other) have been coordinating closely; hence, there is no adjustment cost for coordination between the two agencies for the O&M.

3.5.2 Technical Aspects of Operation and Maintenance

KenGen and KPLC have fully skilled staff (for power plant, sub-stations, reservoir, transmission lines, and other related facilities), and daily training, OJT, and overseas training sessions are conducted in addition to the training by the manufacturer at the hand-over, allowing them to improve their skills; hence, no major problems have been experienced in the implementation of the project. The manuals are employed appropriately. Reduced unplanned outage hours and increased operating hours (Table 4) are evidence for the effective acquisition of techniques.

3.5.3 Financial Aspects of Operation and Maintenance

(1) KenGen

The 2009 drought damaged agricultural production and the supply of hydroelectric power, resulting in a 13% decrease in operational revenue in fiscal year 2010[34]; however, a quick recovery enabled maintaining a stable operational revenue and net profit. Further, financial conditions from Return on Assets (ROA) and self-financing ratio are good. KenGen mostly sells its product to KPLC, but it

[34]FY 2010 covers July 1, 2009, till June 30, 2010.

also sells electricity to Kenya Electricity Transmission Company (KETRACO), which was incorporated in 2008.

The wholesale pricing structure is based upon capacity charges and energy charges. The capacity charge is a fixed charge calculated from peak usage, while the energy charge is an additional variable charge, accounting for 85% and 8% of KenGen's revenue from the project (14,389million KSh as of FY2011). It is KenGen's management policy[35] to focus on the fixed charge.

Table 11 KenGen's Cash Flow and Balance Sheet

Unit：Mil. Ksh

	FY2008	FY2009	FY2010	FY2011
Operational Revenue	11,548	12,652	10,998	14,389
Operational Expenditure	△8,012	△8,247	△8,558	△10,014
Operational Profit	3,537	4,405	2,440	4,376
Interest and Non-Operational Revenue	340	907	786	1,273
Non-Operational Expenditure	△798	△756	△741	△1,997
Pre-Tax Net Profit	3,079	4,556	2,485	3,651
Tax Payment	2,818	△2,485	802	△1,571
Net Profit	5,897	2,071	3,286	2,080
ROA(%)	3.52	4.89	2.20	1.29
Self-Financing Rate (%)	74	97	60	42

Source：KenGen（Annual Report）

Note1：Positive sign in tax payment means tax credit.

Note2：ROA = Return on Assets

(2) KPLC

In general, operational profit and net profit are stable and financial conditions are stable.

Table 12 KPLC's Cash Flow

Unit：Mil. Ksh

	FY2008	FY 2009	FY 2010	FY 2011
Operational Revenue	40,801	65,208	73,166	69,728
Operational Expenditure	37,277	59,531	67,205	62,644
Operational Profit (Pre-Tax)	3,524	5,677	5,951	7,084
Tax Payment	△973	△1,557	△1,917	△2,035
Net Profit	2,551	4,119	4,035	5,049

Source：KPLC（Annual Report）

3.5.4 Current Status of Operation and Maintenance

KenGen conducts daily routine maintenance of the generators, turbines, intake weir, penstock, intake valve, outlet channel, etc., and they are in good condition. Spare parts are procured through OEM[36] without major problems. KPLC conducts daily routine maintenance of procured facilities (transmission line and sub-stations), and they are in good condition.

KenGen's offices are recognized by ISO90201:2000, which ensures client-driven output (electricity) quality, managerial system and a high level of environmental management system, objectively

[35]KenGen Annual Report (FY2011).

[36]Original Equipment Manufacturer

guaranteeing the sustainability of the project.

No major problems have been observed in the operation and maintenance system; thus, the sustainability of the project effort is high.

