People's Republic of China

FY 2017 Ex-Post Evaluation of Japanese ODA Loan Project

"Xinjiang Environmental Improvement Project (I) (II)"

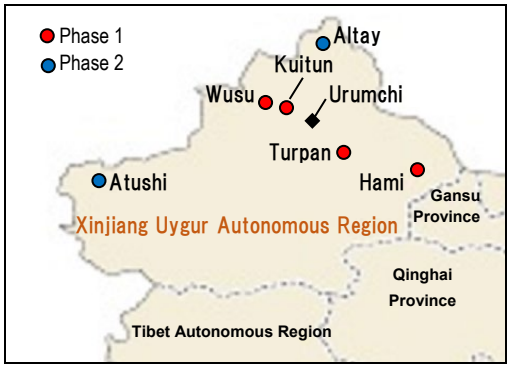
External Evaluator: Hiromi Suzuki S., IC Net Limited

0. Summary

This project was conducted with the aim to improve sewage treatment and water supply capacity and reduce water and air pollutants in a total of six cities, namely Hami, Turpan, Wusu, and Kuitun (Phase 1), and Altay and Atushi (Phase 2) in the Xinjiang Uygur Autonomous Region (hereinafter referred to as "XUAR"), China, by developing sewage, water supply, centralized heat supply, and city gas (Altay City only) facilities, thereby contributing to the improvement of the environment and living standards of residents in the six cities. This project was fully consistent with the development and environmental protection plans and development needs of China and XUAR at the time of the appraisal and the ex-post evaluation as well as Japan's ODA policy toward China at the time of the appraisal, therefore the relevance of the project is high. The outputs of the project were partially reduced in Phase 1 but were as initially planned in Phase 2. In both phases, the total project cost remained within the initially planned range, but the project period exceeded the initial plan. Thus, the efficiency of the project is fair. The outcome expected as the project's effect was to improve sewage treatment and water supply capacity and reduce water and air pollutants, and its impact was to contribute to the improvement of the environment and living standards of residents in the six cities. In both phases, with regard to outcome, the project achieved major indicators' targets set for each sector at the time of the appraisal; therefore, the effectiveness of the project is high. Regarding impact, it was confirmed through interviews with groups of beneficiaries that in the project area of each city, water service /sewage, centralized heat supply, and city gas facilities had been developed and that this contributed to improvement of the environment and the living standards of residents. Land acquisition was carried out appropriately, and no resettlement of residents occurred. During the construction work and at the time of the ex-post evaluation, impacts on the natural environment were monitored appropriately with environmental measures taken properly, and no negative impact was confirmed. As described above, the effects of the project manifested themselves as planned, and the effectiveness and impacts of the project are high. The current statuses of the institutional, technical, and financial aspects at the 15 units that were responsible for the operation and maintenance management of the project implementation are generally favorable, and the sustainability of effects brought by the project is high.

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

1. Project Description



Project Location

Kuitun Sewage Treatment Plant (activated sludge tank)

1.1 Background[1]

In China, the sewage treatment rate in urban areas in 2006 was low at 56%. In the country's rural areas, sewage facilities were underdeveloped, making water contamination in rivers and freshwater lakes increasingly serious. With regard to water service, there were factors for local water shortages such as the concentration of water sources mainly in the southwestern part. In addition, many of the cities had problems such as water intake and supply from water sources, the quality of whose water was poor, and water leaks from the network of water pipes. Regarding the atmospheric environment, about 70% of its energy consumption derived from coal, and acid rain, dust, and other nuisances due to emissions of sulfur oxides that had serious effects on the health of residents and ecosystems. To address this situation, the Chinese government announced in its national development plan that it would work to take measures such as preventing water pollution, giving priority to protecting sources of drinking water for urban residents, and mitigating air pollution. Located along the national border in western China, the Xinjiang Uygur Autonomous Region, covered by the project, was one of the priority areas under the western development plan. In particular, the six project cities (Hami, Turpan, Wusu, Kuitun, Altay, and Atushi) occupied an important place for the development of XUAR. However, while water service and energy demand grew because of urbanization and population increase, the improvement of water service /sewage and centralized heat supply facilities were insufficient, coping with environmental problems such as water contamination and air pollution was becoming an urgent issue to address. Taking these circumstances into consideration, the Autonomous Region's government requested Japanese ODA loans to improve water quality and the air environment. In FY 2006, such a request was made for all the six cities so that the project was carried out in Phases I and II, and it was decided that Phase 1 covered four of them (Hami, Turpan, Wusu, and Kuitun) in FY 2006 and that Phase 2 covered the remaining two (Altay and

[1] This section is based on materials provided by JICA and the ex-ante evaluation table.

Atushi) in FY 2007.

1.2 Project Outline

The objective of this project is to improve sewage treatment / water supply capacities and reduce water and air pollutants in six cities--Hami, Turpan, Wusu, and Kuitun (Phase 1), Altay and Atushi (Phase 2) in XUAR, by developing sewage, water supply, centralized heat supply, and city gas facilities, thereby contributing to the improvement of the environment and living standards of residents in the six cities.

Loan Approved Amount / Disbursed Amount	Phase 1: 12,998 million yen / 12,853 million yen Phase 2: 3,802 million yen / 3,596 million yen	
Exchange of Notes Date / Loan Agreement Signing Date	Phase 1: March 2007 / March 2007 Phase 2: December 2007 / December 2007	
Terms and Conditions	Interest rate	Phase 1: 1.5% (water service) and 0.75% (sewage, heat supply, and training) Phase 2: 1.4% (water supply) and 0.65% (sewage, heat supply, city gas supply, and training)
	Repayment Period (Grace Period)	Phase 1: 30 years (water supply) and 40 years (sewage, heat supply, and training) (Ten years for all sectors) Phase 2: 25 years (water supply) and 40 years (sewage, heat supply, city gas supply, and training) (Seven years (water supply) and ten years (sewage, heat supply, city gas supply, and training))
	Conditions for Procurement	General Untied
Borrower / Executing Agency (ies)	People's Republic of China / People's Government of XUAR	
Project Completion	June 2015	
Main Contractor (s) (Over 1 billion yen)	Hubei International Trade Investment & Development Co., Ltd. (People's Republic of China)	
Main Consultant (s)	-	

(Over 100 million yen)	
Related Studies (Feasibility Studies, etc.)	[Phase 1] Hami City: Xinjiang Urban Planning and Design Research Institute Co., Ltd., January 2007; Turpan City: Xinjiang Design & Research Co., Ltd., January 2007; Wusu City: China Northeast Municipal Engineering Design & Research Institute, December 2006; and Kuitun City: China Northeast Municipal Engineering Design & Research Institute, January 2007 [Phase 2] Altay City: Xinjiang Urban Planning and Design Research Institute Co., Ltd., March 2007; and Atushi City, Xinjiang Urban Planning and Design Research Institute Co., Ltd., March 2007
Related Projects	Projects by other organizations: Asian Development Bank "Xinjiang Region Infrastructure and Environmental Improvement Project" (2006-2008)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiromi Suzuki S., IC Net Limited

2.2 Duration of the Evaluation Study

This ex-post evaluation was conducted with the following schedule.

Duration of the Study: August 2017-November 2018

Duration of the Field Studies: November 29-December 22, 2017 and June 18-27, 2018

2.3 Constraints during the Evaluation Study

During this ex-post evaluation, the evaluator was notified just before the second field study that, because of new regulations by XUAR's government to strengthen safety measures, it was essential for foreign visitors to XUAR to obtain permission from the Region's committee of the Communist Party when traveling there. The evaluator filed an application, but permission was not granted. These sudden regulations were unavoidable for safety management, but the range of information that was planned to obtain during the second field study had to be narrowed down to a necessary minimum for the ex-post evaluation and gathered remotely. Because of these constraints, regarding effectiveness for example, when the evaluation policy was formulated, it was planned to gather not only collecting information on major indicators but also information on auxiliary indicators that supported the effects of the project. However, it was limited to only information on major indicators, and as a result, analyzing indicators could not be performed in detail initially planned. In addition, one situation peculiar to the Autonomous

Region was that all public officials were required to engage in work related to countermeasures against poverty in rural areas over a long period of time; during the field study, lack of personnel at the executing agency and the frequent changes of personnel in charge at project implementation units made it difficult and inefficient to obtain accurate information about the period of project implementation and the moment of the ex-post evaluation. Furthermore, project progress reports were not compiled as required by Japanese ODA loan projects. Project completion reports were submitted only by some of the cities. In most of the cities, personnel involved in this project were not available at the time of the ex-post evaluation. These and other circumstances prevented the collection of information on the period during which the project was carried out.

3. Results of the Evaluation (Rating: A[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plan of China[4]

A) Development Plans[5]

The national development plan at the time of the appraisal was the *Eleventh Five-Year Plan* (2006-2010). This Plan considered it as its priority areas to step up environmental protection and protect and repair natural ecosystems. It set five major goals that should be achieved by 2010, and this project was especially relevant to "improving the environment in regions and cities designated as priority environmental protection areas". The *Xinjiang Uygur Autonomous Region Eleventh Five-Year Construction Project Development Plan* (2006-2010), which XUAR's government worked out following the five-year national plan, announced a goal for each sector (achieving a sewage treatment rate of 65% and a water service penetration rate of 96% and increasing the heat supply service area by 60 million m^2 through centralized heat supply) that should be attained in urban areas by 2010 by promoting infrastructure development for water supply /sewage and the air environment. The national development plan at the time of the ex-post evaluation was the *13th Five-Year Plan* (2016-2020). In particular, the project was in accordance with one of the Plan's major goals, namely the overall

2 A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

3 ③: High, ②: Fair, ①: Low

4 At the time of the appraisal, results were based on appraisal materials and the ex-ante evaluation. At the time of the ex-post evaluation, they were based on the *13th Five-Year Plan* (2016–2020).

5 For Altay and Atushi Cities in Phase 1I, in addition to the national development plan and the autonomous region development plan, the consistency between the project and the cities' development plan was also confirmed at the time of the appraisal. Therefore, at the time of the ex-post evaluation, too, the two cities' development plan was confirmed. The two cities' development plan at the time of the appraisal was the *Eleventh Five-Year Plan* (2006-2010) and that at the time of the ex-post evaluation was the *13th Five-Year Plan* (2016-2010). In each development plan, the city government announced that it would work to increase the water supply and sewage penetration rate, the sewage treatment rate, and the area of centralized heat supply as well as reduce emissions of pollutants by stepping up infrastructure development in the water supply/sewage, energy supply, and air environment sectors and set specific targets. The consistency between the two cities' development plan and the project at the time of the appraisal and the ex-post evaluation was high.

improvement of the quality of the ecological environment. In this goal, the government set specific numerical targets that should be achieved by 2020 for the quality of the air and surface water as well as emissions of major pollutants. The *Xinjiang Uygur Autonomous Region Eleventh Five-Year Construction Project Development Plan* (2011-2020), which XUAR's government formulated following the five-year national plan, established a goal that should be achieved for each sector in urban areas by 2020 (achieving a sewage treatment rate of 90% and a water supply penetration rate of 100% and stepping up construction and expansion of city gas and heating equipment). As described above, the consistency between the project and the national and regional development plans both at the time of the appraisal and the ex-post evaluation was high.

