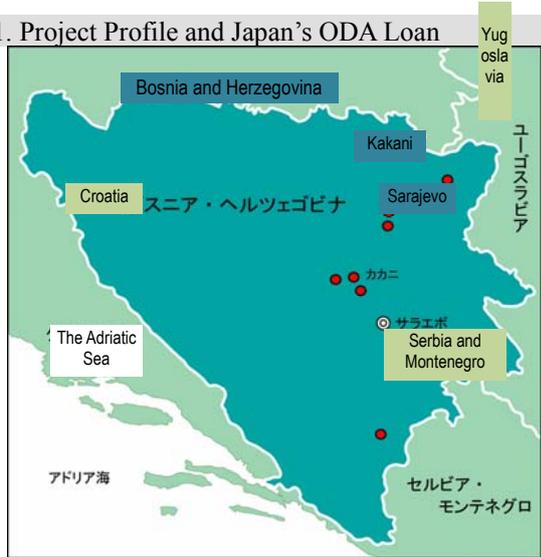


Emergency Electric Power Improvement Project

External Evaluator: Hajime Sonoda (Global Group 21 Japan, Inc.)
Field Survey: October 2008

1. Project Profile and Japan's ODA Loan



Map of project area (● shows project sites)



Kakanj Thermal Power Plant

1.1 Background

Bosnia and Herzegovina is a country on the northwest Balkan Peninsula. Bosnia and Herzegovina declared its independence from Yugoslavia in 1992, but immediately after this event, the three-and-half-year-long Bosnian War broke out. It was started by the Serbs, an ethnic minority calling for sovereignty against the Bosniak and the Croats. In December 1995, the Dayton Agreement (General Framework Agreement for Peace in Bosnia and Herzegovina) brought a cease-fire, establishing the country's present-day structure. The country is now comprised of two governing entities, the Federation of Bosnia and Herzegovina and the Republic of Srpska.¹

Before the war, Bosnia and Herzegovina was capable of supplying sufficient electricity with coal-fired thermal power and hydro power plants while selling approximately 15% of its total electricity to nearby countries. However, after suffering from the devastation of war and a lack of proper maintenance, the post-war production of electricity has dropped to one tenth of its original volume.

After the war, the World Bank launched a reconstruction and development project for Bosnia and Herzegovina, which included the Emergency Electric Power Improvement Project, to immediately revitalize power generation, transmission and distribution systems. Further, to restore pre-war power levels and a stable electric power supply, the World Bank presented the Second Electric Power Reconstruction Project, known as the "Electric Power Reconstruction 2 Project". In December 1998, the ODA loan agreement for this project (the Emergency Electric Power Improvement Project) was signed as part of the World Bank's plan and conducted in a coordinated manner with Japan (Grant Aid², ODA loan), the US, UK, EU, and others.

1.2 Objective

The purpose of the project is to increase the supply of electricity by revitalizing the Kakanj thermal power plant and four coal mines adjacent to thermal power plants (including the Kakanj plant), thereby contributing to post-war economic reconstruction as well as an improved and stable livelihood for the country's people.

¹ The existence of the District Brčko was revealed in 2000, which belongs to neither of the two governing entities.

² Rehabilitation project for major transmission lines (1998, 3.1 billion yen)

1.3 Borrower/Executing Agency

Borrower: Government of the Republic of Bosnia and Herzegovina

Executing agency:

<The Federation of Bosnia and Herzegovina>

Elektroprivreda Bosne i Hercegovine (EPBiH), Brown Coal Mine Kakanj (BCBK), Brown Coal Mine Breza (BCBR), Coal Mines Kreka-Durdvik (CKMD), Brown Coal Mines Banovici (BCBA).

<Republic of Srpska>

Elektroprivreda Republike Srpske (EPRS)

1.4 Outline of Loan Agreement

Loan Amount/Loan Disbursed Amount	4,110 million yen/4,102 million yen
Exchange of Notes/Loan Agreement	September 1998/December 1998
Terms and Conditions	Interest rate: 0.75%, repayment period (Grace Period): 40 years (10 years), General untied
Final Disbursement Date	August 2006 (Amended LA and extended repayment deadline)
Main Contractors (with 10 hundred million yen or above)	Steinmuller-Instandsetzung Kraftwerke, GMBH (Germany)
Consultant Services (with 1 hundred million yen or above)	No service exceeded 1 hundred million yen
Feasibility Study (F/S), etc.	Coal mine refurbishment F/S by USAID (1997) Project formulation by the World Bank "Electric Power Reconstruction 2 Project" (1998)

2. Evaluation Results (Rating: B)

2.1 Relevance (Rating: a)

2.1.1 Relevance at the time of appraisal

After the war ended, the central government of the Republic of Bosnia and Herzegovina gave overriding priority on reconstruction of the electricity sector to foster recovery from war devastation and resumption of economic activities as well as an improved and stable livelihood for the country's people. To achieve a stable power supply, Sarajevo sought persistent equipment investment even after the emergent measures of the First Electric Power Reconstruction Project by the World Bank. Previously, about two-thirds of Bosnia's entire power generation was delivered from four domestic coal-fired thermal power plants. However, in 1997, the yield of coal products faltered to only 26% of its pre-war level in the Federation of Bosnia and Herzegovina. In the Republic of Srpska, the yield was as low as 60% of its previous level. Given this situation, the revitalization of coal mines to supply coal to power plants as well as the refurbishment of the power generation system was urgently needed.

