People's Republic of China

FY2016 Ex-Post Evaluation of Japanese ODA Loan

"Baotou Atmospheric Environment Improvement Project"

External Evaluator: Kenji Momota, IC Net Limited

0. Summary

This project was carried out in Baotou City, an industrial center of the Inner Mongolia Autonomous Region, to construct a natural gas pipeline that should help facilitate energy transition from coal to natural gas and reduce emissions of air pollutants with a view to improving the air quality of the city and raising the levels of living and environmental standards of the people there.

This project is highly relevant, as it agreed with the air pollution countermeasures specified in the development plan from the time of appraisal to the present at all of the nation, autonomous region, and city levels. Efficiency of the project is fair, as both the project cost and project period exceeded the plan. However, influences of the delay were controlled with some measures adopted to improve efficiency, such as replacement of materials and machines with better ones and enhanced efficiency of construction work. The gas supply has achieved the target set for the amount of gas to be supplied. Since the completion of the project, stable distribution has been maintained, with no supply interruption. That has enabled the city to replace coal, an inefficient combustion source, and reduce pollutants in the atmosphere. In 2015, the concentration of pollutants in the air was controlled below the national criteria on more than 90% of the days. As people living there notice improvements in air and living environments, effectiveness and impact of the project are high. The organization operating this project has achieved stability in all of organizational, technical, and financial aspects. Therefore, sustainability of the project effects is high.

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

1. Project Description

Project Location

Western Gate Station

1.1 Background

Amid rapid economic growth from the 1980s, China experienced increasingly serious pollution caused by industrialization and population growth. Especially from the late 1990s, the Chinese government adopted stricter environmental protection policies, achieving some degree of success. Nonetheless, pollution remained quite serious. In China, the atmosphere was seriously polluted, mainly with sulfur oxides (SO_X), total suspended particles (TSP), and nitrogen oxides (NO_X), generated when burning coal, the main energy source for the country. In 2003, the amount of SO_2 emitted by China was more than 30 times the amount of SO_X emitted by Japan. Acid rain was also observed in cities around China.

The site of this project, Baotou City of the Inner Mongolia Autonomous Region, suffered from serious air pollution caused mainly by SO_2 and soot and dust emitted from heavy industry that was achieving rapid growth and ordinary households using coal and coal boilers in winter for heating. Concentrations of SO_2 and TSP were higher than the national air quality standards applicable to residential areas, or Class 2. Among the 113 air-polluted cities designated by the national government for environmental protection, Baotou was ranked 13th from the bottom. Pollution was so serious that improving the air quality was a challenge the city had to address urgently.

Against such backdrops, this project was planned to reduce coal consumption in Baotou and improve the quality of the heavily polluted atmosphere.

1.2 Project Outline

This project was designed to construct a natural gas pipeline in Baotou City, one of the major industrial centers of the Inner Mongolia Autonomous Region, and help facilitate energy transition from coal to natural gas and reduce emissions of air pollutants with a view to improving the air quality of the city and raising the level of living and environmental standards of the people there.

Loan Approved Amount / Disbursed Amount	8,469 million yen / 8,451 million yen	
Exchange of Notes Date / Loan Agreement Signing Date	March 2005 / March 2005	
Terms and Conditions	Interest rate: Repayment: (Grace period: Financing conditions	0.75% 40 years 10 years) General untied
Borrower / Executing Agencies	The Government of the People's Republic of China / Inner-Mongolia Autonomous Regional People's Government	
Project Completion	August 2014	

Main Contractors (Over 100 million yen)	・China Peak Development Limited (PRC) ・Merit Technologies Inc. (Beijing) (PRC) / Beijing Zhonghui United Environmental Engineering Co., Ltd. (PRC) ・Beijing Bril Sanyou Technology Development Co., Ltd. (PRC)
Main Consultant (Over 100 million yen)	-
Feasibility Studies, etc.	F/S: Produced by the North China Municipal Engineering Design Institute of China in August 2004 (Approved by the Development and Reform Commission, Inner Mongolia Autonomous Region Government in September 2004) Special Assistance for Project Formation (SAPROF): Baotou Atmospheric Environment Improvement Project, Inner Mongolia Autonomous Region (January 2005)
Related Projects	・Hohhot and Baotou Environmental Improvement Project (December 1996) ・Hohhot and Baotou Environmental Improvement Project (2) (September 1997)

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited

2.2 Duration of the Evaluation Study

This ex-post evaluation study was conducted according to the following schedule.

Duration of the Study: July 2016–October 2017

Duration of the Field Study: October 18–26, 2016; April 20–22, 2017

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

3.1 Relevance (Rating: ③[2])

3.1.1 Consistency with the Development Plan of China

(1) Consistency with the Policy at the Time of the Appraisal

1) Consistency with the Policy at the National Level

Despite the success of the Chinese Government in achieving the target it had set in the "9th Five-Year Plan for Environmental Protection" (1996–2000) for the environment sector, the amount of pollutants emitted remained huge, and urban areas continued to suffer from a serious level of air pollution. Having seen that, the

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

[2] ③: High, ②: Fair, ①: Low

government drew up the “10th Five-Year Plan for Environmental Protection” (2001–2005), setting a target of reducing emissions of major pollutants (SO_2, TSP, etc.) by 10% from the 2000-level. Especially in the field of air environment, it aimed at reducing SO_2 emissions by 20% from the 2000-level in the “SO_2 Pollution Control Zones” and “Acid Rain Control Zones”, and mentioned promotion of natural gas and other clean energies as another target.

2) Consistency with the Policy at the Autonomous Region and City Levels

In line with the central government's “10th Five-Year Plan for Environmental Protection”, the “Inner Mongolia Autonomous Region Government 10th Five-Year Plan” (2001–2005), set a target of reducing emissions of major pollutants, such as SO_2 and soot and dust, by 10% by 2005 from the 2000 level, and especially in the “SO_2 Control Zones” and “Acid Rain Control Zones”, cutting SO_2 emissions by 21% from the 2000 level. The “Inner Mongolia Autonomous Region Government 10th Five-Year Plan” (2001–2005) also mentioned a program for promoting transition to clean energies.

In the “Baotou City Environmental Protection of the 10th Five-Year Plan” (2001–2005), the municipal government set specific targets. The Baotou City Environmental Protection Regulation stated, “Designation as Area of No Highly Polluting Fuel” and “Obligatory Transition to Natural Gas or Other Clean Energies” among its principles.

(2) Consistency with the Development Policy at the Time of Ex-Post Evaluation

1) Consistency with the Policy at the National Level

The “12th Five-Year National Development Plan” (2011–2015) set the target of reducing emissions of CO_2, SO_2, and NOx per unit of GDP by 17%, 8%, and 10%, respectively. The “12th Five-Year National Plan for Environmental Protection” (2011–2015), which embody the target, placed greater emphasis on efforts to control air pollution, setting a target of increasing the share of non-fossil fuels in primary energy consumption to 11.4% by 2015, mainly through restraining coal use.