B) Environmental Protection Plans

The environmental protection plan at the time of the appraisal was the *Xinjiang Uygur Autonomous Region Eleventh Five-Year Environmental Protection Plan* (2006–2010), which indicated specific goals for environmental protection. The government aimed at reducing the amount of high chemical oxygen demand (COD) sewage discharged in the Autonomous Region in 2010 to 271,000 tons. With regard to water supply, it aimed at raising the National Category III Standard[6] achievement rate for the sources of drinking water in urban areas to 90% in 2010. Regarding the air, it aimed at improving the air environment by maintaining the quantitative and qualitative levels set by the National Air Environmental Standards[7] and promoting wider use of renewable energy such as shifting fuel to centralized heat supply and natural gas in urban areas. The environmental protection plan at the time of the ex-post evaluation was the *Xinjiang Uygur Autonomous Region 13th Five-Year Environmental Protection Plan* (2016-2020). With regard to sewage, this Plan aimed at achieving a sewage treatment rate of 90% and a treated water reuse rate of 30% in urban areas by renewing and expanding existing sewage treatment stations, drainpipes, and other facilities. As for water service, it aimed at a National Standards Category III achievement rate of 91% for the water sources of drinking water in urban areas. The specific goals for the air environment include

[6] Category I of the *Surface Water Environmental Quality Standards* (promulgated by the State Environmental Protection Administration on April 28, 2002) mainly covered water at water sources and national nature reserves; Category II first-class surface water source conservation areas for centralized domestic drinking water, habitats for rare aquatic life, spawning grounds for fish and crustaceans, feeding grounds for fries, etc.; Category III second-class surface water source conservation areas for centralized domestic drinking water, wintering places for fish and crustaceans, migration routes, fishing waters such as nurseries of marine products, and bathing places; Category IV general industrial waters and amusement waters where the human body does not directly touch water; and Category V agricultural waters and general landscape waters.

[7] The *National Air Environmental Standards* revised in 2012 (GB3095-2012), which applied at the time of the ex-post evaluation, were stricter than the standards applicable at the time of the appraisal (GB3095-1996) with regard to NO_2 emissions. In addition, instead of TSP, the revised standards required monitoring of PM2.5, fine inhalable particles with diameters that are generally 2.5 micrometers or less, and PM10, ones with diameters that are generally ten micrometers or less.

lowering the concentration of particulate matter (PM 2.5 and PM 10; refer to Footnote 7) in urban areas by 15% on a cumulative basis. As described above, the consistency between the project and the environmental protection plans at the time of the appraisal and ex-post evaluation was high.

Based on the forgoing, at the time of the appraisal and ex-post evaluation, this project agreed with the goals in the development plans and environmental protection plans of China and XUAR.

3.1.2 Consistency with the Development Needs of China[8]

At the time of the appraisal, because of remarkable population increase and rapid progress in industrialization and urbanization, the six cities in XUAR saw water supply and energy demand grow rapidly and environmental problems, including the contamination of water sources such as surface and underground water and air pollution, become increasingly serious, and developing water supply and sewage treatment infrastructure as well as centralized heat supply and city gas supply facilities was an urgent issue to address. At the time of the ex-post evaluation, the six cities covered by the project were expected to see further population growth, industrialization, and urbanization though the rate of growth therein was slowing down. In addition, as the national environmental standards became stricter, it was necessary to continue to work on infrastructure development to minimize environmental impacts. Development needs in each sector are as follows:

- Sewage: The area covered by the project had only a small amount of rain and a small number of rivers, and at the time of the appraisal, treated water was released directly to deserts, causing environmental pollution. The sewage penetration rate for the six cities was 75% for Hami (urban districts only), 70% for Wusu, 60% for Kuitun, and 75% for Altay (no information for Turpan and Atushi), and the amount of sewage was expected to grow because of population increase, making sewage infrastructure development an urgent issue to address. At the time of the ex-post evaluation, partly because of the project's contribution, the sewage penetration rate improved, at 100% for Hami (urban districts only), 90% for Turpan, 92% for Wusu, 90% for Kuitun, 90% for Altay, 98% for Atushi. Hami and Turpan, where the project helped build sewage treatment facilities, achieved Class 2 of the National

[8] At the time of the appraisal, development needs were based on materials provided by JICA, and at the time of the ex-post evaluation, they were based on materials provided by the executing agency.

Sewage Treatment and Discharge Standards[9] and Kuitun, Altay, and Atushi attained Class 1 B. On the other hand, owing to urban development and population increase, the amount of sewage is expected to grow in the future, and it is necessary to increase the treatment rate and the penetration rate. Therefore, development needs continue to be high.

- Water service: At the time of the appraisal, the water service penetration rate was 73% for Hami, 80% for Turpan, 72% for Wusu, 67% for Kuitun, 85% for Altay, and 0% for Atushi (only the western urban area where distribution pipes were not installed), all lower than the average water service penetration rate of 87% in China's urban areas. It was predicted that the water supply capacity of the existing water purification plants was unable to meet the growing water demand as the population increased and expanding the water purification plants and improving water pipe networks were urgent issues to address. At the time of the ex-post evaluation, partly because of this project's contribution, all cities achieved a penetration rate of 100% except Turpan whose rate was 98%. The quality of groundwater improved from Class 5 at the time of the appraisal to Class 2. But population growth and urbanization are expected to continue to progress in the future, and if this is taken into consideration, there will continue to be needs for equipment renewal and expansion to maintain the water service penetration rate at 100% in the future.
- Air: At the time of the appraisal, residents used less energy-efficient small coal-burning boilers without a dust collector and a desulfurization system for winter heating. With regard to the concentration of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and total suspended particles (TSP) in the air, the six cities failed to meet the national Class 2 standard, which should be satisfied in residential areas mainly during winter. In addition, Altay City had a city gas penetration rate of 56%, much lower than the average rate of 89% for cities in XUAR, and coal used in the civilian sector was also a source of air pollution, making it an urgent issue to address to develop centralized heat supply and city gas facilities. By the time of the ex-post evaluation, because of the progress made in developing centralized heat supply facilities, the number of small coal-burning boilers had decreased substantially, and the six cities met the national standard with regard to the average annual amount of SO_2, NO_2, and other major air pollutants emitted. But in 2016, the monitoring of PM10 instead of

[9] In the *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plants* (GB18918-2002), the basic principle of Class 1 Standard A is to turn treated water into water to be reused. This applies when treated water is used for urban landscape water and general reuse water by letting it into rivers and lakes whose dilution ability is low. Class 1 Standard B applies when treated water is allowed to flow into surface water Category III functional waters, etc. Class 2 Standard applies when treated water is allowed to flow into surface water Category IV and V functional waters. Class 3 Standard applies if, in areas other than priority management valleys and water source reserves, sewage is treated based on local economic conditions and water pollution control requirements. Class 1 Standard A is applicable if water treated at urban sewage treatment stations is discharged to closed or half-closed waters such as priority valleys, lakes, and dams designated by the state and provinces. In the case of GB3838 surface water Category III functional waters (water source reserves for drinking water and swimming areas) and GB3097 seawater Category II functional waters, Class 1 Standard B is applicable (Source: The Sino-Japan Friendship Centre for Environmental Protection).

TSP became mandatory, and Turpan and Kuitun Cities failed to meet the national standard for the fine inhalable particles. The number of small coal-burning boilers used was not reduced to zero, and there continued to be high development needs for environmental improvement.

As explained above, development needs related to water service, sewage, and the air were high both at the time of the appraisal and the ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

Japan's ODA policy toward China at the time of the appraisal was *the Economic Cooperation Plan for China* (2001–2006) as well as *the Implementation Policy for Overseas Economic Cooperation Operations* (2005-2007) and *the FY 2006 Implementation Policy for Operations by Country* of the Japan International Cooperation Agency (JICA) (former Japan Bank for International Cooperation or JBIC). In t*he Economic Cooperation Plan for China* (2001-2006)[10], the goal of Japanese ODA for China was to place emphasis on the protection of the environment and ecosystems whose pollution and destruction had become serious, as well as the improvement of people's livelihood and social development in inland regions, and six priority areas were listed. Particularly, with regard to "cooperation towards coping with global issues such as environmental problems", the Plan clearly stated that Japan would support China's efforts to introduce new types of renewable energy and energy conservation, which is consistent with the project. *The Implementation Policy for Overseas Economic Cooperation Operations* (2005-2007) stated that JICA would help cope effectively with environmental problems and improve the lives of people in developing countries and that it would also contribute actively to solution of problems such as global warming, and this indicated that the Policy was consistent with the project. *The FY 2006 Implementation Policy for Operations by Country*[11] emphasized environmental protection. This is aiming at improving the overall water use efficiency in water service and sewage treatment, including infrastructure development and human resource development. In terms of the air environment, the Policy aimed at developing centralized heat supply facilities, implementing a natural gas project, introducing the monitoring of the air environment, and stepping up support in the intangible aspects of these undertakings, and all these were highly consistent with the project.

3.1.4 Appropriateness of the Project Plan and Approach

In this project, with the revision of the national sewage discharge standards in 2016, all sewage treatment plans in urban areas were newly required to meet the National Standard

[10] Ministry of Foreign Affairs' *Economic Cooperation Plan for China* (2001-2006)
[11] This is based on materials provided by JICA.

Class 1 A[12]. In Turpan City, mainly because of an unexpected increase in industrial wastewater, it became difficult to meet the national water quality standard using the technology provided by the project, and the treatment plant built under the project discontinued its operation in March 2017. During the on-site inspection at the time of the ex-post evaluation, the evaluator found that the treatment plant was not in operation and that the construction of a new treatment plant capable of achieving to meet the National Standard Class 1 A using the anaerobic-oxic (AO) process[13] was under way. The sewage treatment plant built under the project, which used the lagoon treatment method[14], comprised three oxidation ponds where the oxidation process was performed and one sedimentation basin, and it can be said that appropriate technology was selected to meet the nature of sewage expected at the time of the appraisal. Although the treatment plant installed by the project, including aeration equipment etc., were not in operation at the moment of the ex-post evaluation, these will be used in the new treatment plant. Especially the oxidation pond built under the project will be used as a sedimentation basin for the new treatment plant, and it is planned that treated water will be reused for irrigation through natural filtration in this sedimentation basin. Therefore, this does not lower the evaluation of the project.

As described above, both at the time of the appraisal and the ex-post evaluation, the project was relevant to China's national development plan as well as XUAR's construction project development plan and environmental protection plan, which aimed at developing infrastructure for the livelihood of people to improve the overall quality of water service, sewage, centralized heat supply, and city gas service, as well as the natural environment, including water and the air. In addition, it also fully relevant to the development needs of China and XUAR at the time of the appraisal and the ex-post evaluation and Japan's ODA policy toward China at the time of the appraisal. Therefore, its relevance is high.

3.2 Efficiency (Rating:②)

3.2.1 Project Outputs

This project involved construction of sewage, water supply, centralized heat supply, and city

[12] This National Standard required all sewage treatment plants in urban areas to uniformly meet the Class 1 A requirements, but since May 2018, they have been allowed to meet only the Class 1 B requirements according to the nature of sewage in the city concerned.

[13] The anaerobic-oxic process refers to a high-level treatment method aimed mainly at removing phosphorus, and the reactor consists of two tanks: an anaerobic one and an aerobic one. The former has a churning machine to mix activated sludge (Source: Yokohama City Environmental Planning Bureau's website: http://www.city.yokohama.lg.jp/kankyo/).