2.1.2 Relevance at the time of ex-post evaluation

Given the large deposits of coal in Bosnia and Herzegovina, the energy sector is prioritized by both governing entities from the perspective of energy security, industrial promotion, and acquisition of foreign currencies by selling electricity.³ Thanks to a series of aid projects (including projects by the World Bank), Bosnia's power generation, transmission and distribution systems were restored and domestic power consumption recovered to its pre-war level in 2005. In the future, annual growth in power demand is estimated at 4% for the Federation and 2% for the Republic of Srpska. This is in addition to the growing demand in neighboring countries for Bosnia's electricity.⁴

As described above, restoration of the power generation system no longer requires an urgent response. However, coal mines still suffer from limited production capacity. To respond to expected future growth in

³ This is according to hearings from both governing entities. After each entity determines their respective energy strategies, the central government of the Republic of Bosnia and Herzegovina will institute a national energy strategy.

⁴ Bosnia and Herzegovina was an energy base that supplied coal and electricity to the entire former Yugoslavia. Even after the war, electricity has continued to be exported, and the country is considered to be an energy exporter of southern Europe.

power demand, tireless reinforcement of power generation and coal supply capacity is indispensable.

In conclusion, this project is crucial to provide emergency aid for Bosnia and Herzegovina's prioritized electricity sector. Therefore, this project has been highly relevant with the Republic's national policies and development needs at the time of both appraisal and ex-post evaluation.



Dump truck (left) and hydraulic excavator (right) procured at Gacko Coal Mines

2.2 Efficiency (Rating: b)

2.2.1 Output

This project conducted partial refurbishment of Units #5 and #7 of the Kakanj Thermal Power Plant, while rehabilitating and procuring coal mining and transportation equipment for six coal mines. The output achieved for each power plant and coal mine is shown below. Further, consulting services were provided by Japanese consultants to give various aid in the form of detailed designs, procurement, supervision of works, and technical guidance.

Table 1: Project Outline and Output

Target	Project (Output)	Cost
The Federation of Bosnia and Herzegovina		
Kakanj Thermal Power Plant	Rehabilitation of Unit #5 (monitor and control equipment) and Unit #7 (boiler)	11.0 hundred million yen
Kakanj Coal Mines (open-pit)	Maintenance of railway road between coal mines and power plant (bridges and rails), repair of 3 large excavators, procurement of 1 hydraulic excavator and 1 rock drill, refurbishment of maintenance and other related facilities	7.7 hundred million yen
Breza Coal Mines (underground)	Repair of 1 underground excavator, procurement of 1 underground face conveyor, 1 main tunnel belt conveyor, underground brace, electric parts, etc.	4.6 hundred million yen
Kreka Coal Mines (open-pit)	Procurement of 1 bulldozer, 1 hydraulic excavator, 22km of belts for belt conveyor, and spare parts for various equipment	7.5 hundred million yen
Banovici Coal Mines (open-pit)	Procurement of spare parts for dump truck, excavator, etc.	3.2 hundred million yen
Republic of Srpska		
Gacko Coal Mines (open-pit)	Procurement of 3 dump trucks, 1 hydraulic excavator, and other related machines and equipment	6.6 hundred million yen
Ugljevik Coal Mines (open-pit)	Procurement of 4 dump trucks, 3 bulldozers, 1 hydraulic excavator, and other related machines and equipment	

(Source: created from project completion reports and questionnaires of each executing agency.)



Rock drill (left) and dump truck (right) procured by Kakanj Coal Mines

Originally, this project was designed to furnish urgently needed equipment for power plants and coal mines. However, as stated below, the effectuation of the loan agreement has been delayed more than one year, so that almost the entire original project scope was implemented through other funds for all subprojects except Kakanj Coal Mines and Breza Coal Mines. This resulted in a major change in output generated by these subprojects in comparison to the original plan at the time of appraisal.⁵

Although output has changed drastically, the project can be considered reasonable in terms of effectiveness and utilization of equipment (described in detail in section 2.3 Effectiveness).

2.2.2 Project period

At the time of appraisal, the project was designed to be conducted over a period of 33 months between October 1998 and July 2001. However, it was actually executed over a period of 63 months between June 2001 and September 2006, which means an extension of almost five years beyond the planned completion date (191% of the planned period). The delay was primarily caused by: delay in the effectuation of the loan agreement, significant time required to overhaul the project, and a drastic increasing of the period for implementation at Unit #7 of the Kakanj Thermal Power Plant and Breza Coal Mines.

Although the loan agreement was signed in December 1998, effectuation was delayed more than a year as the government of Bosnia and Herzegovina took time to go through the necessary procedures for effectuation.⁶ Furthermore, another year was spent overhauling the entire project since it was partially conducted using other funds due to emergency needs.

At the Kakanj Power Plant, significant time was spent negotiating a loan agreement for the refurbishment of Boiler #7 and advance payment procedures. Construction was processed as planned; however, its completion



Fig 1 Coal mines and thermal power plants under project and beneficially thermal plant

⁵ For project scope at the time of appraisal, see Comparison between Original and Actual Scope at the end of this report.