2) Consistency with the Policy at the Autonomous Region and City Level

In “Inner Mongolia Autonomous Region Government 12th Five-Year Plan” (2011–2015), the natural gas is ranked as a major energy source to replace coal, presenting some initiatives for promotion. Specifically, the plan stated that construction of natural gas pipelines should be accelerated to raise the penetration ratio of natural gas to at least 85%, that construction of pipelines for transporting energy-related

products should be enhanced to raise the capacity to distribute such products out of the region, and that, with the aim of improving the quality of atmospheric environments in the region and urban areas, 70% of the major cities in the autonomous region should achieve Class-2 national standards for air quality on at least 292 days. Baotou City also produced "Baotou City Environmental Protection of the 12th Five-Year Plan" (2011–2015), setting a higher target of satisfying the Class-2 national air quality standards on at least 329 days. In 2014, for helping remove coal-fired boilers and facilitating projects for introducing more energy-efficient central heating systems or gas-fired units to concentrate supply sources into one, the city government implemented policy programs for encouraging removal of small-size boilers in the city.[3]

As described above, since the planning of this project, a series of initiatives with higher targets have been introduced at each of the nation, autonomous region, and city levels for addressing air pollution problems. This project, as a program for implementing the initiatives in a more specific manner, is evaluated to be highly relevant.

3.1.2 Consistency with the Development Needs of China

(1) Consistency with the Development Needs at the Time of the Appraisal

Along with economic growth, the Inner Mongolia Autonomous Region saw an about 81% increase in energy consumption between 1995 and 2003. Coal accounted for about 94% of the consumption, causing a serious air pollution problem. The Autonomous Region emitted about 810,000 tons/year of SO_2 (2003), more than the total SO_X emissions of Japan, about 630,000 tons/year (2000). It suffered from serious air pollution caused mainly by SO_2 and soot and dust emitted from heavy industry that was achieving rapid growth and ordinary households using coal and coal boilers in winter for heating. In Baotou City, concentrations of air pollutants persistently stayed above the Class 2 national air quality standards.

[3] "The Notice Regarding the Guidelines for Removal of Heat-supply Coal-fired Boilers and Networking in Major Urban Areas in Baotou City" and "The Notice Regarding Guidelines for Improvement of Commercial and Residential Coal-fired Boilers in control zones, Baotou City" (both in 2014)

Table 1: Concentrations of Air Pollutants in Baotou City

Indicator	1999	2000	2001	2002	2003	Class 2 National Standards
SO_2 (mg/m^3)	0.085	0.084	0.072	0.084	0.081	0.06
TSP (mg/m^3)	0.439	0.382	0.394	0.378 Note 1	-	0.20
PM_{10} (mg/m^3)	-	-	-	0.237 Note 2	0.277	0.1

Source: Documents provided by JICA (Data provided by Environmental Protection Bureau of Baotou Municipal People's Government)
Note 1: From January to May
Note 2: From June to December. Since June 2002, TSP was replaced by PM_{10} as indicator.

(2) Consistency with the Development Needs at the Time of the Ex-Post Evaluation

The table below shows emissions of air pollutants in the Inner Mongolia Autonomous Region. Even on a downward trend, amounts of pollutants emitted into the air are larger than the total emissions of Japan in 2000. Improving the air quality is a critical challenge to address.

Table 1: Air Pollutant Emissions in the Inner Mongolia Autonomous Region

Indicator	2004	2007	2010	2015
SO_2 (10,000 tons)	-	145.6	139.4	123.1
NOx (10,000 tons)	-	-	-	113.9
TSP (10,000 tons)	-	-	-	-

Source: Responses to questionnaires of Baotou Fuel and Gas Co., Ltd.

The table below presents numbers of factories in heavy industry in Baotou City during the same period. From 2009, factories increased by almost 40%, indicating continued growth of combustion sources causing air pollution.

Table 3: Numbers of Heavy Industry Factories in Baotou City

Indicator	2009	2010	2011	2012	2013	2014	2015
No. of heavy industry factories	12,318	15,998	16,502	16,467	16,640	16,640	-

Source: Responses to questionnaires of Baotou Fuel and Gas Co., Ltd. (Data of Statistics Bureau of Baotou City)
Note: No data were available for a period between 2004 and 2008.

In Baotou City, air pollutants have been at a serious level since the time of the appraisal for this project. To date, heavy industry and urban areas, both of which are major polluters, have been growing. In such circumstances, transforming the energy

structure, from coal combustion to cleaner natural gas, is a critical policy. Thus, it is fair to say that initiatives for transition of energy sources including this project answered a major need of Baotou City for improving the air quality.

3.1.3 Consistency with Japan's ODA Policy

At the time of appraisal for this project, the "Economic Cooperation Program for China" (announced in October 2001) referred to "Cooperation towards resolving environmental and other global issues" and "improvement of living standards and social development in the inland regions" as priority areas. The "Medium-Term Strategy for Overseas Economic Cooperation Operations", announced April 1, 2002, and the "Country Assistance Strategy for China" (FY2004) both placed emphasis on "environmental conservation", and mentioned "support for environmental improvement and pollution prevention" as one of the priority issues. Both policies pointed out environmental improvement as an important issue, a fact demonstrating great consistency with this project.

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

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The table below compares the plan for this project and its actual results. The main parts of the project have been completed almost as planned.

Table 4: Output: Plan and Actual Results

Output	Plan (2004)	Actual At time of project completion (2014) Parenthesized: Percentages to plan
1) Western Gate Station (1 set)	New construction	Almost as planned Location changed to Baotou suburbs.
2) Donghe Gate Station (1 set)	Expansion	As planned
3) Kundulun District Regulating Station (high/medium pressure) (1 set)	New construction	As planned
4) Development Zone Regulating Station (high/medium pressure) (1 set)	Expansion	As planned
5) Special-purpose Regulating Station (high/ medium pressure) (1 set)	New construction: 8 factories Expansion: 3 factories	New construction: 6 factories (75%) Expansion: As planned
6) Regulating Boxes (medium/low pressure)	New construction: 120 units	New construction: 110 units (91%)
7) Gas Pipeline	・High Pressure New construction: 54 km ・Medium Pressure New construction: 52 km Replacement: 270 km ・Low Pressure Replacement: 441 km	・High Pressure: 48.66 km (90%) ・Medium Pressure: 325.24 km (101%) ・Low Pressure: 468.18 km (106%)
8) Gas equipment: Nozzle adjustment & inner pipe repair	Coverage: 147,000 households	As planned
9) SCADA System	1 set	As planned
10) Valves	・High Pressure: 15 units ・Medium Pressure: 100 units ・Low Pressure: 300 units	As planned
11) Training Program in Japan for Air Quality Improvement	3 groups (12 persons in total)	1 group (5 persons) (41%)

Source: Documents provided by JICA; Actual values are based on responses to questionnaires of Baotou Fuel and Gas Co., Ltd.