[14] In the lagoon treatment method, sewage and wastewater are retained for five to 30 days in a pond called the "oxidation pond" where they are treated through self-purification using algae, bacteria, etc. It incurs less treatment and maintenance costs than the AO process but requires a huge site area and causes problems such as the generation of offensive smells because water is retained for a long period of time (Source: National Institute for Land and Infrastructure Management)

gas supply facilities, repair of existing ones, and procurement of materials and equipment for them, as well as provision of training in the six cities of XUAR. In Phase 1, facilities were built and equipment was procured for four cities (Hami, Turpan, Wusu, and Kuitun) as a separate project using domestic funds, and for this and other reasons, the project outputs were mainly reduced. In Phase 2, the project was carried out for Altay and Atushi Cities as planned (Table 1).

Table1 Output: Development of facilities and procurement of equipment

City /Sector	At the moment of appraisal		Actual	Existence of difference (±10%) and reason
	Content	Quantity		
Hami City				
Sewage	Construction and repair of drainage pipe system	74.8km	49.8km	Pipe diameter was expanded, and length was shortened*
Water supply	Construction of water conveyance system	26.5km	31.4km	No changes to the conveyance system from the water source to the water plant. From the plant to the water supply pipe network, length was increased from 9.7km to 14.3km in line with the actual situation
	Construction of new water treatment plant	50,000m^3/day	As planned	—
	Construction of supply pipe system and repair of existing one	94.3km	99km	Total length was increased in line with the actual situation
Central heating supply	Construction of heating supply plant	3×29MW	As planned	—
	Construction of new heating power supply pipe network	56.4km	21.3km	The project constructed only the primary pipe network
	Construction of heat exchange stations	31 places	As planned	—
Turpan City				
Sewage	Construction and repair of drainage pipe system	50.4km	40.4km	Pipe diameter was expanded, and length was shortened*
	Construction of new sewage treatment plant	20,000m^3/day	As planned	—
	Repair of existing sewage treatment plant	No detailed information	No detailed information	No detailed information was provided
Water supply	Construction of water conveyance system	51.7km	46.9km	
	Construction of supply pipe system and repair of existing one	77.7km	69.8km	Pipe diameter was expanded, and length was shortened*
Central heating supply	Construction of heating supply plant	3×46MW	As planned	—
	Construction of new heating power supply pipe network	26.0km	22.63km	Quantity was adjusted as demand was slightly lower than expected
	Construction of heat exchange stations	25 places	21 places	
Wusu City				
Sewage	Construction and repair of drainage pipe system	71.3km	71.6km	—
Water supply	Construction of supply pipe system and repair of existing one	73.9km	67.4km	Adjusted according to the existing situation at the moment of the detailed design
Kuitun City				
Sewage	Construction and repair of drainage pipe system	73.2km	50.1km	The difference was conducted as a separate project
	Construction of new sewage	60,000m^3/day	As planned	—

	treatment plant Expansion of existing sewage treatment plant	 The existing sewage plant with a capacity of 40,000m^3/day was expanded by adding an activated sludge tank	As planned	—
Water supply	Construction of supply pipe system and repair of existing one	81.0km	82.0km	—
Central heating supply	Construction of heating supply plant Construction of new heating power supply pipe network Construction of heat exchange stations	3×46MW 45.5km 30 places	2×72MW 47.4km 32 places	Increased but difference within ±10% Increased but difference within ±10% Increased but difference within ±10%
Altay City				
Sewage	Construction and repair of drainage pipe system Construction of new treatment pond	59.8km 4.86 million m^3	As planned As planned	— —
Water supply	Construction of new water intake facility Construction of water conveyance system Construction of new water treatment plant Construction of supply pipe system and repair of existing one	16,000m^3/day 19.8km 16,000m^3/day 20.0km	As planned As planned As planned As planned	— — — —
Central heating supply	Construction of heating supply plant Construction of new heating power supply pipe network Construction of heat exchange stations	4×14MW 14.2km 14 places	As planned As planned As planned	— — —
City gas supply	Construction of LNG gasification facility Construction of gas supply pipe network	3.6 million Nm^3/year 15km	As planned As planned	— —
Atushi City				
Sewage	Construction and repair of drainage pipe system Construction of new sewage treatment plant Expansion of existing sewage treatment plant	67.86km 3,500m^3/day 8,000m^3/day	As planned As planned As planned	— — —
Water supply	Construction of supply pipe system and repair of existing one	22.7km	As planned	—
Natural gas heating supply	Construction of heating supply plant Construction of new heating power supply pipe network Construction of medium pressure fuel gas supply network	28×1.4MW 25×2.8MW 8×4.2MW 41.6km 17.23km	As planned As planned As planned As planned As planned	— — — — —

Source: JICA provided documents for the time of appraisal. Actuals were provided by the executing agency.

*: According to the Executing Agency, the water supply and sewage pipes that were constructed with the project were primary pipes, even though the diameter was widened, and the length shortened, the planned and actual water distribution area (water supply) and swage collection area (sewage) did not differ significantly.

Training for the executing agency in water supply and sewage business, heat supply business, and city gas supply business was planned in Japan. In Phase 1, technical training in water supply, sewage, waste disposal, and heating supply was provided in Hokkaido and Tokyo from October 18 to 27, 2008, and a total of eleven people from four cities participated in the program. In Phase 2, training was not provided because the regulations for the departure of public officials from China became stricter.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned total project cost at the time of the appraisal was 18,712 million yen (foreign currency: 14,144 million yen; domestic currency: 4,568 million yen; and the cost covered by ODA loan: 12,998 million yen). The actual total project cost was 15,408 million yen (foreign currency: 10,586 million yen; domestic currency: 4,822 million yen; and the cost covered by ODA loan: 10,586 million yen), 82% of the initially planned level, and this means that the cost remained within the initially planned range (Refer to Table 2). This was because for Turpan City, the actual cost exceeded the initial plan, at 127% of the initially planned level, but for the other three cities, the actual cost went below the initial plan because of reduced outputs.

Table 2 Project Cost: Phase 1

(Unit: million yen)

Item		Appraisal			Actual		
		Foreign Currency	Domestic Currency	Total	Foreign Currency	Domestic Currency	Total
Hami City	Total	3,992	839	4,831	1,964	849	2,813 (60% compared to plan)
	ODA loan portion	3,992	0	3,992	1,964	0	1,964
Turpan City	Total	3,151	616	3,767	3,301	1,477	4,778 (127% compared to plan)
	ODA loan portion	3,151	0	3,151	3,301	0	3,301
Wusu City	Total	921	153	1,074	858	176	1,034 (96% compared to plan)
	ODA loan portion	921	0	921	858	0	858
Kuitun City	Total	4,299	1,328	5,627	4,447	819	5,266 (94% compared to plan)
	ODA loan portion	4,299	0	4,299	4,447	0	4,447
Total 4 cities	Total	12,363	2,936	15,299	10,570	3,321	13,891 (91% compared to plan)

	Sewage	4,089	925	5,015	3,893	753	4,647
	Water Supply	4,137	778	4,934	3,123	1,225	4,347
	Centralized heat supply	3,571	1,073	4,644	2,959	1,184	4,894
	ODA loan portion	12,363	0	12,363	10,570	0	10,570
Training	Total	16	0	16	16	0	16
	ODA loan portion	16	0	16	16	0	16
Price escalation	Total	607	0	607	0	0	0
	ODA loan portion	607	0	607	0	0	0
Contingencies	Total	649	147	796	0	0	0
	ODA loan portion	13	0	13	0	0	0
Interest rate during construction	Total	508	109	617	0	832	832
	ODA loan portion	0	0	0	0	832	832
Land acquisition cost	Total	0	233	233	0	0	0
	ODA loan portion	0	0	0	0	0	0
Administration cost	Total	0	1,143	1,143	0	670	670
	ODA loan portion	0	0	0	0	670	670
Total Project Cost		14,144	4,568	18,712	10,586	4,822	15,408 (82% compared to plan)
ODA loan portion		12,998	0	12,998	10,586	0	10,586

Source: JICA provided documents for Appraisal. Executing agency and JICA provided documents for Actuals.
Note 1: Exchange rate at the moment of appraisal: 1 USD=117 yen, 1USD=7.93 yuan, 1 yuan=14.8 yen / price escalation rate: foreign currency 1.7%, domestic currency 0.0% / contingency: 5.0% /Period of cost calculation: December 2006. Exchange rate at the moment of the ex-post evaluation 1yuan=14.47yen (monthly average rates for March 2007 to June 2015).
Note 2: Due to rounding numbers do not necessarily add up to totals.

The planned total project cost for Phase 2 was 6,158 million yen (foreign currency: 4,043 million yen; domestic currency: 2,115 million yen; and the cost covered by ODA loan: 3,802 million yen). The actual total project cost was 5,355 million yen (foreign currency: 3,185 million yen; domestic currency: 2,170 million yen; and the cost covered by ODA loan: 3,596 million yen), remaining within the initial planned range, at 87% of the initially planned level (Table 3). One major reason was that particularly in Atushi City, which was in a tighter financial situation compared to other cities, conducted strict project cost control such as labor cost control, thus the actual cost went well below the initial planned level, at 63%.

Table 3 Project Cost: Phase 2

(Unit: million yen)

Item		Appraisal			Actual		
		Foreign Currency	Domestic Currency	Foreign Currency	Domestic Currency	Foreign Currency	Domestic Currency
Altay City	Total	2,002	827	2,829	2,335	1,737	4,072 (150% compared to plan)
	ODA loan portion	2,002	0	2,002	2,335	0	2,335
Atushi City	Total	1,559	464	2,023	839	433	1,272 (63% compared to plan)
	ODA loan portion	1,559	0	1,559	839	0	839
Total 2 cities	Total	3,561	1,291	4,852	3,174	2,170	5,344 (110% compared to plan)
	Sewage	No detailed information available			1,566	924	2,490
	Water Supply				514	351	865
	Centralized heat supply				853	518	1,371
	City gas				241	377	618
	ODA loan portion	3,561	0	3,561	3,174	0	3,174
Training	Total	4	0	4	0	0	0
	ODA loan portion	4	0	4	0	0	0
Price escalation	Total	214	0	214	0	0	0
	ODA loan portion	214	0	214	0	0	0
Contingencies	Total	177	65	242	0	0	0
	ODA loan portion	11	0	11	0	0	0
Interest rate during construction	Total	75	0	75	0	0	0
	ODA loan portion	0	0	0	0	0	0
Commitment Charge	Total	12	0	12	11	0	11
	ODA loan portion	12	0	12	11	0	11
Land acquisition cost	Total	0	232	232	0	0	0
	ODA loan portion	0	0	0	0	0	0
Administration cost	Total	0	527	527	0	0	0
	ODA loan portion	0	0	0	0	0	0
Total Project Cost		4,043	2,115	6,158	3,185	2,170	5,355 (87% compared to plan)
ODA loan portion		3,802	0	3,802	3,185	411	3,596

Source: JICA provided documents for Appraisal. Executing Agency provided documents for Actuals.

Note 1: Exchange rate at the moment of appraisal: 1USD=121yen, 1USD=7.74 yuan, 1yuan=15.6 yen /price escalation rate: foreign currency 2.4%, domestic currency 0.0% / contingency cost rate: 5.0% / Cost calculation period: June 2007. Exchange rate at the moment of the ex-post evaluation 1yuan=13.59 yen (monthly average rates for December 2007 to September 2013).
Note 2: Due to rounding numbers do not necessarily add up to totals

As described above, the project cost for Phase 1 remained within the initially planned range, at 82% of the initially planned level, and this corresponded with the decrease in project outputs. Phase 2 saw no change in project outputs, but mainly because of project cost control by Atushi City, the cost remained at 86% of the initially planned level.