⁶ Republic of Bosnia and Herzegovina is comprised of two governing entities: The Federation of Bosnia and Herzegovina and the Republic of Srpska. It is politically unstable due to multiethnic makeup of the Serb, the Bosniak and the Croats. The loan agreement was signed in December 1998 during political turbulence— the President of the Republic of Srpska backed by the Serbs was dismissed by the high representative of the Republic of Bosnia and Herzegovina. This led to a delay in the signing by the Republic of Bosnia and Herzegovina required to effectuate the loan agreement.

was delayed until September 2006. This delay was caused by technical problems occurring with a generator (an exception from the ODA loan), which then caused a delay in the completion of performance tests.

At Breza Coal Mines, the price for certain coal mining machines (armored face conveyor) was underestimated at the time of appraisal. After a sharp rise in machine prices, the procurement plan was once derailed due to a shortage of funds. However, upon completion of procurement for the Kakanj Thermal Power Plant, Breza was able to receive reallocation of excess funds. For this reason, Breza could not use these mining machines until June 2006.

Procurement and installation of machines and equipment other than Unit #7 at the Kakanj Thermal Power Plant and those for Breza Coal Mines were mostly implemented as planned, ending March 2004.

Consulting services are considered to have contributed to the smooth implementation of the entire project. However, some executing agencies experienced difficulties in communicating with JICA (former JBIC). These difficulties may have been caused by frequent changes of the personnel in charge and the need for agencies to communicate with JICA Tokyo HQ, which governed the project.

2.2.3 Project cost

As a result of deletion (execution through other funds) and changes in scope to constrained subprojects within the planned budget, the project cost came in under budget at the time of appraisal (98% of planned cost). However, the costs required for the Kakanj and Breza Coal Mines exceeded the budget. With the approval of JICA, the budget for other subprojects was reallocated to the Kakanj and Breza mines. This means that the project was modified to stay within the extent of planned costs; therefore, evaluation of efficiency should not simply focus on the fact that the actual cost did not exceed the planned cost.

Table 2 Planned vs. actual project cost (unit: millions of yen)

	Planned			Actual		
	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total
Kakanj Thermal Power Plant	1,264	17	1,297	1,096	0	1,096
Kakanj/Breza Coal Mines	1,078	15	1,107	1,219	0	1,219
Kreka/Banovici Coal Mines	1,060	15	1,060	1,057	0	1,057
Gacko/Ugljevik Coal Mines	658	6	669	651	0	651
Interest during construction	50	0	50	76	0	76
Total	4,110	53	4,163	4,098	0	4,098

(Source: Project completion reports from executing agencies)

Note: For local currency costs, custom clearance fees were expected at the time of appraisal; however, these fees were not actually paid.

As stated above, although the project cost was almost as planned, the project period significantly exceeded the planned period; therefore the evaluation for efficiency is moderate.

2.3 Effectiveness (Rating: a)

(1) Revitalization of Kakanj Thermal Power Plant

As shown in Table 3, overall performance of Units #5 and #7 at the Kakanj Thermal Power Plant was drastically improved (equipment investment through the ODA loan accounted for 13% of the entire revitalization project).

Rehabilitation of Unit #5 was implemented from 2003 to 2004 at a cost of 21 million EUR. This includes the refurbishment of monitoring and control equipment funded by the ODA loan as well as the boiler, turbine, generator, and other equipment. Further, the life of the equipment was extended to 2018. Investment of ODA loan money accounted for around 5% of the entire rehabilitation cost. This rehabilitation resulted in overall improvement of equipment operation performance. Thanks to developments in monitoring and control equipment, most monitoring, recording, and operation procedures were digitized and automated. This is considered to be a decisive factor contributing to improvements in the safety and reliability of power generation funded by the ODA loan project.

Rehabilitation of Unit #7 was implemented at a cost of 33 million EUR in 2005. Besides refurbishing boilers

funded by the ODA loan, monitoring and control equipment, generators, and other equipment were rehabilitated. This extended the equipment lifetime to 2029. Investment amounts funded by the ODA loan accounted for only about 18% of all rehabilitation costs; however, refurbishing the boiler funded by the ODA loan contributed greatly to improvement in operation performance. Before the refurbishment, the boiler suffered frequent breakdowns due to a piping failure that occurred every 7 to 10 days. Thanks to the project, the piping issues were solved, which brought dramatic improvement to the equipment availability ratio and energy production. Further, due to improvements of the boiler's heat efficiency, SO_x and CO₂ discharge volumes were reduced along with NO_x and dust discharge due to an improvement in combustion temperature. The amount of annual energy production, NO_x, and dust discharge all meet the refurbishment targets.⁷

Table 3 Refurbishment efficiency of Kakanj Thermal Power Plant Units #5 and #7

	Unit #5		Unit #7	
	Before	After	Before	After
Peak power output* (MW)	95	118	230	230
Heat consumption rate* (kJ/kWh)	13500	11500	12816	11811
NO _x * (mg/Nm ³)	1800	750	1800	664 – 879
Dust* (mg/Nm ³)	200	150	180	111
Availability ratio (%)	74	91	68	93
Annual energy production (GWh)	441	681	905	1744
Auxiliary Power Ratio (%)	12.1	10.1	12.5	8.8
Operation hours (hours/year)	5127	6938	4398	8170
Scheduled downtime (hours/year)	3339	1545	2533	392
Unscheduled downtime (hours/year)	302	277	1837	198

Note: Items marked with "*" compare the average before refurbishment with performance test results.

The Availability Ratio compares the average before refurbishment with 2007 performance.

Other items compare the values before refurbishment (Unit #5: 2000-2002 average, Unit #7: 2002-2004 average) and after refurbishment (Unit #5: 2005-2007 average, Unit #7: 2007).