For outputs in which any change was made, major factors that led to the change are shown in the table below.

Table 5: Factors Causing Any Change in Outputs

Output	Changes
1) Western Gate Station	The "12th Five-Year Plan of Baotou City" changed the route of the pipeline to be laid from the Ordos Gas Field. Accordingly, the location of the station was changed from the southern part of Baotou City to its southwestern suburbs to secure safe and stable supply of natural gas.
5) Special-purpose Regulating Station	Fewer new factories are constructed after bankruptcies and relocations.
6) Regulating Boxes	The number of units was changed to 110 at the time of detailed design for the optimal arrangement planning.
7) Gas Pipeline	[Total length] In the latter half of the "11th Five-Year Plan of Baotou City", the city planning was modified with some changes to the routes of new roads. As a result, the total length of the gas pipeline system was altered. [Material] Cast-iron pipes, adopted at the time of the planning, were replaced by steel and polyethylene (PE) pipes, as they are better in pressure resistance.
11) Training Program in Japan for Air Quality Improvement	[Fewer sessions & participants] After a long delay in the bidding, the main construction work had to catch up with the schedule. For that, more people were deployed for the work, and fewer could afford to visit Japan to attend training seminars. [Implementation period] A training seminar was held in April 2010. Originally, three sessions were scheduled for September 2006, September 2007, and September 2008.

Source: Responses to questionnaires of Baotou Fuel and Gas Co., Ltd.

Despite several changes to the outputs mostly due to some modification in the city planning, no significant alternation was made that might give any impact on achievement of the purposes of the project or its efficiency. The project produced most of the outputs as originally planned.

Regulating Box Installed in a Housing Complex

SCADA System
(At Baotou Fuel and Gas Co., Ltd. Headquarters)

3.2.2 Project Inputs

3.2.2.1 Project Cost

At the time of appraisal, the project cost was estimated at 13,962 million yen [foreign currency: 8,469 million yen; local currency: 5,493 million yen]. The actual cost turned out to be 15,351 million yen [foreign currency: 8,443 million yen (100% to the plan); local currency: 6,908 million yen (126% to the plan)] (ODA loan in foreign currency: 8,443 million yen). The actual cost was about 10% higher than that of appraisal (110% to the plan).

Table 6: Project Cost: Breakdown

Unit: million yen

Item	Foreign Currency		Local Currency		Total	
	Total	ODA Loan	Total	ODA Loan	Total	ODA Loan
Materials & Equipment / Civil Engineering	8,435 (8,058)	8,435 (8,058)	3,532 (1,564)	0	11,967 (9,622)	8,435 (8,058)
Training	8 (26)	8 (26)	0 (4)	0	8 (30)	8 (26)
Others (General Administration)	0	0	2,679 (105)	0	2,679 (105)	0
Land Acquisition	0	0	697 (1,335)	0	697 (1,335)	0
Price Escalation	0 (385)	0	0 (32)	0	0 (417)	0
Physical Contingency	0	0	0 (574)	0	0 (574)	0
Interest during Construction	0	0	0 (1,879)	0	0 (1,879)	0
Total	8,443 (8,469)	8,443 (8,469)	6,908 (5,493)	0	15,351 (13,962)	8,443 (8,469)

Note1: Figures in parentheses are estimations.
Note2: The expense for the item “Interest during Construction” is included in the item of “Others”.

The table below shows the factors that pushed up the cost. Among them, increases in material costs for gas pipes and personnel expenses during the project period were significant. Especially, labor costs continued rising between 2004 and 2013, at an annual average of over 15%[4]. Another factor with significant impact was changes in the currency exchange rate. Between 2009, (the year of first disbursement was made from the ODA loan), and 2014, the value of yuan fluctuated by about 4.8 yen from the bottom to the peak.

[4] China's Minimum Wage System and New Trends Toward Development (Ma Xiaoli, 2015), The 12th Northeast Asia Labour Forum: Recent Trends in Wages and Minimum Wage System, *JILPT Foreign Labour Information, February 2015*, The Japan Institute for Labour Policy and Training

Table 7: Factors of Changes in the Project Cost

Factors Pushing Up the Cost	Factors Pushing Down the Cost
• Higher labor costs amid pay increases in China nationwide (Average annual increase of 15.13% between 2004 and 2013 in the Inner Mongolia Autonomous Region).	• Changes in pipeline materials (cast iron to steel & PE).
• Fluctuations in exchange rate that reduced value of funds raised in a foreign currency when converted into CNY (up to about 4.8 JPY/CNY between 2009, and 2014).	• Fewer visits to Japan for a training program
• Higher material cost for PE pipes adopted in the latter half of the project period (Low-pressure: up 18%; Medium: up 21%).	

Despite several factors that pushed up the project cost as mentioned above, a change in pipeline materials, from cast iron to steel, delivered a cost reduction of about 328 million yen. Instead of steel ones, more cost-efficient PE pipes[5] were adopted for the latter half of the project. The savings made up for changes in the specifications stated above, such as the extended total length of the pipeline and purchases of pipes of larger diameter.

As a result, the project cost was indeed higher than planned with increases in labor and other expenses, but cost reductions achieved by changes of materials, and efficient redistribution of the savings helped control the total cost increase to 10%.

3.2.2.2 Project Period

At the time of appraisal, the project was planned to start in March 2005 (signing of Loan Agreement) and end in December 2013 (for 106 months). The actual project period started in March 2005 (signing of Loan Agreement) and ended in August 2014, finished with some delay in 114 months, or 108% of the plan. Periods at each stage of the project are shown below in detail.

[5] However, the material cost for PE pipes also increased by some 20% from around 2013. Because of the higher pipe prices, together with the extension of the total length of the pipeline and other factors, the project was finished with a 10% increase in the total cost, as stated in this report.

Table 8: Project Period: Plan and Actual Results

		Plan			
Main Construction		Detailed Designing	Bidding	Construction	Commissioning
	Started in:	August 2004	April 2005	September 2006	September 2007
	Ended in:	February 2005	August 2006	December 2013	December 2013
Training		Session	1st	2nd	3rd
		Held in	September 2006	September 2007	September 2008
		Actual			
Main Construction		Detailed Designing	Bidding	Construction	Commissioning
	Started in:	August 2004	December 2007	July 2007	December 2013
	Ended in:	January 2006	November 2011	December 2013	August 2014
Training		Session	1st	2nd	3rd
		Held in	April 2010	—	—

Source: Responses to questionnaires of Baotou Fuel and Gas Co., Ltd.
Note: A project is regarded as completed when inspection is finished.

