JAPAN INTERNATIONAL COOPERATION AGENCY

DATA COLLECTION SURVEY FOR ENVIRONMENTAL INFRASTRUCTURE DEVELOPMENT IN ULAANBAATAR CITY MONGOLIA

FINAL REPORT

April 2021

CTI ENGINEERING INTERNATIONAL CO., LTD.

SUURI-KEIKAKU CO., LTD.

TEC INTERNATIONAL CO., LTD.

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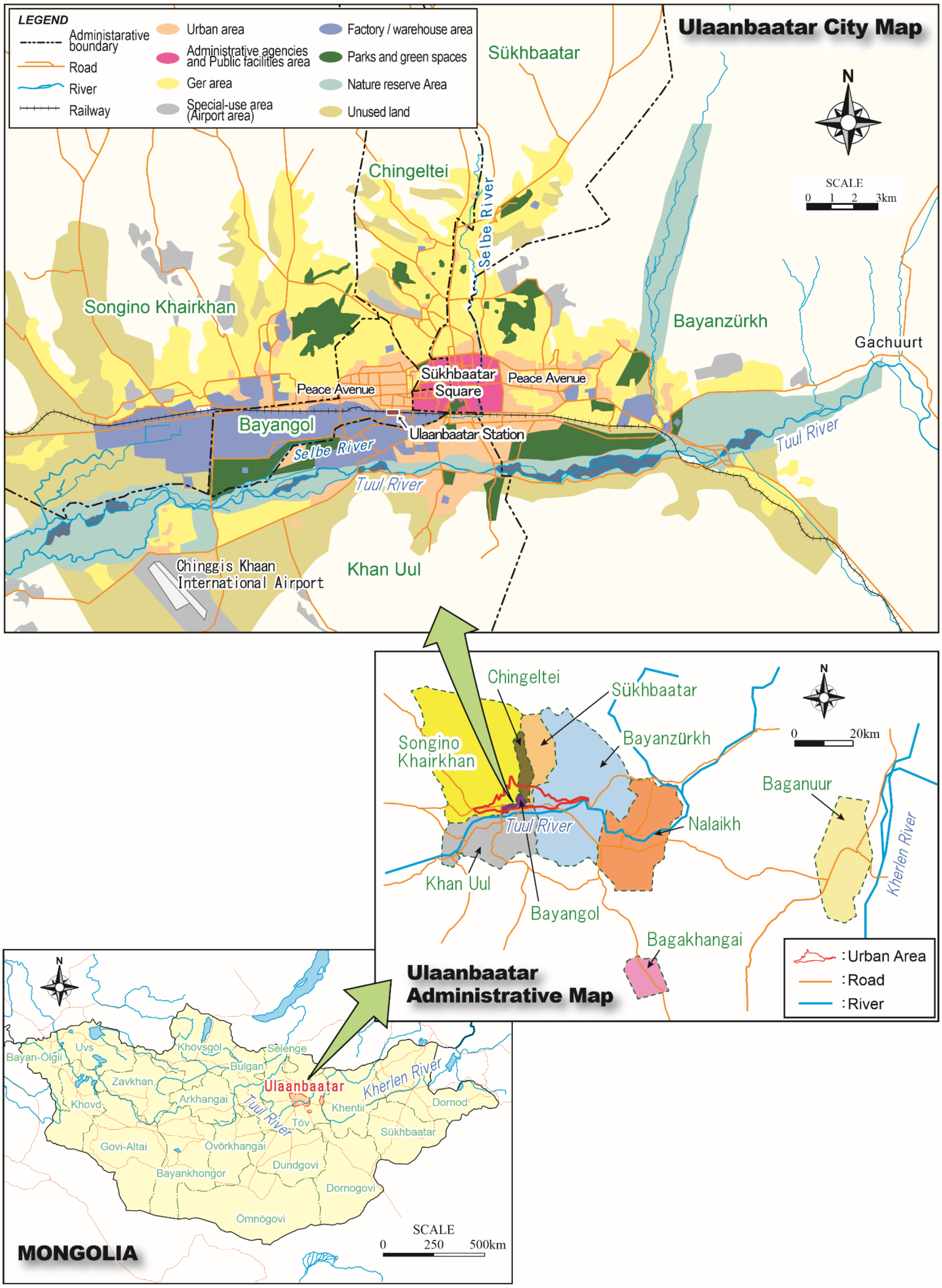
All Mongolia Tugrik amounts including project costs shown in this report are stated in 2020 prices unless otherwise indicated. The amounts are estimated on the basis of foreign prices by applying the interbank currency exchange rates as of 1st of October 2020, namely; USD1 = MNT 2,620 = JPY 105.57.