(Source: Elektroprivreda Bosne i Hercegovine)



Repaired boiler facility #7 (left) and monitoring and control equipment (right) #5 at Kakanj Thermal Power Plant

(2) Rehabilitation of coal mines

At the six coal mines covered in this project, equipment investment equivalent to 15 billion yen was implemented after 1998 to maintain and restore the coal supply in Bosnia and Herzegovina. These investments were funded by donors, borrowing from commercial banks, and Bosnia's own resources. The investment

⁷ Actual annual energy production (Unit #5: 681GWh, Unit #7: 1744GWh) exceeded Elektroprivreda Bosne i Hercegovine targets (Unit #5: 626GWh, Unit #7: 1310GWh). Further, both Units #5 and #7 met targets for discharge densities of NO_x (900 mg/NM³) and dust (150 mg/NM³).

funded by the ODA loan (3 billion yen) accounted for approximately 20% of the entire investment.

Equipment supplied by the ODA loan, other than the railway for Kakanj Coal Mines, is being fully utilized. Notably, bulldozers and excavators are being utilized more than expected in terms of working hours.



Railway system between Kakanj Coal Mines and power plants

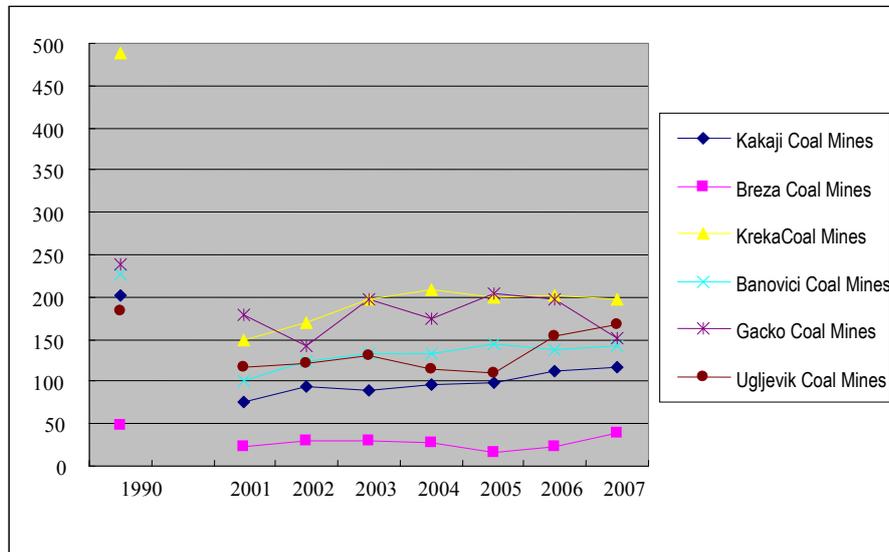
At the Kakanj Coal Mines, railroad bridges and rails were constructed to connect the coal mine and power plants (4.2 hundred million yen). However, the railway has been closed because the coal loading facility remains unconstructed and no wagons or locomotives have yet been procured. These facilities were excluded from the project even at the time of appraisal. Given the situation, coal is still transported by motor trucks; however, such means will no longer be useable following the completion of highway construction in 2012 in an adjacent area. To resolve this problem, Elektroprivreda Bosne i Hercegovine (EPBiH), which runs the Kakanj Thermal Power Plant, determined to supply the funds needed to construct a coal loading facility to be completed before 2010. The bid tendering procedure for the facility began in November 2008.⁸



Repaired large excavator (Kakanj Coal Mines) and bulldozer (Banovici Coal Mines)

⁸ Although coal motor trucks are prohibited from entering highways in Bosnia and Herzegovina, government authorities have granted an exception permitting the use of motor trucks to transport coal by 2012. To support the poorly financed Kakanj Coal Mines (Kakanj), the Federation of Bosnia and Herzegovina shall supply funds enabling coal mines to repay funds by increasing coal production. This plan has been determined in relation to the Federal government's structural reform policy for coal mines.

Fig 2 Annual coal production by coal mine (Unit: 10,000 tons)



(Source: Questionnaire collected from executing agencies)

Considering the investment ratio of the ODA loan against the total equipment investment for coal mines during the post-war period, the timing for procurement, and the facilities and equipment procured, the equipment investment funded by the ODA loan played a central role in restoring and maintaining production, particularly at the Breza and Kreka Coal Mines. Facilities and equipment funded by the ODA loan accounted for only about 10% of total investment at the other four coal mines. However, equipment investment funded by the ODA loan at certain coal mines brought improvements in safety and production efficiency, and reduction of production costs.