The project period was prolonged because, after the signing of the ODA loan agreement, it took a longer time for the Finance Bureau of Baotou City and Baotou Fuel and Gas Co., Ltd., to complete procedures for the sub-loan between them.

As a result, the bidding got started much later with a 32-month delay. The implementing agency, Baotou Fuel and Gas Co., Ltd., took actions stated below to shorten the construction period, successfully limiting the overall delay of the project period to about eight months.

- Cooperation with municipal agencies: The city government, having ranked this project as critical for its environmental policy, provided support by, for instance, allowing simplified procedures at the construction stage. At the preparation stage before the bidding, the Baotou Fuel and Gas Co., Ltd. wasted no time working with relevant government agencies to make arrangements about, for instance, when construction work for building roads should be carried out as the timing would influence when to do work for laying pipes, deciding what solution to apply to problems they could foresee.

- Construction methodology and planning for higher efficiency: Parts of the construction work financed by funds raised in the local currency got started first.

Once having laid pipes at some sections, they started inspection and gas supply there, while carrying out construction work at other sections at a time, pursuing a more efficient construction methodology. The second and third sessions of the training program in Japan were canceled, giving priority to deployment of personnel to the construction work.

Despite a large delay in internal procedures taken necessary for the government to conclude the contract, Baotou Fuel and Gas Co., Ltd., planned and implemented practical tasks for the project in a more efficient manner to minimize the delay in the entire process.

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

Financial Internal Rate of Return (FIRR)

At the time of the appraisal, the financial internal rate of return (FIRR) of the project was computed at 3.65%. A calculation performed again for this evaluation has shown that the FIRR is 25.15%. Just as done at the time of the appraisal, the calculation was carried out with revenues from gas rates counted as a benefit, and initial capital expenditure, together with annual maintenance expenses, included in cost, to find a rate of return during the project life, or 20 years. The larger FIRR is attributable mainly to higher unit prices of gas than at the time of the appraisal, present conditions expected to guarantee a stable growth of supplies at almost 7%, and a larger share of factories, businesses, and other commercial users that pay a higher unit rate than ordinary households. Together with financial sustainability mentioned below, the actual FIRR suggests stable conditions in the operation of gas business.

Both the project cost and the project period exceeded the plan. Therefore, the efficiency of the project is fair.

3.3 Effectiveness[6] (Rating:③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

We compare the effects expected from conversion of energy from coal to natural gas with the actual performance.

(1) Operational Status of the Gas Supply Business

The total amount of gas supply came close to achieving the target volume in 2015 stage; then, the amount of supply as of October 2016 increased to as much as

[6] Sub-rating for Effectiveness is to be put with consideration of Impact.

586,887,300 m^3/year, achieving the targeted volume.

With respect to the gas supply on the basis of sales volume for various uses, the gas supply structure has greatly changed from the one at the time of the appraisal, as the current main demand is for industrial use such as heavy industrial plants, which accounts for 77% of the total. One of the background factors why the gas supply for industrial use has increased, as stated in "Relevance," is that the Baotou Municipal People's Government came out with a policy to promote conversion to natural gas and concrete measures were put in place. It can be evaluated that the rapid conversion was particularly accelerated by the enforcement of city regulation, established in 2014, concerning removal of coal boilers in business establishments and the realization of stable natural gas supply environment by this project. On the other hand, the supply volume for general household use, which was initially anticipated to be the largest source of demand, has been less than half of the target volume. This is because, while the supply volume for general household use has decreased by a great margin, the gas supply for industrial use has increased significantly. The probable reason for the decline of the supply volume for general household use is improvement in the efficiency of gas supply thanks to building of a concentrated heat supply system in the urban area.

Table 9: Operational Status of Gas Supply

Indicator	Baseline 2004 Appraisal Year	Target 2014 1 Year After Completion	Actual value 2015 1 Year After Completion
Amount of natural gas supply (10,000 m^3/year)	730.0	58,067.0	57,919.0
Sales volume of natural gas for general household (residence) use (10^4m^3/year)	0.0	14,488.0	6,330.0
Sales volume of natural gas for industrial use (10^4m^3/year)	730.0	33,923.0	44,345.0
Sales volume of natural gas for public facilities, etc. (10^4m^3/year)	0.0	9,656.0	7,243.0
Number of beneficiaries (users) of natural gas (number of contracts)[Note 1]	-	-	441,500 households
Prevalence rate of natural gas (%)	6.9	91.6	96.0

Source: Standard values are based on the documents provided by JICA; Actual values are based on responses to questionnaires of Baotou Fuel and Gas Co., Ltd.

Note1: The number of beneficiaries (users) of natural gas (number of contracts) indicates the number of households using gas for general residential houses.

Baotou Fuel and Gas Co., Ltd., buys natural gas from Changqing gas field located at Ordos, which is located to the south of Baotou City in the same Inner Mongolia Autonomous Region and known as a resource city with abundant reserves of mineral resources. According to Baotou Fuel and Gas Co., Ltd., the supply environment is stable, as the gas supply has never been interrupted since the start of operation. In addition, as the gas pipeline network was developed as a loop structure, it can cope with temporary interruption of gas supply as a result of accident in the pipeline network, etc., and there has been no interruption since the start of operation.

(2) Amount of Pollutant Emission Reduction

In this section, we analyze to what extent the emission of pollutants from conventional energy sources such as coal was reduced by conversion to natural gas. In concrete terms, we estimated the amount of pollutant emission when the equivalent amount of coal was used to that of natural gas in 2015 ($57,919 \times 10^4$ m^3) and worked out the difference.[7] The table below summarizes the result. The extent of emission reduction by the project has amounted to be approximately 20,000 tons of SO_2, 13,000 ton of NOx, and 124,000 tons of TSP.

Table 10: Simulation of Amount of Pollutants Emission Reduction
(1 Year after Completion: 2015)

Category	SO_2 emission (t/yr)	NO_X emission (t/yr)	TSP emission (t/yr)
Natural gas	365	1,969	166
Standard coal	21,262	15,083	124,584
Amount of emission reduction	20,897 (21,864)	13,114 (7,432)	124,418 (N/A)

Source: Calculated by the evaluator based on responses to questionnaires of Baotou City
Note: The figures in parenthesis are the target values at the time of appraisal.