LOCATION MAP

SUMMARY

1. OUTLINE OF THE SURVEY

Survey Objective

The objective of the survey is to formulate and identify prospective projects which could be financed by foreign loan programs, such as Yen-loans, overseas investment loans, etc. To this end, the survey will review and analyse: 1) all the major environmental problems, 2) the government's priorities and needs for infrastructure development, 3) the JICA Country Analysis Paper, and 4) the current status of assistance by other donors, including the Asian Development Bank and the World Bank.

Survey Site

The survey covers the whole area of Ulaanbaatar, including the Nalaikh, Baganuur, and Bagakhangai districts, as shown in the Location Map.

Survey Team and Survey Process

A joint venture composed of CTI Engineering International Co., Ltd., SUURI-KEIKKU Co., Ltd., and TEC International Co., Ltd. started the survey in February 2020. However, due to the spread of the new coronavirus infection, all field surveys were cancelled, and the survey period scheduled for August 2020 was postponed to May 2021. It was also decided to set up a field survey team (employee) to carry out the field survey by remote (virtual communication).

2. BASIC INFORMATION ON ENVIRONMENTAL ISSUES, UNDERSTANDING THE CURRENT SITUATION AND ANALYZING ISSUES

Socio-Economic Situation

The population of Mongolia is about 3.3 million and the population of Ulaanbaatar (UB) City is about 1.54 million (2019, Population of Mongolia, National Statistic Office, updated data as of June 10, 2020). The population growth rate has been 3% on the national average since 2010, but the average for the five years up to 2018 reached 5.6%. The concentration has thus been increasing.

Policy and Plan

The vision and development policy keywords shown in "Vision-2050", which is the long-term development policy of Mongolia, states that Mongolia will be a developed country in terms of socio-economic development, with sustainable protection of nature, language, borders, and culture by 2050. The five-year policy stipulates the development policy of Mongolia for 2021-2025, which include the Basic Development Policy, the Evaluation Index and Achievement Targets, the Five-Year Investment Program and the List of Projects and Businesses.

Understanding the Current Status of Environmental Issues related to Air Pollution Countermeasures and Analyzing Issues

About 80% of the air pollution in UB City originates from ger stoves and HOBs (Heat Only Boilers) in the ger area, 10% from cars driving through the city, 5-6% from thermal power plants, and 4% from ash landfills of thermal power plants and wind-blown dust from roads, as well as other sources such as dumped wastes. Replacement of the stoves into improved ones and the use of more efficient fuels have been introduced; however, the effects are yet to be evaluated. Since it is difficult for Mongolia to abolish the use of HOBs in the ger area, the introduction of improved fuels instead of coal is expected to mitigate air pollution. In addition, the improvement of roads and intersections is considered to reduce traffic jams. The simulations on the effect of grade separation and road improvement on travel speed undertaken the Ajilchin Flyover Construction Project and the Green Avenue Construction Project have found that these measures will greatly contribute to the mitigation of air pollution.

Understanding the Current Status of Environmental Issues related to Water Pollution Countermeasures and Analyzing Issues

Water pollution on the Tuul River, which flows in the southern side of UB City, has been a long-standing issue for the City. This condition is attributed to the fact that the treated water at the CWWTP (Central Wastewater Treatment Plant) does not comply with the Effluent Quality Standards of Wastewater Treatment Plant for Discharging into Public Waterbody (MNS4943: 2015). The high-concentration of factory wastewater in the City also puts a heavy pollution load on the sewage treatment process at the CWWTP. In addition, cracks and leakages are observed aged sewer pipes that have been used for more than 50 years. Moreover, the non-installation of storm water drainage pipes has caused flood damage in the City and, combined with the leakage of wastewater, may bring soil contamination and groundwater pollution in the surrounding area.