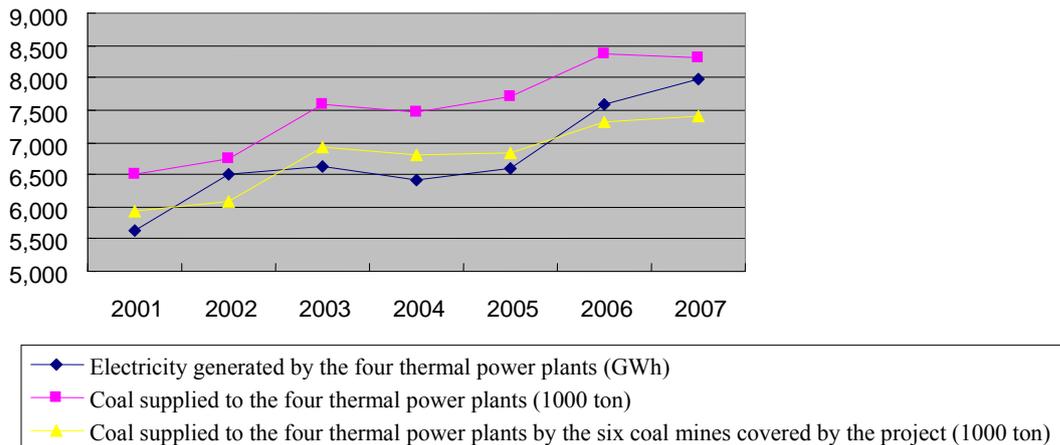
Table 4 Major contributions of the ODA loan project at each coal mine

Target	Major contribution of ODA loan project	Fund contribution ratio
Kakanj Coal Mines	Refurbishment of excavator contributed to maintaining or increasing manufacturing efficiency and production volume. Production volume increased by 7% during the period from 2003 to 2004. However, the contribution ratio of the ODA loan is insignificant.	11%
Breza Coal Mines	Refurbishment of underground excavation facility and main tunnel conveyor brought a 60% increase in 2007 production volume in comparison with the 2001-2006 average. Investment funded by the ODA loan was a primary contributor.	75%
Kreka Coal Mines	Production volume by open-cast mining increased by approximately 35% after investment (2002-2004). This was achieved only with investment funded by the ODA loan due to insufficient transportation performance.	17%
Banovici Coal Mines	Contributed to maintaining or increasing production capacity due to the extended service life of degraded equipment and improved availability ratio. Production volume increased by 33% after the investment (2002-2004). However, the contribution ratio of the ODA loan is insignificant.	7%
Gacko Coal Mines	Contributed to maintaining or increasing production capacity due to renewal of a degraded dump truck. Also contributed to improved profitability by cutting outsourcing. However, the contribution ratio of the ODA loan is insignificant.	11%
Ugljevik Coal Mines	Contributed to maintaining or increasing production capacity due to renewal of a degraded dump truck and bulldozer. Also contributed to improved profitability by cutting outsourcing. However, the contribution ratio of the ODA loan is insignificant.	10%

Note: The fund contribution rate is the ratio of the investment amount funded by the ODA loan against the total amount of equipment investment in coal mines after the war.

Total coal production for the six coal mines increased by 27%, going from 6.44 million tons (2001) before the project to 8.17 million tons (2007) after the project. This is equivalent to 59% of the pre-war figure of 13.89 million tons (1990). Furthermore, 89% (7.3 million tons) of total production was supplied to power plants.

Fig 3 Power generated by four domestic thermal power plants and volume of coal supplied



(Source: Questionnaire collected from state-run power companies under two political entities)

Previously, the main factor constraining energy production was mainly degraded facilities and frequent equipment breakdowns. Therefore, the shortage in coal supply never constrained the energy production. Since coal production at each coal mine is planned according to the quantity demanded by power plants, Bosnia and Herzegovina's coal mines have almost reached maximum production capacity with the exception of Banovici Coal Mines, which has less energy demand.

After 2001, coal production by the six coal mines covered by this project have accounted for almost 90% of the entire coal supply for the four thermal power plants. As shown in Fig. 3, coal supply to thermal power plants and energy production has consistently increased. This suggests that the coal secured by this project contributed steadily to enhanced energy production.

(3) Summary of effectiveness study

Due to the delay in project implementation, a significant portion of the emergency aid was implemented by other donated funds. Therefore, the project resulted in mostly non-emergency aid. Nonetheless, the project presented almost 20% of all post-war equipment investment to the two units of the Kakanj Power Plant and the six coal mines. Furthermore, over 80% (in terms of investment amount) of the equipment supplied by this project has been fully utilized. The only exception is the equipment supplied for the Kakanj Coal Mines railroad because some executing agencies had difficulty constructing the necessary facilities. Although the contribution ratio in terms of investment is rather low, the project can be considered to have contributed to a drastic increase in energy production at the Kakanj Power Plant as well as to securing the coal supply for all four domestic power plants. Therefore, this project has largely achieved its objectives, and effectiveness is highly satisfactory.



Conveyor installed in main tunnel and underground coal excavation and transportation system (Breza Coal Mines)

2.4 Impact

(1) Contribution to securing power supply

Bosnia and Herzegovina has not suffered from an electricity shortage, even after the war. This is because in Bosnia and Herzegovina, there was a sharp drop in demand for electricity due to the devastation in industry and cutoffs in the power grid during the post-war period. In the following years, the power grid was revitalized one piece at a time and the power generation system was rehabilitated, restoring domestic power supply and power consumption to their pre-war levels by 2005 (approximately 11,500GWh). Furthermore, the country was able to enjoy sufficient power supply even after the war, allowing it to continue exporting an average of 1,200GWh/year of electricity to neighboring countries after 1996. In terms of electricity quality (frequency, voltage, power failure), no particular problems were found in the high-tension power grids of Bosnia and Herzegovina, since the country's power grid had been connected to the European power grid in 2004.⁹