3.2.2.2 Project Period[15]

At the time of the appraisal, the planned project period for Phase 1 was 68 months (five years and eight months) from May 2007 to December 2012. The actual project period was 98 months (eight years and two months) from March 2007 to June 2015. If the sewage development in Kuitun City is excluded, the project period remained within the initially planned range. However, because Kuitun's sewage development took about two years and six months longer than initially planned, the project period for Phase 1 exceeded the initial plan, at 144% of the initially planned level.

At the time of the appraisal, the planned project period for Phase 2 was 66 months (five years and six months) from January 2008 to June 2013. The actual project period was 70 months (five years and ten months) from December 2007, when the loan agreement was signed, to September 2013. Because the development of centralized heat supply facilities in Altay City took three months longer than initially planned, the actual project period for Phase 2 exceeded the initial plan, at 106% of the initially planned level.

As explained above, in Phase 1, the project remained within the initial plan except the sewage development project in Kuitun City, and this corresponded with the decrease in project outputs. But since the project period exceeded the initial plan despite decreased outputs from sewage development in Kuitun, the overall project period for Phase 1 exceeded the initial plan. In Phase 2, the project outputs were as planned, but the actual project period slightly exceeded the initial plan.

3.2.3 Results of Calculations of Internal Rates of Return (Reference Only)

In this project, at the time of the appraisal, Financial Internal Rates of Return (FIRR) were calculated by city and by project, and they were recalculated at the time of the ex-post evaluation. The results of calculations for projects on which information could be collected are as described below.[16] In Phase 1, a recalculation of FIRR for the centralized heat supply

[15] The completion of the project was defined as the expiration of the guarantee period.
[16] The assumptions for calculations of FIRR at the time of the appraisal were as described below. Costs consisted of

project in Hami at the time of the ex-post evaluation indicated that it was minus 0.02% while it was 6% at the time of the appraisal. This was attributed to the slowdown of revenue growth because the project cost was kept lower than at the time of the appraisal since the executing agency could not expect fare revisions. For Turpan, FIRR for the centralized heat supply project was recalculated. The project cost was larger than at the time of the appraisal, but while FIRR was 9.6% at the time of the appraisal, it was more favorable at the time of the ex-post evaluation, at 17% because more revenue was anticipated owing to growth in the number of users. Similarly, while FIRR for the centralized heat supply project in Kuitun was 6.3% at the time of the appraisal, it was 19% at the time of the ex-post evaluation. On the other hand, FIRR for the sewage project was 4.7% at the time of the appraisal but was minus 8% at the time of the ex-post evaluation because there was no plan for fare revisions, meaning that revenue would remain sluggish. For Phase 2, FIRR for Altay's centralized heat supply and city gas projects and that for Atushi's sewage project were recalculated. While FIRR for Altay's centralized heat supply project was 6.2% at the time of the appraisal, it was minus 2% at the time of the ex-post evaluation. The reason was that as the growth in maintenance management costs exceeded the growth in fare revenue, initial investments would not be recovered unless the fares were revised. Regarding city gas, while FIRR was 4.4% at the time of the appraisal, it was favorable at the time of the ex-post evaluation, at 19%, because revenue was expected to grow as the number of users increased in the future. FIRR for Atushi's sewage project was 10.4% at the time of the appraisal, but it was minus 9% at the time of the ex-post evaluation because the executing agency could not expect fare revisions for more revenue, and in addition, because additional investments were planned to upgrade the treatment plant in 2019.

The project outputs for Phase 1 were reduced mainly because, by the time of detailed design, demand had not increased more than projected at the time of the appraisal. In addition, since in some projects it took more time to follow fund-raising procedures based on ODA loans than

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project costs and operation/maintenance management costs, and benefits comprised fee revenue, and the project life was 20 years. At the time of the ex-post evaluation, the evaluator attempted to use the same assumptions, but available information was not that which focused on the project, but which was collected for the executing agency as a unit (same as one that was obtained from its financial statements). In the first place, there was no information on the project's revenue, nor was there any information on renewal costs. For these and other reasons, it was difficult to recalculate FIRR at the time of the ex-post evaluation, and the project's FIRR at the time of the appraisal was 4.4% for sewage and 6.0% for water supply in Hami; 10.3% for sewage and 7.5% for water supply in Turpan; 4.5% for sewage and 6.2% for water supply in Wusu; 6.3% for sewage in Kuitun; 4.5% for sewage in Altay; and 9.4% for water supply and 8.9% for centralized heat supply in Atushi. In Turpan, the sewage treatment plant built under the project discontinued operation in 2017, and in addition, since it will be used as a final reservoir for a new purification plant in the future, FIRR was not recalculated for the city's sewage project at the time of the ex-post evaluation. For Wusu, FIRR was not calculated at the time of the ex-post evaluation because information was not provided. For Atushi's centralized heat supply project, the evaluator tried to recalculate FIRR using information that she obtained from the executing agency, but as a result, she found FIRR incalculable. The maintenance management costs obtained were extremely high, suggesting that they might include maintenance management costs for projects other than the present one. Therefore, the result was probably that if the maintenance management cost obtained applied, it would be extremely difficult to recover initial investments in 20 years.

when funds were domestically procured, some facilities were built under separate projects using domestic funds, and this led to reduced project outputs. Moreover, the project cost was strictly controlled in Phase 2 as described under "3.2.2.1 Project Cost", enabling the project cost to remain within the initially planned range in both phases. In the two phases, the project period exceeded the initial plan : in Phase 1, the sewage project in Kuitun was prolonged, and in Phase 2, the centralized heat supply development project in Altay was slightly delayed.

As described above, although the project cost remains within the plan, its period exceeded the plan. Therefore, efficiency of the project is fair.

3.3 Effectiveness and Impacts[17] (Rating:③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

The outcome of this project is "to improve sewage treatment /water supply capacity and reduce water and air pollutants." In regard to targets of the major indicators for water and sewer service, centralized heat supply and city gas (Phase 2 only), a total of four cities was set in Phase 1 and a total of two cities was set in Phase 2. In addition, the target year for both phases was set at the time of the project completion. Evaluation was carried out in the ex-post evaluation based on the definition at the time of the appraisal.[18]

A) Sewage Works (Table 4)

During Phase 1, among five major indicators, (1) sewage treatment population, (2) sewage treatment amount and (3) sewage treatment rate in 2012, which was the time of project completion, achieved more than 80% of the target, and actual from 2015 to 2017 tended to increase every year. However, as (2) sewage treatment amount achieved 86% of the target at the time of the project completion, the target reached 88% as of 2017, and has not reached 100%. That is because Hami City is the only city that achieved a low rate, 54%. In Hami City, the number of residents on industrial estates that was estimated at the time of the appraisal is decreasing, which means that the sewage treatment amount is not increasing as much as expected. As for (4) Biochemical Oxygen Demand[19] (hereinafter referred to as BOD) density

[17] Sub-rating for Effectiveness is to be put with consideration of Impacts.
[18] In addition to the main indicators, the ex-post evaluation is made for the purpose of further detailed operation effects of project; therefore, supplementary indicators of each sector were also set. However, the 15 company units (in total) that took responsibilities of the project operation were undisciplined, and the evaluation was made exclusively on the main indicators.
[19] Biochemical oxygen demand is the amount of oxygen consumed when organic substances in water are dissolved by activity of aerobic microorganisms. A higher value means water pollution is significant. (Source: Japan Society on Water Environment)

of effluent related to water quality and (5) COD[20] density of effluent, Hami City, Wusu City and Kuitun City achieved the target; however, Turpan City achieved BOD density at the time of the project completion but density increased between 2015 and 2017. In regard to COD density of effluent, Turpan City has failed to achieve the target since the time of project completion. According to the sewage company in Turpan City, the city used its geographic superiority to promote the construction of economic development areas, which change sewage properties and it is difficult to treat sewage with existing treatment methods. This is why BOD and COD density of effluent did not reach the target. The company took this situation seriously and constructed a new treatment facility with an intention of starting to operate at the end of 2008. (Refer to "3.1.4. Appropriateness of the Project Plan and Approach" for details) Regarding sewage works of Phase 1 in general, project effect has been realized since the time of project completion and effectiveness is high.

Table 4 Operation and Effect Indicators: Sewage

(a) Phase 1

Indicator	Reference Value 2007	Target Value Moment of project completion	Actual Target achievement rates between parenthesis			
			2012 Project Completion	2015 3 years after project completion	2016 4 years after project completion	2017 5 years after project completion
(1) Population with sewage treatment (10,000 persons)	42.3	78.8	73.0 (93%)	82.4 (105%)	83.1 (104%)	87.6 (111%)
(2) Amount of sewage treated (10,000 m^3 /day)	10.1	23.5	20.1 (86%)	20.2 (86%)	20.2 (87%)	20.6 (88%)
(3) Sewage treatment rate (%)	63.0	97.9	98% (100%)	99% (101%)	100% (101%)	100% (101%)
(4) BOD concentration of effluent (mg /L)	18-121	≦20-36	20-35 (100%)	21-*38* 3 out of 4 cities achieved the target	20-*41* 3 out of 4 cities achieved the target	20-*58* 3 out of 4 cities achieved the target
(5) COD concentration of effluent (mg /L)	59-226	≦60-100	40-*110* 3 out of 4 cities achieved the target	42-101 3 out of 4 cities achieved the target	41-*124* 3 out of 4 cities achieved the target	40-*141* 3 out of 4 cities achieved the target

[20] Chemical oxygen demand is the amount of oxygen consumed when organic substances in water are oxidized with oxidizing agent. A higher value means water contains lots of organic substances, etc. and the pollution burden is high. (Source: Japan Society on Water Environment)

(b) Phase 2

Indicator	Reference Value 2007	Target Value Moment of project completion	Actual Target achievement rates between parenthesis			
			2013 Project Completion	2015 2 years after project completion	2016 3 years after project completion	2017 4 years after project completion
(1) Population with sewage treatment (10,000 persons)	9.7	19.0	*13.9 (73%)*	*14.7 (77%)*	*15.0 (79%)*	15.1 (80%)
(2) Amount of sewage treated (10,000 m^3 /day)	2.3	5.5	*3.5 (63%)*	4.4 (80%)	4.2 (76%)	4.3 (77%)
(3) Sewage treatment rate (%)	70.0	98.0	90.0% (92%)	95.0% (103%)	97.5% (103%)	99.0% (102%)
(4) BOD concentration of effluent (mg /L)	70-90	≦40-80	30-68 (100%)	29-65 (100%)	32-69 (100%)	28-60 (100%)
(5) COD concentration of effluent (mg /L)	80-150	≦80-150	15-130 (100%)	26-128 (100%)	19-115 (100%)	16-120 (100%)

Source: Reference and target values from JICA provided documents. Actuals from documents provided by the Executing Agency.
Note: Italics indicate that target achievement rate is fair (more than 50%, less than 80%).

In regard to Altay City and Atushi City in Phase 2, (1) sewage treatment population and (2) sewage treatment amount among five indicators achieved more than 50% and less than 80%, which is the level of fair. According to the executing agency, this was because prediction of population increase was overestimated at the time of the appraisal. In particular, Atushi City delayed its development the most among the six cities and the population did not reach the population increase at the time of the appraisal; therefore, sewage treatment population and sewage treatment amount did not grow as much as expected. As for (3) sewage treatment rate, (4) BOD density of effluent and (5) COD density of effluent, targets were achieved, and it is confirmed that some effect was realized at the time of the project completion.