Understanding the Current Status of Environmental Issues related to Solid Waste Management Countermeasures and Analyzing Issues

With the concentration of population in the urban areas, the amount of waste generated in UB City has been increasing. However, heavy machinery such as bulldozers used for final disposal site maintenance, as well as waste collection and transportation equipment, are aging and there is a chronic shortage of equipment owned by the CLCSD (City Landscaping and Cleaning Service Department) which is in charge of cleaning activities in UB City. Additionally, the number of scrapped home appliances and automobiles is increasing and proper treatment has become an issue. The problem of proper treatment of livestock carcasses and livestock chemicals also has become apparent as well. UB City lacks the technology, financing, and legal systems for the increasing and diversifying wastes, and this may result in risk of environmental pollution and public nuisance in the future, and can be a factor that hinders the socio-economic growth of the City.

Understanding the Current Status of Environmental Issues related to Climate Change Mitigation Countermeasures and Analyzing Issues

Although GHG emissions are expected to increase in parallel with economic growth and industrial development, there is some potential of interference from industrial development since as a country it is necessary to reduce GHG emissions under the Paris Agreement, etc.

3. ANALYSIS OF UTILIZATION OF JAPANESE TECHNOLOGY

Survey of Technological Innovation Trends of Japanese Companies

To understand technological innovation trends of cold region technology possessed by Japanese companies, interviews have been conducted with government agencies in Hokkaido, Japan. As a notable cold region technology, the urban energy master plan project implemented by Sapporo City is considered to be useful knowledge for UB City. Major companies currently planning to aggressively enter the Mongolian market were not confirmed, but it is necessary to expand the scope of Japanese technology utilization in addition to cold region technology when considering a yen-loan fund project related to environmental infrastructure.

Utilization of Japanese Technology on Air Pollution Control

The use of Japanese technology is expected to include infrastructure technology from LNG and CNG storage to safety measures, technology for improved fuel manufacturing and DPF (Diesel Particulate Filters). In terms of improvement of intersections and road networks for the mitigation of traffic congestion, prefabricated members manufactured in workshops and Japanese construction technology adjacent to railway tracks (Steel Girder, Rotary Penetration Steel Pipe Pile) can be applied for bridge construction without disturbing railway operations.

Utilization of Japanese Technology on Water Pollution Control

The SPR method, a Japanese technology, can be applied for the rehabilitation of aged sewer pipes. Since UB City has no experience on the pipe jacking method for sewer pipe construction, the SPR method may be workable for the City. The case of Tokyo Metropolitan Government can be used as reference for the monitoring technology of wastewater from factories. Furthermore, regarding rainwater drainage, pump gates and plastic rainwater retention facilities can be applied.

Utilization of Japanese Technology on Solid Waste Management

Although Japan has a wealth of experience in waste incineration and energy recovery technologies, the competitiveness is not high because facility maintenance costs are higher than in other countries and the technical level of other countries is improving. In terms of intermediate treatment technology, for solid waste and scrapped automobiles, such as recycling, the legal system should firstly be in place. The final disposal site technology can be applied for facility construction based on Japanese knowledge and experience.

Utilization of Japanese Technology on Climate Change Mitigation

It is difficult to find a big advantage in introducing the Japanese technology on energy conservation and thermal storage heaters. It is also not necessary to introduce new storage batteries by 2030 in Mongolia. Geothermal heat pumps, however, can be fully utilized.

4. TRENDS IN OTHER DONORS AND GREEN CLIMATE FUND (GCF) UTILIZATION RELATED TO ENVIRONMENTAL PROJECTS

Support Policies, Achievements, and Related Aid Coordination Frameworks of Other Donors