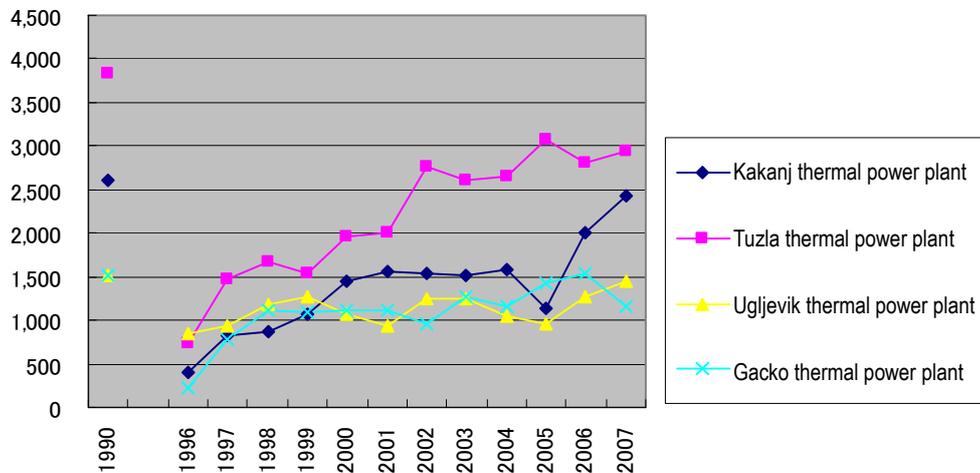
The total annual power generation of the four thermal power plants has been restored to 7,972GWh (84% of the pre-war level). The four plants receive their supply of coal from the six coal mines covered by this project. Also, coal supply for the four thermal power plants (including supply from other coal mines not covered by this project) was restored to 8.31 million tons by 2007, equivalent to 74% of the pre-war level.

The four thermal power plants that have been directly or indirectly aided by this project account for about 70% of the entire national power production. As stated in section 2.3 Effectiveness, the project has contributed to improved performance of Units #5 and #7 at the Kakanj Thermal Power Plant and to the maintenance and increase of production at several coal mines. However, the contribution ratio of this project in terms of total equipment investment in the post-war period for the four thermal power plants and six coal mines was 10% or less.

Given these facts, it is true that Bosnia and Herzegovina's power supply was able to be secured even after the war, but contribution of this project was insignificant.

⁹ Some rural areas still require improvement of power grids to a certain extent.

Table 4 Annual Generation of Thermal Power Plants (Unit: GWh)



(Source: Questionnaire from state-run power companies under two political entities)

(2) Contribution to economic reconstruction and improvement of people's livelihoods

In post-war Bosnia and Herzegovina, tertiary industries demonstrated rapid growth. The country's GDP growth has been around 4% since 2000, which is fairly good. Recently, the number of small-and-medium-sized enterprises in the service business and in commerce has started to increase, backed by a stable supply of electricity. On the other hand, heavy industries, formerly the driving force of the pre-war economy, still suffer from serious stagnation due to market losses caused by the breakup of Yugoslavia and to delays in equipment investment caused by war devastation. Power supply is indispensable for these heavy industries; however, electricity itself was not the decisive factor in their revitalization. In any case, excess electricity was sold to neighboring countries to earn foreign currency, which salvaged the country's economic reconstruction.

In Bosnia and Herzegovina, per-capita power consumption (civilian use) is thought to have increased by 40-50%. A stable power supply is considered one of the primary factors contributing to improvements in the livelihood of the people¹⁰.

Consequently, this project has contributed indirectly to economic reconstruction and improvements to the livelihood of the people of Bosnia and Herzegovina through partially securing the power supply.

(3) Impact on the Environment

Through refurbishment of Boiler of Unit #7 at the Kakanj Thermal Power Plant, contaminants contained in emissions were reduced. NO_x and dust emission levels met environment standards; in addition, the rehabilitation achieved a 17% reduction in CO₂ and SO_x emissions.¹¹

Kakanj Thermal Power Plant supplies hot steam to the town of Kakanj (population: 50,000) for urban heating. Similarly, the Tuzla thermal power plant supplies hot steam to the towns of Tuzla (population: 130,000), and Lukavac (population: 70,000). Heat supply from power plants to these three towns has increased by about 33% during the period between 2000 and 2005. Since the government encouraged people to use hot steam instead of firewood, implementation of this project is considered to have contributed to mitigating

¹⁰ According to state-run power companies under the two political entities, power demand for large-scale industry accounted for two-thirds of the total demand in the pre-war period; however, this has been reduced to one-third of total demand. Since total power demand (industrial and civil use) has been restored to pre-war levels, it is thought that per-capita civilian power consumption has increased.

¹¹ Elektroprivreda Bosne i Hercegovine continuously monitors the discharge volume of NO_x and dust at the Kakanj Power Plant. According to the data, the Kakanj plant achieved a NO_x discharge of 664-879mg/N m³ against the environmental standard of 900mg/N m³. For dust discharge, the plant achieved a maximum 111mg/Nm³ against the environmental standard of 150 mg/N m³. Further, discharge volume per unit of power generation was reduced for both CO₂ and SO_x due to improvements in boiler heat efficiency.

deforestation.

In addition, before implementation of this project, the necessary approval was obtained by following the proper environmental procedures. No newly acquired land was needed and no residents were forced to move from their original location for the sake of the rehabilitation project.

2.5 Sustainability (Rating: b)

2.5.1 Executing agency

2.5.1.1 Operation and maintenance system

Bosnia and Herzegovina must formulate an action plan aimed at structural reform of the power sector as a part of preparatory measures for entering the European power market. Various measures have been implemented accordingly: establishment of an independent controlling organization (already launched), separation of the power transmission sector (already launched), separation of the power generation sector and distribution sector (already launched in the Republic of Srpska and being prepared in the Federation of Bosnia and Herzegovina).

