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.

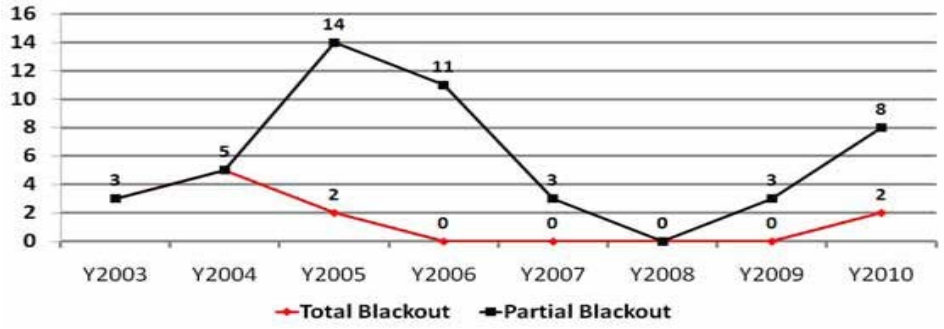
3.2.2 Qualitative Effects

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）