- Asian Development Bank (ADB)
  Air Pollution Control: PBL (Policy Based Loan, Total 1,600 billion USD)
  Water Pollution Control: Sub-center project (heat supply pipes, and water supply and sewer pipes, etc.), Construction of infrastructure center in ger area (heat supply pipes, and water supply and sewer pipes, etc.)
  Solid Waste Management: Ulaanbaatar Community Food Waste Recycling Project with support by JFPR (Japan Fund for Poverty Reduction)
  Climate Change Mitigation: Assistance for the National Dispatching Center on storage batteries
- The World Bank (WB)
  Air Pollution Control: UBCP (Ulaanbaatar Clean Air Project, Total 24 million USD loan)
- European Bank for Reconstruction and Development (EBRD)
  Water Pollution Control: Ulaanbaatar Wastewater Expansion Programme - Feasibility Study (the Emeelt Industrial Park Wastewater Treatment Facility)
  Solid Waste Management: Ulaanbaatar Solid Waste Modernization Project (16.7 million USD)
- MCC (The Millennium Challenge Corporation) and the MCA (The Millennium Challenge Account)
  Water Pollution Control: Groundwater development projects in the lower reaches of CWWTP, Sewage Treatment Water Reuse Project, Assistance activities related to sustainable, policy reform, capacity building and technical support for the Ulaanbaatar City water sector
- GIZ: Deutshe Geselleschaft fuur Internationale Zusammenarbeit
  Air Pollution Control: Support for the UB City Air Pollution Abatement Agency and the National Agency for Meteorology and Environmental Monitoring (NAMEM)
- KOICA: Korea International Cooperation Agency
  Air Pollution Control: Support for the Central Laboratory for Environment and Metrology (CLEM), 14 million USD soft loan
  Solid Waste Management: Construction of ELV Recycling Park including ELV Dismantling Plant, Recycled Resource Storage, Repair Plant and Technical Training Center (2.784 million USD)
- SDC: Swiss Development Cooperation
  Solid Waste Management: UB City Household Waste Collection and Transportation Management Project (WCTM: Waste Collection and Transportation Management in Ulaanbaatar), 3.8 million CHF
- UNICEF: United Nations International Children's Emergency Fund
  Air Pollution Control: Measures related to indoor pollution in kindergartens; Monitoring; and Online Systems
- Export-Import Bank of China
  Water Pollution Control: Construction of new CWWTP in UB City
- GGGI: Global Green Growth Institute
  Climate Change Mitigation: Support for the Government's green development targets, such as introduction of renewable generated electricity
- MGFC: Mongolia Green Finance Corporation
  Climate Change Mitigation: Technical assistance to operationalize MGFC, and build the capacity of Government of Mongolia and the financial sector stakeholders

GCF: Green Climate Fund

Currently, there are Nine (9) projects including assistance for renewable energy projects as GCF projects related to Mongolia.

5. SUMMARY OF SURVEY RESULTS

Consideration of Narrowing Down Projects

The long list of 20 candidate projects proposed to be funded with Yen-Loan from the Government of Japan has been prepared on the basis of projects judged to be highly needed in Mongolia, in addition to the candidate projects of other JICA studies. For these candidate projects, their feasibilities were evaluated from the viewpoint of development impact, investment impact, utilization of Japanese technology and implementation environment. Priorities were set, and a short list was created as a candidate project summary table of the top Six (6) candidate projects for the Yen-Loan Fund, as itemized below:

Evaluation Results of Yen-Loan Fund Projects

No.	Projects	Development Impact	Investment Impact	Japanese Technology	Implementation Environment	Total	Ranking
		30	10	20	40	100	
Air01	Introduction of improved coal-fired hot water supply boiler	20.70	6.00	7.20	10.00	43.90	20
Air02	Central heating using renewable energy, incineration equipment, etc.	18.48	2.00	10.80	24.00	55.28	18
Air03	LNG/CNG introduction infrastructure development	25.80	6.00	12.00	21.00	64.80	10
Air04	Construction of improved fuel manufacturing plant	22.56	7.20	14.00	34.00	77.76	3
Air05	Improvement of intersections and road networks for the mitigation of traffic congestion	27.24	8.00	17.60	29.00	81.84	1
Air06	Introduction of DPF for public buses	20.28	7.20	15.20	20.00	62.68	12
Wat01	Main line pipe maintenance in the central treatment area	23.28	6.00	13.60	24.00	66.88	8
Wat02	Reconstruction of aged sewer pipes in the central treatment area	22.92	8.00	17.20	33.00	81.12	2
Wat03	Installation of wastewater pre-treatment facility at factories	28.68	2.00	5.60	32.00	68.28	6
Wat04	Sewage sludge utilization digestion gas power generation project	18.60	2.00	5.60	22.00	48.20	19
Wat05	Urban rainwater drainage plan / facility improvement management	23.28	2.00	8.80	27.00	61.08	15
WM01	Construction of WtE facility (waste power generation / heat supply facility)	20.76	6.80	11.60	27.00	66.16	9
WM02	Construction of intermediate treatment facility (recycling facility) for solid waste	23.52	6.80	6.40	25.00	61.72	13
WM03	Construction of recycling facility for automobile parts	22.32	5.20	8.00	26.00	61.52	14
WM04	Hazardous waste final disposal site (managed final disposal site)	21.12	5.20	9.60	31.00	66.92	7
WM05	Introduction of hazardous waste treatment facility	21.60	6.40	8.00	33.00	69.00	5
WM06	Construction of a comprehensive waste treatment facility (EPC + SV dispatch)	21.60	6.40	13.60	33.00	74.60	4
ClC01	Introduction of energy saving technology (hot water valve control system for heating)	20.76	5.60	8.80	24.00	59.16	16
ClC02	Effective utilization of renewable energy by introducing storage batteries	20.40	9.20	8.80	17.00	55.40	17
ClC03	Introduction of heat pump and heat storage heater	20.46	6.80	8.40	29.00	64.66	11