In the Federation of Bosnia and Herzegovina, power plants are included in the state-run power company. However, each coal mine is an independent government-run enterprise. These coal mines suffer difficulties that include a surplus of labor force, persistent operation deficits, and insufficient equipment investment as described below:

- Disabled workers (those injured by mining work or war) account for 20 to 30% of all employees at the coal mines. These workers are fully paid even though they make virtually no contribution to production activities and serve only to bring about increases in production cost.
- As it stands, the government controls the selling price of coal to power plants in order to keep costs to a level below production costs. This causes persistent operation deficits for the coal mines. Furthermore, production volume has remained at 60% of pre-war levels, and enormous fixed costs burden sound operation, further contributing to increased production costs.
- Most of the coal mines are not able to invest in equipment and facilities in a timely manner, as persistent operation deficits put pressure on management. This brings about poor production efficiency.

To resolve these problems and achieve stable supply of the coal needed by power plants, the federal government has made it a policy to integrate the eight coal mines and state-run power company (power generation sector). Furthermore, a law regarding government-run companies has been amended. Thanks to this amendment, management integration is planned to take place by the end of 2008, making the state-run power company a controlling company under which the coal mines will be dependent enterprises.

In the Republic of Srpska, the coal mines are a department of the state-run power company and managed as companies alongside the power plants. Both the power plants and the state-run power company are wholly owned by the government. The coal mines in the Republic of Srpska also suffer from surplus in labor force; however, unlike the coal mines in the Federation of Bosnia and Herzegovina, problems such as persistent operation deficits and insufficient equipment investment have yet emerged as the mines are part of the state-run power company.

2.5.1.2 Operation and maintenance technology

In August 2008, the Kakanj Thermal Power Plant acquired an ISO certificate for quality control and environmental consideration. Since operation performance of its generators is superior after rehabilitation, the plant's technical skill is considered to be outstanding.

With over 100 years of history, experienced and expert engineers are allocated to the coal industry in Bosnia and Herzegovina. To a certain extent, this ensures high-level skills in the industry.¹²

2.5.1.3 Financial status of operation and maintenance

(1) Financial status of state-run power company

Elektroprivreda Bosne i Hercegovine (EPBiH) moved into the black in 2005. Although 4% of annual sales is

¹² In 2007, the number of employees holding degrees reached 866 (college graduate: 811, master's: 46, doctorate: 9) for all coal mines in Bosnia and Herzegovina, meaning that 4 to 8% of all coal workers hold a degree. In addition, according to the Japanese consultant who supported this project, the technical performance of Bosnia and Herzegovina's engineers is considerably high.

allocated to the maintenance budget at the Kakanj Power Plant, the plant side does not meet the required amount. Further attention to the vulnerable financial status of the company is required due to the integration of management with other coal mines.

The financial status of the Republic of Srpska's state-run power company improved drastically after 2001. From 2004 to 2006, the company had a surplus or almost equal balance between revenues and expenditures. However, the company again reported a loss of about 20 million KM (approximately 1.6 billion yen) in 2007. The immediate reason for the deficit was a slight decrease in revenue of electricity sold compared to the previous year and an increase in labor costs. However, this loss was insignificant compared to the revenue generated by selling electricity at the same year (approximately 400 million KM, or 32 billion yen). Also, long-term financial strength is judged superior due to the company's Debt Equity Ratio of only about 6%.

Table 5 Revenue and expenditures of state-run power companies (Unit: millions of KM)

	2001	2002	2003	2004	2005	2006	2007
The Federation of Bosnia and Herzegovina	-77.8	-74.8	-145.2	-55.3	2.7	5.4	11.5
Republic of Srpska*	-141.2	-108.2	-27.5	3.3	3.4	-0.2	-20.1

*Note: The Republic of Srpska's state-run power company includes the coal mine sector.
(Source: State-run power companies)

(2) Financial status of coal mine sector

Coal mines in the Federation of Bosnia and Herzegovina (except the Banovici Coal Mines) are plagued by a deficit operating. Since the government supports the mines through tax allowance, coal mines other than the Banovici Coal Mines suffer serious restrictions in terms of their maintenance budget. The primary factors contributing to the deficit in Bosnia and Herzegovina's coal mines are: (1) the selling price of coal to power plants is held down politically, (2) fixed costs weigh on operations due to insufficient production, and (3) a significant number of disabled employees with low productivity are hired.

Contrary, coal mines in the Republic of Srpska are included in the state-run power company, so no particular restrictions are incurred in terms of the maintenance budget.



Rock drill under refurbishment
(Kakanj Coal Mines)



Dump truck under refurbishment
(Ugljevik Coal Mines)

2.5.2 Operation and maintenance status

Facilities at the Kakanj Power Plant are well operated and equipments are properly maintained in general, **although the company leaves much to be tidied.** A maintenance department is established at each coal mine to conduct maintenance and repairing work on equipment. The level of equipment at each repair shop varies according to coal mine; however, basic servicing and repairs can be conducted using existing facilities and techniques. Both power plant and coal mines implement daily maintenance and repair at their own facilities and outsource overhauls and refurbishment.