As we used different estimation conditions from those that were used for target values at the time of the appraisal,[8] we cannot make simple comparison; however, with regard to target values, as the amount of SO_2 emission reduction is 21,864 (t/yr) and

[7] We had a reply from the Environmental Protection Bureau of the Baotou Municipal People's Government saying that the data regarding amount of pollutant emission cannot be disclosed as they are confidential. For this reason, in this report, the evaluator carried out estimation by comparing the amount of pollutant emission in case an equivalent amount of standard coal equivalent to the current amount of natural gas being supplied were used, with the amount of pollutant emission in case of natural gas. The estimation was carried out on the following assumptions. The amount of coal used (1,661,117 tons) when the amount of natural gas supplied in 2015 is converted to that of standard coal, amount of energy for natural gas: about 8,604 kcal/m^3 with energy efficiency of 80% and the amount of energy for standard coal: about 7,004 kcal/t with energy efficiency of 40%. As for the amount of pollutant emission of natural gas and standard coal, we used standard coefficients in consideration of the results of the interviews.

[8] At the time of the appraisal, it is assumed that all the sources of pollutant coming from the respective energy sources used by those enterprises that are scheduled to be converted to natural gas in this project as well as respective amounts of energy used in those general households that are assumed to convert to natural gas are all converted to natural gas.

the amount of NO_X emission reduction is 7,432 (t/yr), the target value for NO_X has been achieved.

A scene of heavy industrial area before implementation of the project

A scene of heavy industrial area after implementation of the project

3.3.2 Qualitative Effects (Other Effects)

The effectiveness regarding the environmental improvement of the city will be discussed below in "Impact". As for other effectiveness, the effectiveness of the training through this project is worth mentioning. Although the number of training programs in Japan was reduced from three to one, as the participants gave positive comments that the knowledge and experience gained in the training program has positively impacted the operation of their business, we can evaluate that the program had positive effects, particularly on raising safety awareness. In the following section, aspects mentioned in concrete terms, particularly in regard to safety area, are summarized in four points.

(1) Effects of the Training Program in Japan

At the time of the field study, we interviewed Mr. Yan-lei Sun, current Deputy General Manager[9] of Baotou Fuel and Gas Co., Ltd., with regard to the effectiveness and what was learned in the training program in Japan. Mr. Sun, who has been involved in process management since the beginning of this project, gave an assessment that the training program in Japan was effective in both short-term effects in the implementation process of the business and long-term measures for managerial improvement of Baotou Fuel and Gas Co., Ltd., as a whole. It is fair to say that, as the objective of the training program in Japan is to learn construction, engineering work, and maintenance of natural gas pipelines as well as the advanced managerial experience of the gas company, it is highly effective particularly for improvement of

[9] General manager is the name of an office/post in China which is equivalent to president in a Japanese company.

“safety” awareness. In the interview with Mr. Sun, we were able to confirm his view that acknowledges the learning and effects from the training in the following concrete aspects.

1) Change of Business Plan and Specifications

After listening to the experience at the time of the Great Hanshin Earthquake, they changed the specifications for medium pressure gas pipeline and low-pressure gas pipeline to use PE as the material of the pipe, as it has better quake-resistant characteristics and durability.

2) Systematization to ensure safe operation

While visiting Japanese gas companies, they became aware of the importance of the safety management system of the gas supply facilities; this awareness became a momentum towards accelerated introduction of an automatic control system.

3) Awareness concerning importance of human resources development

As improvement of the skills of employees, particularly maintenance skills, also leads to safe operation, they established an in-service training institute which provides practical training and introduced, from 2013, a program which puts more emphasis on practical training for new employees.

4) Awareness concerning importance of public relation activities for the purpose of improving penetration rate

After witnessing the situation in Japan where Japanese gas companies engage in such public relations activities as cooking classes for housewives, briefing sessions, and annual “Day of Gas”, they decided to improve the content of customer service and engage in PR activities for introduction of gas alarms to ensure the safety of users, resulting in an increase in the use rate from 20% to 90%.

A scene of discussion with
Mr. Yan-lei Sun

3.4 Impacts

3.4.1 Intended Impacts

Improvement of atmospheric environment and living environment of the residents in Baotou City is analyzed from the following points of view. With respect to quantitative effectiveness, effectiveness of atmospheric environment improvement based on the statistical data will be discussed; and, in regard to qualitative effectiveness, the effectiveness of this project will be described based on the opinions of the residents expressed in the results of beneficiary survey.

(1) Quantitative Effectiveness

1) Improvement of Atmospheric Environment in Baotou City

As shown in the figure below, compared with the situation at the time of the appraisal (2004), improvement is evident, as SO_2 emission concentration, NO_X emission concentration, and TSP emission concentration in 2015 are all on downward trends. As all these substances meet, in terms of annual average, the Class-2 national standards, it can be evaluated that a certain level of atmospheric environment is maintained even with the current national standards.

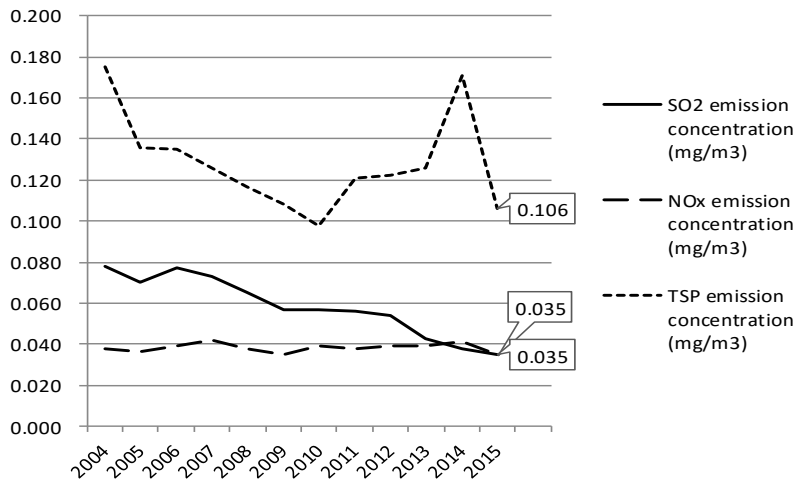

Figure 1: Status of Atmospheric Pollution – Year to Year Data
(Annual Average Concentration)
Source: Data provided by Baotou Fuel and Gas Co., Ltd., obtained from the Environmental Protection Bureau of Baotou Municipal People's Government

The figure below shows yearly data of how many days in a year the atmospheric quality in Baotou City met the Class-2 national air quality standards. Although only 178 days out of 365 days satisfied the standards at the time of the appraisal, the rate increased to as much as 329 days in 2015, satisfying the target of Baotou City's

Environmental Protection of the 12th Five-Year Plan. As shown in Table 3, as economic growth continues in Baotou City, the number of heavy industrial plants is also increasing. As this project is playing an important role as a source of gas supply for these industries, it can be evaluated that it is making a positive contribution to air pollution control for the city as a whole.