Summary of Shortlisted Candidate Projects for the Yen-Loan Fund

Ranking	No.	Projects	Outline	Implementation Body	Project Cost (Billion Yen)
1	Air05	Improvement of intersections and road networks for the mitigation of traffic congestion	Ajilchin Flyover Construction Project (8 billion Yen) and Green Avenue Construction Project (4-10 billion Yen)	Ministry of Road and Transport Development (MRTD) and UB City	12-18
2	Wat02	Reconstruction of aged sewer pipes in the central treatment area	Reconstruction of the existing 50 km of sewer pipes	Water Supply and Sewerage Authority of UB City (USUG)	7.1-7.5
3	Air04	Construction of improved fuel manufacturing plant	Installation of crushers, high pressure molding machine and conveyor, etc. in addition to the existing plant	Ministry of Energy	3.5-4
4	WM06	Construction of a comprehensive waste treatment facility (EPC + SV dispatch)	Engineering, Procurement and Construction (EPC) of a comprehensive waste treatment facility including hazardous waste and dispatching of supervisors	Ministry of Environment and Tourism (MET) and UB City Environmental Pollution and Waste Management Division (EPWMD)	20
5	WM05	Introduction of hazardous waste treatment facility	EPC of hazardous waste treatment facility and dispatching of supervisors	EPWMD	5
6	Wat03	Installation of wastewater pre-treatment facility at factories	Installation of wastewater pre-treatment facility at about 150 factories	USUG	30.9

<u>Examination of Technical Assistance under the Yen-Loan Fund</u>

- Technical Cooperation Project for Capacity Strengthening of Monitoring and Management System for Factory Wastewater: To implement efficiently and effectively the aforementioned "Shortlisted Candidate Projects for Yen-Loan Fund Ranking No.6, Wat03: Installation of Wastewater Pre-Treatment Facility at Factories", it is necessary to strengthen the monitoring system of USUG and GASI, which is currently lacking, and to establish a management system on the factory side.
- Technical Cooperation Project for Formulation of Discarded Automobile Recycling System: Considering automobile recycling system in Japan, a discarded automobile recycling system, such as the automobile registration system and the establishment of a fund for the treatment of hazardous waste derived from discarded automobiles, should be formulated to carry out the automobile recycling project locally.

6. RECOMMENDATIONS FOR FUTURE SUPPORT POLICIES

<u>Air Pollution Control</u>

- Introduction of additional equipment to improve the improved fuel as a model equipment
- Support for the establishment of Improved Fuel Development Center (tentative name) that can conduct industrial analysis and combustion tests
- Support the introduction of gas power generation as a middle power source
- Development of infrastructure for introduction of LNG and CNG
- Review of the preparatory survey of the Ajilchin Flyover Project
- Formulation of scope for Green Avenue Construction Project

<u>Water Pollution Control</u>

- Technology demonstration project to promote the introduction of Japanese technology for reconstruction of the existing aged sewer pipes
- Financial support by the government for the installation of pre-treatment facilities at factories
- Strengthening of regulatory capacity and self-monitoring of wastewater treatment by factory

<u>Solid Waste Management</u>

- Mitigation of project risk to Japanese companies
- Implementation of survey for partner companies
- Securing the superiority of Japanese companies
- Collection of basic waste information