4. Conclusions, Lessons Learned, and Recommendations

4.1 Conclusions

This project is consistent with Kenyain the operation and maintenance system (electricity) qualityly sells its produccal and national needs for its electricity supply, and Japanese aid policy at that time, so the relevance is high. There is no major operational problem in the constructed power plant, and in general, the target goals for annual power generation, operational ratio, etc. have been achieved; thus, the effectiveness is also high. There are no serious negative impacts on the natural environment, relocation, or pollution and its related health effects. The project cost slightly exceeded the plan, and the project period significantly exceeded the planjor operational problem d national needs 4t to each other) ssion division, and does not outsourcthe efficiency is low. The project cost slightly exceeded the planned value, and the project period significantly exceeded the planned duration—there was a delay of more than five years in the signing of Loan Agreement (L/A) —owing to which the efficiency is low. There is no major problem in structure, finance, technique or the current status of operation and maintenance; hence, the sustainability is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

（1） Diversification and Stabilization of Power Sources

About 65% of the electricity generated in Kenya depends on hydroelectric power[37]. This creates a seasonal fluctuation in electricity generated between the dry and rainy seasons, even at the national level. The Government of Kenya also recognizes this structural issue[38] that hydropower is vulnerable to available water supplies and seasonal fluctuations as a “supply gap,” if not as serious as “supply gap; in order to cope with the rainy-dry seasonality, the Government of Kenya purchases electricity from a UK generator rental firm and fills in supply gaps from other hydropower stations using different river systems. However, these are only temporary measures and they will not be sufficient as medium- and long-term solutions; therefore, it is desirable to take fundamental measures to stabilize the seasonal supply gap, by diversifying electricity sources (e.g. geothermal, thermal, pump-up), as already planned by the Government of Kenya.

4.2.2 Recommendations to JICA

None.

[37]Share of total capacity. For actual generation, it is about 50%, adjusted for seasonality.
[38]As stated in the Kenya National Energy Policy (2012, under revision).

4.3 Lessons Learned

When the project implementation involves environmental issues and compensation related to resettlement, as in this project, the establishment of a consultative body that listens to requests and claims from local people, professionals, and NGOs (the "Technical Committee" as in this project or any other term such as "Town Meeting" would be fine), with persistent efforts to engage in a dialogue with the executing agency, would eventually contribute to winning support from the local people for the project; thus, it would contribute to realizing the efficient and effective implementation of the project, consistent with the realities of the local economy. In this case, however, it is important to closely share information with local people to avoid any perception gaps regarding the activities of the Technical Committee. The Technical Committee, while listening to the opinions of the local people, has made various recommendations to KenGen contributing to mitigating the negative impacts by its own efforts, and this should be recognized as an output available for the local people themselves.

Comparison of the Original and Actual Scope of the Project

Sondu-Miriu Hydropower Project I

Item	Original	Actual
1.Project Outputs	1. Civil Works (Lot I-1) River Works, Intake Weir, Tunnel, Serge Tank, Penstock, Access Road, Base Camp 2. Consulting Services	1. As planned, except for Intake Weir and Penstock, carried over to Phase II, and Base Camp, expanded 2. Additional Surveys
2.Project Period	January 1997 – July 2002 (67 months)	March 1997 – April 2004 (97 months)
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 5,583million yen 2,573million yen (1,356million KSh) 8,156million yen 6,933million yen 1KSh = 1.90 yen (As of Appraisal)	 5,639million yen 3,449million yen (2,223million KSh) 9,088million yen 6,933million yen 1KSh = 1.55 yen (1996-2007 Average)

Sondu-Miriu Hydropower Project II

Item	Original	Actual
1.Project Outputs	1. Civil Works (Lot I-2) Tunnel (Added), Power Station (Inside), Outlet Channel, Power Station (Building), Distribution Line, Intake Weir 2. Civil Works Lot II Water Gates, Penstock 3. Civil Works Lot III Turbine Generator and related facilities 4. Civil Works Lot IV Installation of Transmission Line, Rebhabilitation of Sub-Stations 5. Consulting Services	1. As planned, except for Outlet Channel, expanded, and Intake Weir, carried over from Phase I 2. As plannned, excpt for Penstock, carried over from Phase I 3. As Planned 4. As planned 5. Additional Surveys
2.Project Period	October 2010 – June 2003 (36 months)	February 2004 – March 2010 (74 months)
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 8,841million yen 3,575million yen (1,752million KSh) 12,416million yen 10,554million yen 1KSh = 2.04 yen (As of Appraisal)	 7,833million yen 7,346million yen (4,622million KSh) 15,719million yen 10,554million yen 1KSh = 1.59 yen (2004-2007 Average)