In general, the sewage project for both phases demonstrated its expected effect.

B) Waterworks project (Table 5)

The major indicators of the waterworks project are (1) service coverage ratio of water supply system, (2) population served and (3) water supply amount. As of 2012, all indicators of Phase 1 achieved more than 90% of target values and project effect was evident. The reason why the achievement of population served in 2012 was 90% is because three cities, Hami City, Wusu City and Kuitun City reached 100% of the target as of 2012, while the population of Turpan

Hami Water Treatment Plant No.4: High-speed Flocculation and Sedimentation Pond

City alone increased more slowly than estimated; therefore, the achievement of the target was 57%, which is the level of fair. However, the achievement increased to 97% in 2017.

Table 5 Operation and Effect Indicators: Water Supply

(a) Phase 1

Indicator	Reference Value 2007	Target Value Moment of project completion	Actual Target achievement rates between parenthesis			
			2012 Project Completion	2015 3 years after project completion	2016 4 years after project completion	2017 5 years after project completion
(1) Water supply coverage rate (%)	72.7	99.6	99.7 (100%)	100 (100%)	100 (100%)	100 (100%)
(2) Population served (10,000 persons)	46.0	79.3	71.6 (90%)	85.6 (108%)	90.7 (114%)	97.0 (122%)
(3) Water supply amount (10,000 m^3 /day)	18.2	30.0	39.9 (111%)	43.4 (121%)	44.9 (125%)	46.9 (131%)

(b) Phase 2

Indicator	Reference Value 2007	Target Value Moment of project completion	Actual Target achievement rates between parenthesis			
			2013 Project Completion	2015 2 years after project completion	2016 3 years after project completion	2017 4 years after project completion
(4) Water supply coverage rate (%)	85	100	100 (100%)	100 (100%)	100 (100%)	100 (100%)
(5) Population served (10,000 persons)*	6.7	10.7 (out of which 8.5 is Altay)	*5.6 (52%) (Only Altay 66%)*	*5.5 (51%) (Only Altay 65%)*	*5.7 (53%) (Only Altay 67%)*	*5.8 (54%) (Only Altay 68%)*
(6) Water supply amount (10,000 m^3 /day)	2.1	4.1	4.7 (114%)	5.1 (123%)	5.2 (128%)	5.3 (130%)

Source: Reference and target values from JICA provided documents. Actuals from documents provided by the Executing Agency.

Note: Italics indicate that target achievement rate is fair (more than 50%, less than 80%).

*: Actual values of population served in Atushi City were not provided even in the second field study. Therefore, the only actual values for Altay City are indicated in the Table.

As for Phase 2, (1) service coverage ratio of water supply system and (3) water supply amount at the time of the project completion in 2013 reach more than 100% of the achievement. As Atushi City did not submit the actual figures of (2) population served,[21] Table 5 (b) mentioned actual figures of Altay City only. As the target of the same indicator in Altay City is 85,000, even Altay City alone, the achievement of the target value was 66% as

[21] When the second local survey was conducted, there were circumstances where resubmission of indicators of this ex-post evaluation was postponed because of labor shortage and frequent replacement of personnel in Atushi City.

of 2013 and 68% at the time of the ex-post evaluation, which is the level of fair[22]. According to the executing agency, this is because the rate of population increase in the feasibility study was overestimated. Among the three major indicators, only achievement of population served is at the level of fair, which proves that Phase 2 demonstrates its effect.

Overall, both water and sewer service demonstrated their expected effect.

C) Centralized heat supply and city gas (Table 6)

As Phase 1 included centralized the heat supply project only, the major indicators were (1) number of beneficiaries, (2) SO_2 emission reduction, (3) nitrogen oxides (herein after referred to as NO_X) emission reduction and (4) TSP emission reduction. As for the achievement of targets at the time of the project completion in 2012, all indicators achieved more than 100%. Likewise, the achievement of targets by city is 100% and project effectiveness is high in all four cities.

Table 6 Operation and Effect Indicators: Central Heating Supply and City Gas

(a) Phase 1

Indicator	Reference Value 2007*	Target Value Moment of project completion			
		2012 Project Completion	2015 3 years after project completion	2016 4 years after project completion	2017 5 years after project completion
(1) Beneficiary Population (10,000 persons)	28	280 (101%)	36 (120%)	38 (126%)	41 (147%)
(2) SO_2 emission reduction amount (t/year)	1,186	1,258 (106%)	1,586 (129%)	1,587 (134%)	1,539 (130%)
(3) NO_X emission reduction amount (t/year)	619	642 (104%)	895 (132%)	866 (144%)	797 (129%)
(4) TSP emission reduction amount (t/year)	20,834	21,871 (105%)	26,543 (129%)	27,825 (127%)	26,253 (126%)

(b) Phase 2

Indicator	Reference Value 2007	Target Value Moment of project completion			
		2013 Project Completion	2015 2 years after project completion	2016 3 years after project completion	2017 4 years after project completion
(1) Population served with heat supply (10,000 persons)	Approx. 9.2	13.02 (142%)	14.1 (153%)	14.4 (157%)	14.6 (158%)
(2) Population served with city gas (10,000 persons) (only Altay City)	Approx. 5.5	*4.2 (77%)*	4.6 (84%)	4.8 (88%)	5.0 (92%)
(3) SO_2 emission reduction amount (t/year)**	480	402 (84%)	472 (98%)	*No information*	*No information*
(4) NO_X emission reduction amount (t/year)**	845	636 (75%)	783 (93%)	*No information*	*No information*

[22] Assuming Atushi City achieves 100% of the target that is 22,000 people, achievement in 2013 was 73% and effectiveness is fair.

(5)	TSP emission reduction amount (t/year)**	3,530	*1,890 (54%)*	*2,367 (67%)*	*No information*	*No information*
(6)	Coal usage reduction amount (t/year)	49,050	45,600 (93%)	45,705 (93%)	46,400 (95%)	46,500 (95%)

Source: Reference and target values from JICA provided documents. Actuals from documents provided by the Executing Agency.
Note: Italics indicate that target achievement rate is fair or low.
*: When target values for Phase 1 were checked in the Detailed Design, it was found that the values differed to those indicated in the Ex-ante Evaluation Table. Therefore, these were corrected after discussions with the Executing Agency.
**: Actual values for 2016 and 2017 were not provided based on the reason that these are not included in the New National Emission Standards.


City Gas Project (Altay City)


Boiler from the Central Heating Supply (Natural Gas) (Atushi City)

As for Phase 2, in addition to development of centralized heat supply facilities, city gas facilities are developed. (1) number of beneficiaries, (2) beneficiaries of city gas supply, (3) SO_2 emission reduction, (4) NO_X emission reduction, (5) TSP emission reduction and (6) coal use reduction are set as the major indicators. Looking at the achievement of target values at the time of the project completion in 2013, (1), (3) and (6) achieved more than 80% but (2), (4) and (5) achieved more than 50% and less than 80%, which is the level of fair. However, as for (2) beneficiaries of city gas supply, the number tended to increase after the project completion, increasing to 92% at the time of the ex-post evaluation. As for (3), (4) and (5) which indicate effect of improvement in the atmospheric environment, these achieved more than 90% in 2015 except (5), and the effectiveness of the central heat supply and city gas project of Phase 2 can be recognized.

In general, effectiveness of the centralized heat supply project in both phases and city gas project in Phase 2 emerged generally as planned.

Overall, in regard to the sewage project, waterworks project and centralized heat supply project of Phase 1 and Phase 2 and the city gas project of Phase 2, the achievement of targets for the major indicators is moderate or high. Although the achievement is moderate, it has tended to increase every year since 2015 and achieved more than 80% at the time of the ex-post evaluation in 2017; therefore, it is recognized that the project in both phases is generally effective as expected.

3.3.1.2 Qualitative Effects (Other Effects)

The qualitative effects of this project are "to improve the living environment of residents and living standard by improving sewage treatment capacity and water supply capacity in the six target cities." As this can be understood as effectiveness at the impact level of this project, it is evaluated in "3.3.2.1 Intended Impacts."

3.3.2 Impacts

3.3.2.1 Intended Impacts

The impacts of this project are "to contribute to improvement of the environment in six cities and improvement of residents' living standards."

As the indicator to grasp this impact quantitatively, it is estimated in Phase 2 alone that approximately 110,000 tons of carbon dioxide (hereinafter referred to as CO_2) per year are reduced as a total of the two cities. As actual figures, 113,000 tons were reduced in 2015 and 2016 and 114,000 tons were reduced in 2017, which slightly exceeds the plan of CO_2 emission effect.[23]

In regard to the impact above in this ex-post evaluation, as it was difficult to obtain statistics except CO_2 emission reduction, qualitative analysis was conducted through group interviews with beneficiaries. In the group interviews, the following were confirmed: (1) satisfaction with this project and the current water and sewer service, heat supply and city gas service and (2) changes in living and health condition before and after the project by improving water and sewer service, centralized heat supply and city gas service.[24] Examination results by city and sector are indicated in Table 7. In regard to (1), all survey respondents of all cities and sectors answered "highly satisfactory." Satisfaction was extremely high. In particular, in regard to sewage and centralized heat supply that were maintained badly before the project, these were improved significantly after the project; therefore, the level of satisfaction among survey respondents was remarkably high. In regard to sewage, residential wastewater was discharged before the project but was significantly improved. Hygiene environment, living environment and urban environment were improved after the project. In regard to centralized heat supply, there were many opinions that room

[23] Four cities in Phase 1 did not set CO_2 emission reduction as a quantitative effect. In addition, new emission standards in heat supply projects in China are limited to emission of SO_2, NO_x and soot. Thus, none of the cities monitored CO_2 emission reduction because there was no regulation related to the emission of CO_2 and it was difficult to obtain the actual figures. Therefore, in this ex-post evaluation, only the effect of CO_2 emission was evaluated in Phase 2 as it was planned at the time of the appraisal.

[24] Following is an outline of the group interviews. Survey respondents were called by the executing agency; they comprised at least 10 beneficiaries in six cities. The executing agency asked residents committees and real estate companies in target areas to call survey respondents, tell them the date of the group interview and ask residents if they could participate in the group interview. The group interview was held for six days in total between December 3 and 19, 2017. Beneficiaries subject to survey were 73 people in total in six cities (40 men and 33 women.) They ranged in age from 20s to 80s.

temperature was kept stable compared to compact coal stoves and small-scale coal boilers used before the project and that improvement of the atmospheric environment in each city brought a significant change to the living environment. As waterworks were already developed before the project in each city with the exception of some parts of the cities of Wusu, Kuitun and Atushi (western urban area) that were using water from wells before the project, there were no significant changes to the living environment and living standards compared to sewage and heat supply. However, water supply has been further stabilized owing to the improvement of water pressure through improved service. The living standards of residents that used to consume water from wells have improved, as they do not need to use time and labor to carry water anymore.