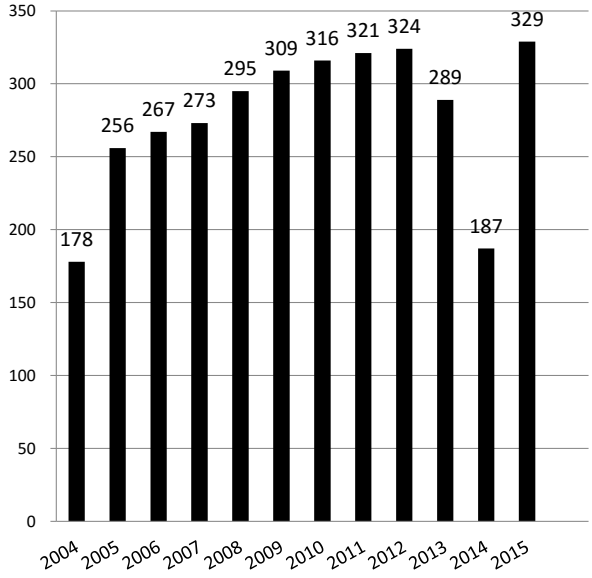

Figure 2: Number of Days Achieving the Class-2 National Standards
Source: Data obtained by Baotou Fuel and Gas Co., Ltd., from the Environmental Protection Bureau of Baotou Municipal People's Government

2) Qualitative Effectiveness

With respect to qualitative effectiveness of environmental improvement in Baotou City and improvement of living environment for the residents, we conducted a survey of 120 beneficiaries[10] from 120 households to confirm the positive change of living environment and the effectiveness brought about by the conversion to natural gas on people's lives.

With respect to improvement of living environment in Baotou City, when we asked questions about housing environment and atmospheric environment, and matters related to health in comparison with those of approximately 10 years ago; i.e., at the time of commencement of the project, more than 75% of the respondents answered, "it became better/has been improved" in relation to all items. Among other things, we were able to confirm those opinions that give a positive assessment to the explicit change of immediate living environment by the conversion to gas; for example, as a

[10] We conducted the survey by randomly extracting, as object of the survey, 120 households living in four districts of Baotou City (Qingshan, Kundulun, Donghe, and Jiuyuan districts), the targeted area of supply by this project, since 2005. The survey was conducted by face-to-face question and answer session by a researcher, obtaining 120 valid responses. Survey implementation period: the middle of December 2016.

result of conversion to gas, as they have fewer opportunity to use coal inside the house, they are generating less soot and dust.

Table 11: Improvement of Living Environment in Baotou City

Item	Result of answers and main opinions
	For residents (120 households)
Improvement of living environment compared with 10 years ago	"Improved" was selected by 94 people (78%). Main reasons include "Soot and dust was reduced" and "There is no need to stock coal now."
Improvement of atmospheric environment compared with 10 years ago	"Considerably improved" was selected by 92 people (77%). Main reasons are "Air became clean," "Dust was reduced," and "Living environment became clean."
Improvement in health compared with 10 years ago	"Considerably improved" was selected by 90 people (75%). Main reasons are "Sinus condition has improved," "Coughing was reduced," "Health conditions have improved," "I no longer need to wear a mask when I go out," "Breathing has become easy" and "Skin became better."

Source: Survey of beneficiaries

According to the beneficiary survey, not only did all the respondents completely convert their cooking equipment to natural gas, but many households also converted their hot water systems and heating devices to natural gas. Further, with respect to those pieces of equipment that have not been converted to natural gas at the moment, about 70% of respondents answered that they want to carry out conversion in the future because they have received a subsidy for the cost of natural gas conversion. As for other reasons for the change, apart from receiving a subsidy for the cost of natural gas conversion, "Natural gas is cheaper" and "It's good for air environment" are reasons many of them quoted for the selection.

As discussed above, the concentration of air pollutants in Baotou City has significantly improved, and it has improved to the level that achieves the current national air quality standards. As discussed in "Effectiveness" above, since the main role of the natural gas in this project is to be supplied to heavy industrial plants, etc., which are the main source of pollution in Baotou City, it can be evaluated that it is playing a major role in improving the air quality in the city as a whole. In addition, as the results of the beneficiary survey support the finding that improvement of the air quality has progressed in such way that local residents can actually feel it, it is evaluated that, in terms of both quantitative and qualitative aspects, the impact, i.e., improvement of atmospheric environment and improvement of level of living environment for the residents, has been achieved.

Air environment of Baotou City
(at the time of field study in October 2016)

3.4.2 Other Positive and Negative Impacts[11]

(1) Impacts on the Natural Environment

As this project is classified as category B under the "JBIC Guidelines for Confirmation of Environment and Social Considerations" (established in April 2002) at the time of appraisal[12], it is not assumed that there will be a significant negative impact on the environment. During the project period, no problems that were not assumed in the environmental impact assessment report have arisen, and there were no particular negative impacts on the natural environment.

(2) Land Acquisition and Resettlement

As the gas pipeline network was laid down in accordance with city planning avoiding residential areas, there has been no relocation of residents. If agricultural products had been cultivated at a site where gas pipeline was buried, as harvesting could not be done temporarily, compensation has been paid in accordance with the estimated harvest at that site. With respect to the payment, the user of the land and the constructor made an agreement in conformity with the domestic law.

(3) Unintended Positive and Negative Impact

As the gas company, at the time of construction, took such necessary measures as adherence to regulations concerning work time and installation of soundproof huts to reduce the work noise in accordance with the "People's Republic of China Environmental Noise Pollution Control Act" established in 1997, there has been no case of compensation payment, etc. paid because of noise.

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[11] Based on answers to the questionnaire by Baotou Fuel and Gas Co., Ltd., and additional confirmation with the person in charge of the site at the time of the project implementation.

[12] The environmental impact assessment report of this project was approved by the Environmental Protection Bureau of Inner Mongolia Autonomous Region in November 2004 (based on the documents provided by JICA).

In addition, with respect to measures against soot and dust, as the company took such measures as placement of sprinkler trucks and shielding off of the work area in accordance with the "People's Republic of China Environmental Protection Act," the "People's Republic of China Air Pollution Control Act," and other law and regulations concerning prevention of soot and dust, there has been no compensation payment, etc. paid because of soot and dust problem.

This project has achieved its objectives. Therefore, effectiveness and impact of the project are high.