For both the power plant and coal mines, procurement of spare parts often requires a long time. This can be

an obstacle for speedy repairs. Even worse, procurement procedures became stricter in 2003, making the situation more complicated. To cope with this, the Federation of Bosnia and Herzegovina's state-run power company is now considering simplifying their internal procedures required for equipment procurement.

Given these facts, concerns for the future remain in the sustainability of this project. It requires reform of the coal mine sector of the country, which suffers from a surplus in labor force, persistent operation deficits, insufficient equipment investment, and other problems. Therefore, the sustainability of this project is moderate.

3. Feedback

3.1 Conclusion

This investment project is highly appropriate in terms of the power sector of Bosnia and Herzegovina, funding almost 20% of equipment investment conducted during the post-war period at two units at the Kakanj Thermal Power Plant and six domestic coal mines. Power generation is an overriding sector in the country. Due to delays in project implementation, a significant portion of the project has been modified according to emerging needs; however, the equipment and facilities actually procured are being fully utilized except for the railway at the Kakanj Coal Mines. The project has therefore contributed to securing the coal supply needed by thermal power plants and drastically increasing power generation at the Kakanj Thermal Power Plant.

In Bosnia and Herzegovina, power supply was secured even after the war, and no power shortages occurred. Although the contribution of this project is limited, it obviously contributed indirectly to the country's industrial rehabilitation by affecting the power supply and improving people's livelihood during the post-war period.

The technical level of executing agencies is outstanding in terms of operation and maintenance of facilities. However, the coal mines in the Federation of Bosnia and Herzegovina have persistently suffered from deficits. This causes future concern in terms of financial resources for maintenance and renewal of facilities. Close tabs must be kept on the situation regarding management integration with the power company as planned by the federal government.

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

3.2 Lessons Learned

Partial investment in facilities requires careful consideration of feasibility for the remaining areas, so that the facilities covered by the project can be properly utilized. For example, procurement of a railway station, bridge, and rails are included in this project for the purpose of transporting coals from Kakanj Coal Mines to the power plants. However, those facilities remain unused even after the completion of construction, because the needed coal loading facility, locomotives and wagons have not been procured.

3.3 Recommendations

- Kakanj Coal Mines must procure a coal loading facility as well as locomotives and wagons as soon as possible in order to start coal transportation via railway.
- The federal government must establish a system to allow the continuous investment needed for coal mines as soon as possible by integrating the coal mines and power plants to enhance the efficiency of coal production.

Comparison of Original and Actual Scope

Item	Plan	Actual
(1) Output	<p>(1) Rehabilitation of Kakanj Thermal Power Plant</p> <ul style="list-style-type: none"> • Refurbishment of Units #5 and #6 (monitoring and controlling equipment, supply of spare parts) • Refurbishment of water treatment plant, including cooling water system, pump, pipes • Refurbishment of Unit #6 (air heater and boiler piping) • Supply of spare parts to boilers and turbines <p>(2) Rehabilitation of Kakanj and Breza Coal Mines</p> <ul style="list-style-type: none"> • Maintenance of railways to transport coal (bridges and rails) • Supply of spare parts for excavator, transportation vehicles for coal mines and other equipment • Refurbishment of belt conveyors <p>(3) Rehabilitation of Kreka and Banovici Coal Mines</p> <ul style="list-style-type: none"> • Supply of spare parts for excavator, transportation vehicles for coal mines, and other equipment • Refurbishment of belt conveyors • Supply of bulldozer and dump truck • Supply of drain pump <p>(4) Rehabilitation of Gacko and Ugljevik Coal Mines</p> <ul style="list-style-type: none"> • Supply of spare parts for excavator, bulldozer, transportation vehicles for coal mines and other equipment • Supply of bulldozer and dump truck <p>(5) Consulting services</p> <ul style="list-style-type: none"> • Validation of project, detailed design, assistance for bid tender • Supervision of works and technical guidance • Operation guidance in terms of environmental considerations • Coordination and communication, assistance in preparing various reports 	<p>(1) Rehabilitation of Kakanj Thermal Power Plant (Most of the original plan was implemented using other funds)</p> <ul style="list-style-type: none"> • Refurbishment Unit #5 (monitoring and controlling equipment) • Refurbishment of Unit #7 (boiler) <p>(2) Rehabilitation of Kakanj and Breza Coal Mines</p> <ul style="list-style-type: none"> • Almost as planned (Partially implemented by other funds, modified, etc) <p>(3) Rehabilitation of Kreka and Banovici Coal Mines (Original scope was planned for urgent needs. The entire scope was modified.)</p> <ul style="list-style-type: none"> • Supply of bulldozer and excavator • Spare parts for belt conveyors and heavy machinery <p>(4) Rehabilitation of Gacko and Ugljevik Coal Mines (Original plan was implemented by other funds)</p> <ul style="list-style-type: none"> • Supply of bulldozer, excavator, dump truck, and other equipment <p>(5) Consulting services Almost as planned</p>
(2) Project Period	October 1998 - July 2001 (33 months)	June 2001 - September 2006 (63 months)
(3) Cost Total	<p>Foreign currency 4,110 million yen</p> <p>Local currency 53 million yen</p> <p>Total 4,163 million yen</p> <p>ODA Loan Portion 4,163 million yen</p> <p>Exchange rate 1 USD=126.05 yen (as of March 1998)</p>	<p>4,098 million yen</p> <p>0 million yen</p> <p>4,098 million yen</p> <p>4,098 million yen</p> <p>(based on exchange rate at the time of payment)</p>