Table 7 Project Impact: Main Results from the Group Interviews

Sector	Result
Sewage	**(1) Degree of satisfaction regarding the project and the current services** • All six cities answered "highly satisfactory". Main reasons being that the content of services have diversified and quality has improved (clogged drainage pipelines have diminished dramatically). Time to respond has quickened. **(2) Changes in living standards because of improved services before and after the project** • Residents that were not connected to the drainpipe before the project, needed to dig holes outside their one-storied houses, or had to use nearby public toilets among other measures. However, after the project, these houses also were connected to the drainpipe, flush toilets inside the house were built, significantly improving the living and hygienic environment. As for the residents that lived in apartment houses since before the project, and were connected to the drainpipe, suffered from bad smell because before the project, domestic wastewater was discharged without treatment in the roads and rivers. Also, the diameters of the drainpipes were narrow resulting in constant clogging. After the project, the city in general is clean and the townscape has improved. With regards to water-borne illness, they do not feel a big change before and after the project.
Water Supply	**(1) Degree of satisfaction regarding the project and the current services** • All six cities answered "highly satisfactory". Water supply cutoff are limited to planned cutoffs after the project. Information on water quality is now provided every month and water pressure is stable. There are different alternatives to pay as well. They take care to do the maintenance works during the night time when there is less use of water. Significant improvement in services was the main reason. **(2) Changes in living standards because of improved services before and after the project** • With the exception of some respondents from Wusu City, Kuitun City and Atushi City, that used water from wells before the project, the rest already had water supply services. In addition, since water quality of the water source was good, they relatively do not feel a big change in their living standards because of the project compares to other sectors. • Those residents that used water from wells before the project, used to carry water enough for 2 to 3 days from the wells to water jugs with the help of the whole members of the family. In average they had to make 3 to 4 roundtrips to wells located in 5 to 10 minutes of walking distance. After the project, time and labor to carry water is no longer necessary and quality of life has improved.
Central Heat Supply	**(1) Degree of satisfaction regarding the project and the current services** • All five cities answered "highly satisfactory". Main reason being that content of services is complete, and response of the heat supply company's hotline is quick among others. **(2) Changes in living standards because of improved services before and after the project** • Air environment before the project was extremely bad, with dust flying all the time, causing symptoms such as black nasal cavities, coughs and aching of eyes and sore throat. Room temperatures would not stabilize with compact coal stoves and small-scale coal boilers, and children and elderly persons tend to easily get sick, catching cold or with joint pains. Residents that used compact coal stoves, had a permanent risk of carbon monoxide intoxication. After the project, room temperature is kept stable 24 hours, and health condition has generally stabilized.
City Gas	**(1) Degree of satisfaction regarding the project and the current services**

(Only Altay City)	• All respondents answered "highly satisfactory". **(2) Changes in living standards because of improved services before and after the project** • Before the project, each household had to change their gas cylinder, but after the project this labor is no longer required. There are no concerns of air pollution and they are highly convenient. It is now possible to take a warm bath any time, and have a secure and comfortable life.

Source: Summary made by the evaluator based on the results of the group interviews.

Generally, it is confirmed that this project contributes somewhat to the (1) improvement of residents' living environment and living standards, (2) improvement of water and sewer service, centralized heat supply and city gas supply capacity, and the improvement of service in project target cities.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment[25]

The Environmental Impact Assessment (hereinafter referred to as "EIA") related to this project obtained approval from the environmental protection agency of Xinjiang Uygur Autonomous Region.[26] At the time of the appraisal, emphasis was put on the following pollution control common to six cities: (1) Drainage from sewage treatment plants and centralized heat source factories is treated to satisfy drainage standards of China and discharged to rivers and deserts, etc. Some sewage treatment drainage is used as irrigation water for tree planting. (2) Sludge generated in sewage treatment plants is partially used as fertilizer for tree planting. Highly-polluted sludge is properly treated at the existing waste landfill disposal plant. (3) In regard to atmospheric pollution, etc., after the launch of the project, dust-collecting devices and desulfurization devices are installed to satisfy environmental standards in China. In regard to (1), it has been argued that drainage from the sewage treatment plant in Phase 2 is mainly used for tree planting irrigation around the treatment plant which in the long-term it could result in greening and purification of atmosphere, because the water treated in the oxidation pond which will be used for irrigation can have an improving effect on alkaline soil. In regard to environmental measures and monitoring at construction, an environmental observation station that has jurisdiction over each city planned to monitor noise, water quality, atmospheric pollution and drainage etc. for both phases. It was confirmed that proper measures were implemented according to the plan at the time of the appraisal based on the records and interviews

[25] As a quantitative impact of relief on atmospheric pollution burden in Phase 1 in this project, approximately 150,000 tons of CO_2 was estimated to be reduced because of control of small-scale pollution emission sources. However, the executing agency replied that they did not have any information of CO_2 because it was no longer monitored since national atmospheric environmental standards were revised in 2012. This impact was excluded in the ex-post evaluation.

[26] As for approval from the environmental protection agency of Xinjian Uygur Autonomous Region, Turpan received this in January 2007, Hami City, Wusu City, and Kuitun City in February 2007 and Altay City and Atushi City in December 2006 and August 2007.

confirmed during observation, and monitoring and instruction were conducted by the environmental protection agency of each city. Moreover, monitoring of water quality and sewer service and atmospheric pollutants at the time of the ex-post evaluation was strictly conducted in real time by the health and environment bureau and environmental protection agency of each municipality. Overall, the impact on the environment at construction and at the time of the ex-post evaluation is minimal, and negative impact on the environment is not confirmed.[27]

(2) Resettlement and Land Acquisition

At the time of the appraisal, approximately 52 ha land was set to be obtained in total in Hami City and Turpan City in Phase 1. The actual figure was 51.6 ha, which was mostly as planned and the land was acquired according to the procedure in China. In Phase 2, the right to use approximately 148 ha of state-owned land was already acquired at the time of the appraisal according to the domestic procedure in order to maintain sewage facilities in Altay City and Atushi City. As these lands were waste land allocated by the government, residents did not have to relocate and the company did not need to pay compensation etc.

(3) Other Positive and Negative Impacts

Acceleration of poverty reduction was expected as "other positive and negative impacts" at the time of the appraisal. The poverty rate in the six cities at that time was more than 2.8% of the national average in five cities except Kuitun City, whose poverty rate was 1.2%. As consideration to the poor in all six cities, there is a system to reduce charges for water and sewer service and heat supply. It was expected to contribute to reducing poverty by continuously applying this system after the project completion. The latest available poverty rate at the time of the ex-post evaluation was the rate in 2016. According to this rate, the poverty rate in four cities decreased in Phase 1 to below the national average, but the poverty rate of Altay City and Atushi City in Phase 2 became worse, which is 15.6% and 35.3% respectively. Partial exemption from public utility charges is conducted for households living in poverty in all cities, but there is no clear basis for relationship between this project

Ex-site of small-scale coal boiler: Park in Hami Citv

[27] At the time of the appraisal, project target areas of both phases do not correspond to areas that are easily influenced such as national park etc. or surrounding areas, so it is estimated that undesirable influence on the natural environment is minimal. When on-site investigation of this ex-post evaluation was conducted, it is confirmed that the estimation made at the beginning of the plan was correct and no particular problem has occurred.

and acceleration of poverty reduction.

As “other positive and negative impacts” that are not assumed in this project, the following two impacts are indicated. (1) Developing centralized heat source factories enables the removal of existing small-scale coal boilers, and the site can be reused. When local observation was conducted, it was confirmed that a heat exchange station was developed on some former sites of small-scale coal boilers. On the other hand, there were some cases where the site was reused as a new public facility such as green space, park and place for sharing bicycles and cafeteria for government officials, which led to more a convenient and comfortable life of residents. (2) In the process of sewage disposal in Altay City, treated drainage is discharged to a regenerated water pond and is used as circulating water. By doing this, water is not discharged to Kelan River, which is a drainage destination and helps to improving the surrounding ecology. In 2013, the company was selected as a company of outstanding achievement in the achievement evaluation of national urban sewage treatment plant energy saving /emission reduction. Overall, positive impact that was not estimated is confirmed.

The outcome of this project is “improvement of sewage treatment capacity and water supply capacity and reduction of water pollution and atmospheric pollutants” and impact is set to “contribute to improving the environment and residents living standards in six cities.” In regard to the outcome, major indicators of effectiveness prove that it achieves the target in Phase 1 and Phase 2. In regard to quantitative impact, CO_2 emission reduction achieves impacts expected at the time of the appraisal. As qualitative impact, evaluation based on the group interview with beneficiaries showed that the level of satisfaction in project content and service is high in every sector and living environment, living standard and natural environment are improved significantly after the project, which shows that the contribution of this project is high. Environmental monitoring and environmental pollution measures during construction and at the time of the ex-post evaluation were conducted based on the plan and negative impact on the environment was kept low. In regard to land acquisition, as state-owned waste land is allocated, there was no need to relocate residents nor pay compensation, etc. As for other positive and negative impacts, there is no confirmed direct relationship regarding the acceleration of poverty reduction, but a system to reduce charges for the poor that was planned at the time of the appraisal continues to apply, and measures for the poor are carried out. In addition, unintended positive impacts such as the following are recognized: the sites of small-scale coal boilers were reborn as facilities that contribute to improving residents’ living environment.

From the above, this project has mostly achieved its objectives. Therefore, effectiveness and

impacts of the project are high.

3.4 Sustainability (Rating:③)

3.4.1 Institutional / Organizational Aspects of Operation and Maintenance

Table 8 shows the project implementation unit that is in charge of operation and maintenance of infrastructure facilities developed in this project. Through observation and interviews with employees in local observation, it was confirmed that the organization chart and the decision-making process of operation and maintenance are clear in all project implementation units. In all sectors of water and sewage service, centralized heat supply and city gas and human resources are secured to ensure proper operation and maintenance. In regard to the working situation of employees, a reasonable shift system of employees is secured to conduct operation safely and effectively.

Table 8 Project implementation units and Their Organization at the Moment of the Appraisal and the Ex-post Evaluation*

City	Sector	Name of the Project implementation units at the moment of Appraisal *	Changes in the name of the Project implementation units at the moment of the Ex-post Evaluation / new names / type of entity / number of employees, number of technicians **
Hami City	Sewage	Hami City Sewage Treatment Plan	No change /State-owned enterprise 136 persons (out of which 81 technicians)
	Water Supply	Xinjiang Hami Water Works Limited Liability Company	Hami Water Works Limited Liability Company / State-owned enterprise 110 persons (out of which 44 technicians)
	Central Heating Supply	Hami Míngzhū Heat Supply Limited Liability Company	Changed / State-owned enterprise 141 persons (out of which 96 technicians)
Turpan City	Sewage	Xinjiang Turpan City Wanquan Water Supply and Sewage Company	No change / State-owned enterprise No information on total was provided (14 technicians)
	Water Supply		
	Central Heating Supply	Turpan City Heat Supply Company	No change / State-owned enterprise 79 persons (out of which 57 technicians)
Wusu City	Sewage	Wusu Sewage Treatment Plant	Wusu City Water Supply and Sewage Limited Liability Company / State-owned enterprise 108 persons (out of which 23 technicians)
	Water Supply	Wusu Water Supply Company	
Kuitun City	Sewage	Kuitun Sewage Treatment Plant	No change / State-owned enterprise No information on total was provided (33 technicians)
	Water Supply	Kuitun Water Supply Company	No change / State-owned enterprise 65 persons (out of which 24 technicians)
	Central Heating Supply	Kuitun Heat Supply Company	Kuitun Dzungar Heat Supply Limited Liability Company / Private company 65 persons (out of which 22 technicians)
Altay City	Sewage	Altay City Sewage Treatment Plan (38 persons)	No change / State-owned enterprise 75 persons (out of which 68 persons)
	Water Supply	Altay City Jinshan Water Supply Company (88 persons)	No change / State-owned enterprise 71 persons (out of which 59 persons)
	Central Heating Supply	Altay City Central Industrial Heat Supply Limited Liability Company (89	No change / State-owned enterprise 89 persons (out of which 71 persons)

		persons)	
	City Gas	Huali Gas Investment Limited Liability Company (38 persons)	Altay Guanghui Natural Gas Limited Liability Company / Private company 168 persons (out of which 118 persons)
Atushi City	Sewage	Atushi City Water Supply and Sewage Company (80 persons)	Atushi City Quankang Water Supply and Sewage Limited Liability Company / State-owned enterprise 64 persons (out of which 44 persons)
	Water Supply		
	Central Heating Supply (Natural Gas)	Atushi City Heat Supply Public Company (104 persons)	Atushi City Guang Zheng Heat Supply Limited Liability Company / Private company 44 persons (all technicians)

Source: Information regarding the appraisal moment is based on JICA provided documents. Information regarding ex-post evaluation moment is based on documents provided by the Executing Agency
*: There was no information regarding number of persons in each of the project implementation units for Phase 1. In addition, all project implementation units were state-owned enterprises.
**: Technicians refer to personnel with national qualifications and professional qualifications.