3.5 Sustainability (Rating:③)

3.5.1 Institutional Aspects of Operation and Maintenance

(1) Project Implementation Structure

There has been no change of the plan since the time of the appraisal; and, the leading group of the Inner Mongolia Autonomous Region Atmospheric Environment Improvement Project was authorized to make decisions concerning important matters of this project, being a body in charge of formulation of relevant policies, coordination with relevant organizations, and implementation of loans. As the secretariat for this, the Inner Mongolia Autonomous Region Environment Improvement Project Japanese ODA Loan Management Office was established at the same time to be in charge of concrete operations. As for the implementing organization of this project, Baotou Fuel and Gas Co., Ltd., a holding company 100% owned by the state, was commissioned to carry out the operation.

(2) Structure of Operation and Maintenance after the Completion of the Project

Although the Financial Affairs Agency is in charge of governmental portfolio after the completion of the project, as many people have been continually in charge of this project since the planning stage, the continuity of policies and operation and collaboration between relevant organizations are both maintained well. Baotou Fuel and Gas Co., Ltd., the implementing agency, is currently providing 100% of natural gas in the city. The supplier of natural gas is Western Natural Gas Co., Ltd. in the Inner Mongolia Autonomous Region, with which it has concluded a 30-year long-term supply contract up to 2034. The number of employees is 598 (451 during implementation of this project) of which engineering employees account for about 50%. Although the number of engineers was expected to be 202 at the time of the appraisal, it was increased to be as many as 270 now; and the company has developed a system sufficiently capable of handling the operation in terms of scale as well. The operation

and management system has been systematized and, as shown below, inspection items and person in charge for individual facilities, inspection frequency, etc. have all been stipulated in great detail.

Table 12: Maintenance and Management System of the Main Facilities and the Management Details

Facilities	Prescribed frequency/ number of times, etc.	Inspection details
Gate Station	360 times/month; nine people are assigned to each station	Operational status of the facility, confirmation of operational data, checking of gas leakage, etc. On top of above, weekly routine inspection, cleaning of filters to remove foreign matters, monthly tuning test, large-scale inspection once a year and once in three years (overhauling, etc.)
Regulating Station	Four times/month; five people are assigned to each station	As above
Regulating Boxes	Four times/month; 20 people are assigned	As above
Gas Pipeline	30 times/month; 35 people are assigned	Confirmation of operational status of the gas pipeline, confirmation of the status of construction work on the ground, leakage inspection, etc.

Source: Responses to questionnaires of Baotou Fuel and Gas Co., Ltd.

As the number of employees is being increased to expand the destination of natural gas and to strengthen safety measures, it is considered that stable business operation will continue to be maintained in the future. In terms of structure, as privatization is not scheduled in the future, it is considered that there will be no major organizational changes in the immediate future either.

3.5.2 Technical Aspects of Operation and Maintenance

As stated above, Baotou Fuel and Gas Co., Ltd., is in charge of all the gas supply in the city; and, on the basis of the experience of business operation so far, the company has sufficient experience and knowledge base in the area of maintenance as well. As a result of the interviews with the people in charge of relevant facilities at the time of the field study, we were able to confirm the following details:

- At all outputs, the local employees had a good understanding of the framework for inspection implementation work as their routine duties and were able to explain it in an accurate fashion. In addition, with respect to handling of the emergency situation, a communication system and mobilization system are established in a

proper fashion including cooperation with on-site patrol teams, resident technicians, and the central control room of the headquarters of the gas company.

- Engineers belonging to the company are required to obtain technical qualifications according to the company regulations. In addition, they are employed after they go through the training course. Technical provisions associated with safety management such as acquisition of certificate of operation for relevant facilities have been developed and current engineers have all satisfied these provisions.
- The company implements in-house training courses targeting its engineers 12 times a year; not only courses for existing technologies, but also when the company introduces a new technology; in addition, the company formulates an annual plan for training.

On the basis of above, it is fair to say that Baotou Fuel and Gas Co., Ltd., has technical capability required for the sustainability of project effects.

Demonstration of gas pipe replacement work at the training center

Patrol car and the person in charge

3.5.3 Financial Aspects of Operation and Maintenance

According to the plan at the time of the appraisal, the funds required for the implementation of this project were scheduled to be supplied by Japanese ODA Loan, loans from domestic banks and private funds of Baotou Fuel and Gas Co., Ltd.; this project was implemented according to the plan without the need for supplementary expenditure from the government.

As the organization commissioned to implement the project, Baotou Fuel and Gas Co., Ltd., operates on a stand-alone basis; the company never had supplementary funding from the government in relation to its business operation. There is no plan to receive supplementary funding from the government in the future, either, as the company keeps operating in the black year after year from the time of implementation of this project to now. The table below shows major management indicators for the

most recent three years.

Table 13: Recent Management Status of Baotou Fuel and Gas Co., Ltd.

Unit: million yuan

	2013	2014	2015
Gross sales	1,060	1,155	1,241
Year-on-year		108.9%	107.5%
Gross profit on sales	383	418	350
Gross margin percentage	36.1%	36.2%	28.2%
Business profit	337	370	334
Operating income margin	31.8%	32.0%	26.9%
Current net earnings	287	322	292
Capital-to-asset ratio	25.8%	29.7%	21.0%
Liquidity ratio[13]	122.7%	124.9%	106.6%

Source: Calculated by the author on the basis of the data provided by Baotou Fuel and Gas Co., Ltd.

As the company has achieved stable business profit each year with a high level of income margin, it can be said that the company has been able to manage the business in a stable manner on the basis of its business income. According to Baotou Fuel and Gas Co., Ltd., in addition to charging for supply of gas, it also sells, for example, gas utensils for general households (kitchen goods, hot water utensils, etc.) for the sake of stable management. Further, Table 14 shows the trend of gas rate year-by-year, which shows that it increased by as much as 30% to almost 200% compared to that of 2004 or at the time of appraisal.

Table 14: Natural Gas Rate in Baotou City

Unit price per m^3	2004 (at the time of appraisal)	2016 (figures in parentheses show comparison with the time of planning)
Residential use	1.45 yuan	1.82 yuan (126%)
Industrial use (depends on the scale)	0.98–1.15 yuan	1.74–2.246 yuan (178-195%)
Public facilities	1.45 yuan	1.82 yuan (126%)
General business	1.7 yuan	2.346 yuan (138%)

Source: Data provided by Baotou Fuel and Gas Co., Ltd.

[13] For reference, in case of Japanese gas companies, the figures are: Tokyo Gas (2013: 157%, 2014: 151%, 2015: 155%) and Saibu Gas (2014: 96%, 2015: 70%).

Gas rate is set by the Baotou Municipal Government (Development and Reform Commission); when the government revises the rate, market research is carried out in advance by the Development and Reform Commission so that the setting of the rate is adjusted in such manner that Baotou Fuel and Gas Co., Ltd., maintains a certain profitability. In addition, it is possible for Baotou Fuel and Gas Co., Ltd., to apply for review of the gas rate to the Development and Reform Commission; in fact, the rise of gas rate from 2009 to 2010 was the result of an application submitted by Baotou Fuel and Gas Co., Ltd.