All project implementation units were state-owned companies at the time of the appraisal, but at the time of the ex-post evaluation, three within 15 companies (Kuitun Dzungar Heat Supply Limited Liability Company (hereinafter referred to as "LLC"), Altay Guanghui Natural Gas LLC, and Atushi Guang Zheng Heat Supply LLC) were privatized.[28] In China, public service sections have been privatized for the purpose of conducting efficient management; however, at the time of the ex-post evaluation, the organization chart of all project implementation units including privatized project implementation units was made clear and has a scale necessary for operation and maintenance. At the same time, the system for decision-making, instruction system, instruction and supervising functions, etc., are sufficient systems to secure sustainability of this project.

3.4.2 Technical Aspects of Operation and Maintenance

Technical aspects of operation and maintenance of the departments executing this project were evaluated based on the familiarity of technology adopted by the facility developed by this project, especially the number of people who acquire national certification, maintenance of training system, operation and maintenance manuals and usage situation.

In regard to technical standards and training system of operation and maintenance of personnel, technicians who have the necessary national certification and engineers who have expert knowledge are assigned about 60% to 70% in most

Various certificates of qualifications (City gas project from Atushi City)

[28] In the case of Kyutun Zuungar Thermal LLC and Atushi Guanzheng Thermal LLC, property and obligation to pay are passed to private companies, but local government and the autonomous region financial office secure their repayment. In the case of Altay Guanghui Natural Gas LLC, the municipal government has an obligation to pay and the autonomous region financial office secures them. Each municipal government has authority of supervision.

of project implementation units of water and sewer service, centralized heat supply and city gas; therefore, there is no issue on technical aspects (Refer to Table 8). Occupations requiring national certification are mainly: electrician, electric welder, desulfurization staff, water treatment staff, water quality staff, boiler operator, meter operator and water heat operation worker, etc. Acquisition of certification is managed by every project implementation unit. With regard to training, each department grasps the needs for training every year in all project implementation units, reports to the "human resources section" and creates an annual human resources development plan. Necessary budget is then included in the budget of the next fiscal year and it is conducted mostly as planned. Skill evaluation is conducted on a regular basis by combining in-house training (lectures by invited domestic specialists and training by manufacturers, etc.) and outside training organizations. Outside training is conducted mainly to professionals of electricity, plumber, boiler operation, water examination, sewage plumber and sewage treatment investigation, etc. and for most of the cases, training is conducted in Urumqi City. Regarding water and sewer service, some technical training is conducted by municipal and autonomous wastewater association. National certification is categorized as beginner, intermediate and advanced-level. Three to five years of experience, taking lectures, and national certification are required. All personnel take a certain amount of training and knowledge is always updated. Experienced engineers and young members always form teams on the spot to pass on techniques and knowhow in the workplace.[29]

Operation and maintenance manuals are developed and maintained in all project implementation units of water and sewer service, centralized heat supply and city gas. Originals of manuals are stored and managed in a section of each project implementation unit and content of main operation processes is displayed on poster-sized sheets and installed on the wall so that anyone can refer to it at any time. Operation and maintenance records are kept in each main facility and flow and daily reports are also kept. Water examination is conducted ,monitored and recorded at a frequency defined by the national environmental protection agency.

Overall, employees in charge of operation and maintenance in every project implementation unit have sufficient technical level. The training system is well organized, and the company always works to maintain and improve technical level and technology for sustainability of this project.

[29] Training in Japan was held in Phase 1 only, but among trainees who participated in this training, only three in Kuitun City belong to each project executing department at the time of the ex-post evaluation. This training in Japan resulted in the materialization of the technology and equipment that should be brought in the project. As training participants from other three cities were positioned as managers, they are relocated or changed their job at the time of the ex-post evaluation. They do not stay in the project executing department. In the case of Kuitun City, promising young personnel at a practical level who have technical expertise are selected from each project execution department and asked to participate in the training. Therefore, they remain in each project executing department and succeed to work as middle managers on the spot.

3.4.3 Financial Aspects of Operation and Maintenance

In this project, expenses for operation and maintenance after the project completion are covered by income from charges (such as sewage fee, water charge, heat supply fee and city gas fee).[30] If funds go into shortage, financial funds from each municipality are additionally expended and there was no change to this system at the time of the ex-post evaluation.[31] In this project, it is estimated that cities where the scope of development was limited to sewage pipeline and piping for water and sewer service in particular can reduce maintenance costs; therefore, charges at the time of the project completion are reduced from those at the time of the appraisal. However, at the time of the ex-post evaluation, all sectors in six cities except water and sewer service in Atushi City had increased their charges. Meanwhile, charges to households are slightly reduced and charges increase only to commerce and industry.

Among 15 project executing units, 14 units except Wusu City Water Supply and Sewage LLC obtained profit and loss statements of the past three years (Refer to Table 9.)

[30] Authorization of public service charges in Xinjiang Uygur Autonomous Region is owned by each municipality. When charges are revised, the project executing department applies, holds a public hearing to reflect user needs and the municipality approves it. In every project operating department, charges are paid in bill collecting places or via prepaid card. Some cities allow payment of charges via mobile phone.

[31] Privatization is promoted as a policy of the Chinese Government. However, in regard to companies related to basic infrastructure such as water and sewer service, heat supply and town gas, it is determined by the law that these companies are subject to receive national, autonomous and each municipal preferential treatment (such as subsidy, tax exemption, loan, etc.) ("Guidance and opinion related to cooperation between government of national development/reform committee and private capital" development and reform investment (2014) No. 2724), Finance Department of National Tax General Office "Notification about tax increase to heat supply company, real estate tax and urban land use tax preferential treatment" Property and tax (2016) No. 94 and Finance Department, National General Tax Affairs "Measure to collect and use urban public infrastructure maintenance in Xinjing Uygur Autonomous" August 24, 2016.)

Table 9　Income Statements of the Project Implementation Units

(Unit: 1000 yuan)

Phase 1

Hami City Sewage Treatment Plant		2015	2016	2017
	Operating Income	10,329	10,147	10,521
	Operating Expense	16,340	15,641	18,981
	Operating Profit	▲ 6,011	▲ 5,494	▲ 8,460
	Other (Subsidies, etc)	2,434	2,223	3,509
	Ordinary Profit	▲ 3,577	▲ 3,271	▲ 4,951
Xinjiang Hami Water Works Limited Liability Company		2015	2016	2017
	Operating Income	75,407	89,669	84,145
	Operating Expense	75,619	84,700	78,033
	Operating Profit	▲ 212	4,969	6,112
	Other (Subsidies, etc)	2,202	8,898	18,744
	Ordinary Profit	1,990	7,394	24,856
Hami Mingzhū Heat Supply Limited Liability Company		2015	2016	2017
	Operating Income	16,287	16,287	10,598
	Operating Expense	19,877	19,878	19,794
	Operating Profit	▲ 3,590	▲ 3,591	▲ 9,196
	Other (Subsidies, etc)	3,894	3,895	10,712
	Ordinary Profit	304	304	1,516
Xinjiang Turpan City Wanquan Water Supply and Sewage Company		2015	2016	2017
	Operating Income	18,797	23,011	29,522
	Operating Expense	22,865	24,871	26,989
	Operating Profit	▲ 4,068	▲ 1,860	2,533
	Other (Subsidies, etc)	1,578	537	11
	Ordinary Profit	▲ 2,490	▲ 2,397	2,544
Turpan City Heat Supply Company		2014	2015	2016
	Operating Income	30,180	34,645	35,881
	Operating Expense	31,244	33,993	34,562
	Operating Profit	▲ 1,064	652	1,319
	Other (Subsidies, etc)	1,677	2,653	1,540
	Ordinary Profit	613	3,305	2,859
Kuitun City Water Supply Company		2014	2015	2016
	Operating Income	27,262	27,651	29,581
	Operating Expense	22,600	26,748	27,176
	Operating Profit	4,662	903	2,405
	Other	▲ 443	60	▲ 64
	Ordinary Profit	4,219	963	2,341
Kuitun City Sewage Treatment Plant		2015	2016	2017
	Operating Income	10,767	10,950	11,680
	Operating Expense	9,992	10,103	10,830
	Operating Profit	775	847	850
	Other	▲ 116	▲ 128	▲ 127
	Ordinary Profit	659	719	723
Kuitun City Heat Supply Company		2015	2016	2017
	Operating Income	45,934	44,850	5,133
	Operating Expense	46,261	47,879	3,243
	Operating Profit	▲ 327	▲ 3,029	1,890
	Other (Subsidies, etc)	3,256	3,171	▲ 37
	Ordinary Profit	2,929	142	1,927

Phase 2

Altay City Jinshan Water Supply Company		2015	2016	2017
	Operating Income	9,124	9,337	7,544
	Operating Expense	8,702	8,742	6,773
	Operating Profit	422	595	771
	Other	▲ 96	▲ 179	▲ 72
	Ordinary Profit	326	416	699
Altay City Sewage Treatment Plant		2015	2016	2017
	Income (including subsidies)	6,206	8,390	5,601
	Expense	6,243	8,390	5,251
	Difference	▲ 37	0	350
Altay City Central Industrial Heat Supply Limited Liability Company		2015	2016	2017
	Operating Income	35,916	28,572	30,102
	Operating Expense	37,051	30,908	31,324
	Operating Profit	▲ 1,135	▲ 2,336	▲ 1,222
	Other (Subsidies, etc)	1,600	2,932	2,214
	Ordinary Profit	465	596	992
Altay Guanghui Natural Gas Limited Liability Company		2015	2016	2017*
	Operating Income	27,086	32,886	24,255
	Operating Expense	22,787	25,864	21,499
	Operating Profit	4,299	7,022	2,756
	Other	▲ 488	▲ 554	▲ 440
	Ordinary Profit	3,811	6,468	2,316
Atushi City Quankang Water Supply and Sewage Limited Liability Company	Water Supply Business	2015	2016	2017
	Income from charges (A)	10,690	2,900	3,100
	Labor Expense	80	40	60
	O&M Expense	350	390	410
	Other Expenses	340	380	360
	Total Expenses (B)	0	3,710	3,930
	(A)-(B)	10,690	▲ 810	▲ 830
	Sewage Business	2015	2016	2017
	Income from charges (A)	2,930	3,330	3,080
	Labor Expense	900	1,020	840
	O&M Expense	110	140	160
	Other Expenses	350	410	540
	Total Expenses (B)	1,360	1,570	1,540
	(A)-(B)	1,570	1,760	1,540
Atushi City Guang Zheng Heat Supply Limited Liability Company		2014	2015	2016
	Operating Income	12,707	13,725	15,162
	Operating Expense	14,732	16,085	19,466
	Operating Profit	▲ 2,025	▲ 2,360	▲ 4,304
	Other	0	2,877	▲ 22
	Ordinary Profit	▲ 2,025	517	▲ 4,326

Source: Documents provided by the Executing Agency

*: Actuals up to November 2017

In the past three years, 10 out of 14 companies were able to cover operation and maintenance with income from charges (operating profit is in black) and the operating profit of the following four companies only went into the red: Hami City Sewage Treatment Plant, Hami City Mingzhu Heat Supply, Kuitun City Sewage Treatment Plant, and Altay City Industrial Central Heat Supply LLC. However, subsidy is invested to Hami City Mingzhu Heat Supply, Kuitun City Sewage Treatment Plant, and ordinary profit went into the black. From the

perspective of “securing people’s livelihood,” water and sewer service, centralized heat supply and city gas are committed to continuously receiving various subsidies from the government (Refer to footnote 31 for details.) When considering this matter, it is fair to say that financial sustainability of the project implementation unit in charge of operation and maintenance of this project is generally secured.