On the basis of above, being an entity operating on a stand-alone basis, the management status of Baotou Fuel and Gas Co., Ltd., can be described as generally good considering that it not only has stable income from gas supply business and sales of gas appliance to households, but also is trying to diversify its income base. It is fair to say that it has a sufficient financial base to continue to manage & maintain the natural gas business in the future.

3.5.4 Current Status of Operation and Maintenance

The status of operation and maintenance of each gas supply system is given in the respective paragraph as follows.

(1) Stability of Gas Supply and the Conditions of Main Facilities

As stated in “Effectiveness,” the gas pipeline network of Baotou City is structured as a loop network. There has been no record of interruption of gas supply by inspection work, etc. since the start of gas supply through this project. There has been no interruption of gas supply at any stations where we had field tours, including the Western Gate Station, the regulating station built in the aluminium plant, and the regulating station built in a residential area. In addition, there has been no record of repair work apart from replacement of consumable parts.

With respect to the gas pipeline in Baotou City as a whole, the aging sections are being replaced one by one; on that occasion, the steel pipes that have been used in the past are changed to PE pipes. In addition, there are around ten cases of reports of gas leak from the general public and identification of gas leakage by the employees; apart from these, there are a few times of emergency dispatch in a year because someone has broken the gas pipeline and so on.

The current amount of natural gas supply by Baotou Fuel and Gas Co., Ltd., is approximately 580 million m^3/year; and, it is expected that it will increase by 20% every year. Although the capacity of supply with the current system is 1,000 million m^3/year, as it is highly likely that the company needs to expand its supply capacity in

the future, and it is making necessary investment in plant and equipment to ensure continual gas supply in Baotou City even after the ODA Loan project; for example, by its own funds, it is not only replacing aging gas pipeline, but also replacing the existing pipes with larger diameter ones in preparation for increased amount of gas supply. No particular problem was identified in this area.

(2) Conditions of the Control System

The SCADA system introduced to the central control room is being updated as needed in response to the increase in number of stations. As engineers dedicated to the maintenance of the SCADA system (updating and programming) are stationed in Baotou Fuel and Gas Co., Ltd., at the moment, it is operating without a problem.

From the perspectives stated above, it is fair to say that maintenance and operating conditions of outputs will continue without a problem.

No major problems have been observed in the institutional, technical, financial aspects and current status of the operation and maintenance system. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was carried out in Baotou City, an industrial center of the Inner Mongolia Autonomous Region, to construct a natural gas pipeline that should help facilitate energy transition from coal to natural gas and reduce emissions of air pollutants with a view to improving the air quality of the city and raising the levels of living and environmental standards of the people there.

This project is highly relevant, as it agreed with the air pollution countermeasures specified in the development plan from the time of appraisal to the present at all of the national, autonomous region, and city levels. Efficiency of the project is fair, as both the project cost and project period exceeded the plan. However, influences of the delay were controlled with some measures adopted to improve efficiency, such as replacement of materials and machines with better ones and enhanced efficiency of construction work. The gas supply has achieved the target set for the amount of gas to be supplied, and since the completion of the project, stable distribution has been maintained, with no supply interruption. That has enabled the city to replace coal, an inefficient combustion source, and reduce pollutants in the atmosphere. In 2015, the concentration of pollutants in the air was controlled below the national criteria on more than 90% of the days. As people living

there notice improvements in air and living environments, effectiveness and impact of the project are high. The organization operating this project has achieved stability in all of organizational, technical, and financial aspects. Therefore, sustainability of the project effects is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Realization of enhanced project effects by comprehensive measures of environmental improvement

This project has achieved significant effects; and one of the important factors for this is implementation of appropriate policies and measures to facilitate the effectiveness of this project. To promote conversion to natural gas, it is important to encourage users to convert from existing energy; therefore, in this project, smooth conversion to natural gas was facilitated by encouraging people to abandon inefficient coal boilers at the same time. In addition, with regard to gas rate, financial sustainability was achieved by setting a rate structure which ensures certain profitability. It is fair to say that such stable financial base is also effective in maintaining stability and reliability of gas supply. It also seems that this project has produced excellent project effects, by virtue of having been implemented in conjunction with a package of policies which help enhance the effects of the project. When a project is aimed at conversion of the energy source for an entire city like this project, in many cases, it involves development of basic infrastructure. Thus, it becomes important to focus not only on the physical development through the project, but also on the enhancement of the policy effect by introducing such policy measures that facilitate its effectiveness.

Comparison of Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs 1) Western Gate Station of Baotou City: 1 set	New construction	Almost as planned (change of location)
2) Donghe Gate Station of Baotou City: 1 set	Expansion	As planned
3) Kundulun District Regulating Station (High/ Medium Pressure): 1 set	New construction	As planned
4) Development Zone Regulating Station (High/ Medium Pressure): 1 set	Expansion	As planned
5) Special-purpose Regulating Station (High/ Medium Pressure): 1 set	New construction: 8 plants Expansion: 3 plants	New construction: 6 Plant expansion: As planned
6) Regulating Boxes (Medium/ Low Pressure)	New construction: 120 units	New construction: 110 units
7) Gas Pipeline	・High pressure gas pipeline New construction: 54 km ・Medium pressure gas pipeline New construction: 52 km Rebuilding installation and replacement: 270 km ・Low pressure gas pipeline Rebuilding installation, and replacement: 441 km	Total length for each gas pipeline: ・High pressure gas pipeline: 48.66 km ・Medium pressure gas pipeline: 325.24 km ・Low pressure gas pipeline: 468.18 km
8) Nozzle adjustment and repair of inner tube of gas equipment	Number of targeted households: 147,000	As planned
9) SCADA system	1 set	As planned
10) Valves	・For high pressure: 15 units ・For medium pressure: 100 units ・For low pressure: 300 units	As planned
11) Training program in Japan concerning atmospheric environment improvement	3 groups (12 in total)	1 group (5 in total)
2. Project Period	March 2005 - December 2013 (106 months)	March 2005 - August 2014 (114 months)
3. Project Cost Amount Paid in Foreign currency	8,469 million yen	8,443 million yen
Amount Paid in Local Currency	5,493 million yen	6,908 million yen
	(413 million yuan)	(413million yuan)
Total	13,962 million yen	15,351 million yen
ODA Loan Portion	8,469 million yen	8,443 million yen
Exchange Rate	1 yuan = 13.3 yen (As of September 2004)	1 yuan = 14.77 yen (Average between 2005 and 2015)
4. Final Disbursement	July 2014	