3.4.4 Status of Operation and Maintenance

The operation and maintenance statuses of all facilities and equipment developed in this project are as follows. Some cities and sectors need improving but the operation and maintenance statuses are generally satisfactory. Even if there is a matter to consider, efforts to improve are already conducted.

- Hami City: As for the sewage project, all sewage pipe networks are cleaned twice a year, but existing dredging devices and garbage collection vehicles are not sufficient given the scale of the city. In the next two to three years, it is planned to upgrade machinery such as water-pipe survey equipment, etc. In addition, some industrial drainage does not follow drainage standards, which increases burden in the sewage treatment plant. The project implementation unit requests that the government tighten regulations.
- Turpan City: As for sewage, it aims to achieve at least the National Sewage Drainage Standard Class B after a new sewage treatment plant is completed in the second half of 2018. As for the water project, leakage problems occurring in partially deteriorated drainpipes (mainly branch pipe network) in the city area are worsening, which causes insufficient quantity of water supply. It is planned to update these drainpipe networks. As for the centralized heat supply project, water treatment equipment needs to be updated, which is already included in the FY 2019 budget. In addition, as problems occur in the online system of the heat supply factory and heat exchange station on rare occasions, this system will be upgraded and monitoring control will be installed in 2019.
- Altay City: As for sewage, a “plan to mechanize Altay City drainage pipe networks” has been promoted. By 2020, it is planned to mechanize maintenance of drainage pipe networks (install four smart device cleaners.) Furthermore, it aims to raise the national sewage drainage standard of treated water from the current grade B to grade A. To do so, existing equipment is being reformed (such as aeration sedimentation tank, biological reaction tank, replacement of screen, sand filter process, etc.), which will be completed at the end of 2018.

Overall, through observation of local surveys and interviews with each project implementation unit, operation and maintenance of all facilities in six cities are generally satisfactory. Each project implementation unit operates facilities more efficiently and installs new equipment to always make an improvement.

From the above, it can be said that 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 effectiveness is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was conducted with the aim to improve sewage treatment and water supply capacity and reduce water and air pollutants in a total of six cities, namely Hami, Turpan, Wusu, and Kuitun (Phase 1), and Altay and Atushi (Phase 2) in XUAR, China, by developing sewage, water supply, centralized heat supply, and city gas (Altay City only) facilities, thereby contributing to the improvement of the environment and living standards of residents in the six cities. This project was fully consistent with the development and environmental protection plans and development needs of China and XUAR at the time of the appraisal and the ex-post evaluation as well as Japan's ODA policy toward China at the time of the appraisal, therefore the relevance of the project is high. The outputs of the project were partially reduced in Phase 1 but were as initially planned in Phase 2. In both phases, the total project cost remained within the initially planned range, but the project period exceeded the initial plan. Thus, the efficiency of the project is fair. The outcome expected as the project's effect was to improve sewage treatment and water supply capacity and reduce water and air pollutants, and its impact was to contribute to the improvement of the environment and living standards of residents in the six cities. In both phases, with regard to outcome, the project achieved major indicators' targets set for each sector at the time of the appraisal; therefore, the effectiveness of the project is high. Regarding impact, it was confirmed through interviews with groups of beneficiaries that in the project area of each city, water service /sewage, centralized heat supply, and city gas facilities had been developed and that this contributed to improvement of the environment and the living standards of residents. Land acquisition was carried out appropriately, and no resettlement of residents occurred. During the construction work and at the time of the ex-post evaluation, impacts on the natural environment were monitored appropriately with environmental measures taken properly, and no negative impact was confirmed. As described above, the effects of the project manifested themselves as planned, and the effectiveness and impacts of the project are high. The current statuses of the institutional, technical, and financial aspects at the 15 units that were responsible for the operation and maintenance management of the project implementation are generally favorable, and the sustainability of effects brought by the project 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

In regard to efforts described in "3.4.4 Status of Operation and Maintenance," each project implementation unit in each city conducts as planned and will make efforts to ensure sustainability of effectiveness expressed in this project in the future.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Plan measures related to project supervision when the project extends to many cities and sectors and the executing agency and/or municipalities do not have experience in Japanese ODA loan projects

This project conducts projects of three to four sections in six cities in the extensive Xinjiang Uygur Autonomous Region. As described in "2.3 Constraints during the Evaluation Study," project progress reports were not regularly elaborated and submission of project completion reports was limited to a few cities. These factors hinder collection of information related to the project executing period. In addition, as it was not possible to go into the project site at the second local survey in this project owing to the safety management issues in Xinjiang Uygur Autonomous Region, information that was possible to collect was limited. This information contains data to be described in project progress reports and project completion reports that are mandatory to submit for loan contracts. Like China where this project was being conducted, if many official development assistance projects are conducted at the same time, it is admittedly difficult to monitor all projects in detail. However, from the perspective of project cycle management, if the next "risk" is confirmed, it is desirable to conduct proper project supervision according to the current situation as follows: (1) municipalities with no experience in Japanese ODA loan projects (provincial governments and city governments), (2) there is a shortage of human resources in the executing agency in charge of many projects when considering the scale of the project, (3) location of the project is physically away from the local office location and it is estimated that it is difficult to make a procedure to obtain information because of safety management when compared to other municipalities. In this case, (1) increase the frequency of mid-term review and supervise projects in more detail, (2) although the frequency of submitting project progress reports is reduced from the current twice to once, be sure to submit reports at the agreed frequency, and (3) submit project completion reports thoroughly and provide support to create such reports if necessary. Doing this enables course correction as necessary from time to time in the project cycle. Even if human resources of the executing agency and municipality related to the project change, the project management will be taken over, and will contribute to the project's further efficiency and effectiveness.

END

Comparison of the Original and Actual Scope of the Project

Item	Plan (after revision)	Actual
(1) Project Outputs 【Development of facilities, procurement of equipment】		
＜Phase 1＞		
Hami City		
1. Construction and repair of drainage pipe system	74.8km	49.8km
2. Construction of water distribution pipeline	26.5km	31.4km
3. Construction of new water treatment plant	50,000m^3 /day	As planned
4. Construction and repair of water supply pipe system	94.3km	99km
5. Construction of heat supply plant	3×29MW	As planned
6. Construction of heating power supply pipe network	56.4km	21.3km
7. Construction of heat exchange stations	31places	As planned
Turpan City		
1. Construction and repair of drainage pipe system	50.4km	40.4km
2. Construction of new sewage treatment plant	20,000m^3 /day	As planned
3. Repair of existing sewage treatment plant	No information	No information
4. Construction of water distribution pipeline	51.7km	46.9km
5. Construction and repair of water supply pipe system	77.7km	69.8km
6. Construction of heat supply plant	3×46MW	As planned
7. Construction of heating power supply pipe network	26.0km	22.63km
8. Construction of heat exchange stations	25 places	21 places
Wusu City		
1. Construction and repair of drainage pipe system	71.3km	71.6km
2. Construction and repair of water supply pipe system	73.9km	67.4km
Kuitun City		
1. Construction and repair of drainage pipe system	73.2km	50.1km
2. Construction of new sewage treatment plant	60,000m^3 /day	As planned
3. Expansion of sewage treatment plant	An activated sludge tank was added to an existing plant with a sewage treatment capacity of 40,000 m^3/day	As planned
4. Construction and repair of water supply pipe system	81.0km	82.0km
5. Construction of heat supply plant	3×46MW	2×72MW

6. Construction of heating power supply pipe network	45.5km	47.4km
7. Construction of heat exchange stations	30 places	32 places
<Phase 2>		
Altay City		
1. Construction and repair of drainage pipe system	59.8km	As planned
2. Construction of new sewage treatment pond	4.86 million m^3	As planned
3. Construction of new water intake facility	16,000 m^3 /day	As planned
4. Construction of water supply pipe	19.8km	As planned
5. Construction of new water treatment plant	16,000 m^3 /day	As planned
6. Construction and repair of water supply pipe system	20.0km	As planned
7. Construction of heat supply plant	4×14MW	As planned
8. Construction of heating power supply pipe network	14.2km	As planned
9. Construction of heat exchange stations	14 places	As planned
10. Construction of LNG gasification facility	3.6 million Nm^3 /year	As planned
11. Construction of gas supply pipe network	15km	As planned
Atushi City		
1. Construction and repair of drainage pipe system	67.86km	As planned
2. Construction of new sewage treatment plant	3,500 m^3 /day	As planned
3. Expansion of existing sewage treatment plant	8,000 m^3 /day	As planned
4. Construction and repair of water supply pipe system	22.7km	As planned
5. Construction of heat supply plants	28×1.4MW 25×2.8MW 8×4.2MW	As planned As planned As planned
6. Construction of heating power supply pipe network	41.6km	As planned
7. Construction of medium pressure fuel gas supply network	17.23km	As planned
【Training】		
1. Target Cities	6 cities	Only Phase 1 (Hami, Turpan, Wusu, Kuitun)
2. Content	Technologies on projects related to sewage, heat supply facilities and city gas supply	Technologies related to water supply and sewage, waste treatment and heat supply
3. Number of persons	No information	11 persons
4. Period	No information	October 18 to 27, 2008
(2) Project Period	【Phase 1】 May 2007 to December 2012	【Phase 1】 March 2007 to June 2015

	(68 months, 5 years 8 months) 【Phase 2】 January 2008 to June 2013 (66 months, 5 years 6 months)	(98 months, 8 years 2 months) 【Phase 2】 March 2007 to September 2013 (70 months, 5 years 10 months)
(3) Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate Foreign Currency Domestic Currency Total ODA Loan Portion Exchange Rate	【Phase 1】 14,144 million yen 4,568 million yen (309 million yuan) 18,712 million yen 12,998 million yen 1yuan=14.8 yen (As of December 2006) 【Phase 2】 4,043 million yen 2,115 million yen (259 million yuan) 6,158 million yen 3,802 million yen 1yuan＝15.6 yen (As of June 2007)	【Phase 1】 10,586 million yen 4,822 million yen (333 million yuan) 15,408 million yen 10,586 million yen 1 yuan=14.5 yen (Average between March 2007 and June 2015) 【Phase 2】 3,185 million yen 2,170 million yen (160 million yuan) 5,355 million yen 3,596 million yen 1yuan＝13.6 yen (Average between December 2007 and September 2013)
(4) Final Disbursement	【Phase 1】September 2015 /【Phase 2】July 2016	