<u>Climate Change Mitigation</u>

- Support of business environment

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ABBREVIATIONS AND ACRONYMS

3R	Reduce, Reuse, Recycle
ADB	Asian Development Bank
AE	Accredited Entity
APRD	Air Pollution Reducing Department of Capital City
ASR	Automobile Shredder Residue
ATS	Automatic Transfer Switch
BAU	Business-as-usual
BCP	Business Continuity Plan
BESS	Battery Energy Storage System
BPO	Business Process Outsourcing
BRT	Bus Rapid Transit
CCT	Clean Coal Technology
CFWH	Coal Fired Water Heaters
CHF	Confoederatio Helvetica Franc (Swiss Franc)
CHPP	Combined Heat and Power Plant
CP	Counterpart
CPUA	City Maintenance and Public Utilities Agency
CLCSD	City Landscaping and Cleaning Service Department
CLEM	Central Laboratory of Environment and Metrology
CNG	Compressed Natural Gas
CTII	CTI Engineering International Co., Ltd.
CWWTP	Central Wastewater Treatment Plant
DAAP	Department of Against Air Pollution of the Capital
DBO	Design, Build and Operate
DIIP	Development Initiative Infrastructure Project
DME	Dimethyl ether
DPF	Diesel Particulate Filter
EBRD	European Bank for Reconstruction and Development
EFF	Extended Fund Facility
EIRR	Economic Internal Rate of Return
EPC	Engineering, Procurement and Construction
EPL	Environmental Protection Loan
EPWMD	Environmental Pollution and Waste Management Division
ERC	Energy Regulatory Commission of Mongolia
ESCO	Energy Service Company
EVRL	End-of-life Vehicle Recycling Law
FP	Focal Point
FRG	Federal Republic of Germany
FS	Feasibility Study

GASI	General Agency for Specialized Inspection
GAVS	General Authority for Veterinarian Services
GCF	Green Climate Fund
GDP	Gross Domestic Products
GHG	Greenhouse Gas
GIS	Geographic Information System
GIZ	Deutshe Geselleschaft fuur Internationale Zusammenarbeit
GGGI	Global Green Growth Institute
GOJ	The Government of Japan
GOM	The Government of Mongolia
GUBBG	Geodesy Usnii Barilga Baiguulamjiin Gazar (Geodesy and Hydraulic Facility Agency)
HOB	Heat Only Boiler
ICR	Inception Report
ICT	Information and Communication Technology
IHI	IHI Corporation
IPPU	Industrial Processes and Product Use
ITP	Industry Technology Park
JARC	Japan Automobile Recycling Promotion Center
JCC	Joint Coordination Committee
JCM	Joint Crediting Mechanism
JCOAL	Japan Coal Energy Center
JETRO	Japan External Trade Organization
JFPR	Japan Fund for Poverty Reduction
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
KIWWTP	Khargia Industrial Wastewater Treatment Plant
KOICA	Korea International Cooperation Agency
LMHIW	Law of Mongolia on Household and Industrial Waste
LMW	Law of Mongolia about Waste
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LR	Land Readjustment
MCA	Millennium Challenge Account
MCC	Millennium Challenge Corporation
MCUD	Ministry of Construction and Urban Development
ME	Ministry of Energy
MET	Ministry of Environment and Tourism
METI	Ministry of Economy, Trade and Industry
MFA	Ministry of Foreign Affairs
MOFALI	Ministry of Food, Agriculture and Light Industry

MGFC	Mongolia Green Finance Corporation
MHI	Mitsubishi Heavy Industries, Ltd.
MMHI	Ministry of Mines and Heavy Industry
MNS	Mongolian National Standard
MNT	Mongolia Tugrik
MOH	Ministry of Health
MOU	Memorandum of Understanding
MP	Master Plan
MRTD	Ministry of Road and Transport Development
MRV	Measurement, Reporting and Verification
MSFA	Mongolia Sustainable Finance Association
MUGCUP	Project on Capacity Development in Urban Development Sector in Mongolia
NAMEM	National Agency for Meteorology and Environmental Monitoring
NDA	National Development Agency
NDA	National Designated Authority
NDC	Nationally Determined Contribution
NEDS	Narangiin Enger Disposal Site
NEEAP	National Energy Efficiency Action Program
NPO	Non-Profit Organization
O&M	Operation and Maintenance
OSNAAG	Oron Suuts, Niitiin Aj Ahuin Udirdah Gazar (Ulaanbaatar Housing and Public Services Company)
PBL	Policy Based Loan
PIP	Public Investment Program
PIU	Project Implementation Unit
PLC	Programmable Logic Controller
PMU	Project Management Unit
PPP	Public Private Partnership
RSD	Remote Sensing Device
SC	Steering Committee
SDC	Swiss Development Cooperation
SDGs	Sustainable Development Goals
SDV2030	Sustainable Development Vision 2030
SLCPs	Short-Lived Climate Pollutants
SME	Small and Medium Scale Enterprises
SNG	Synthetic Natural Gas
SUR	SUURI-KEIKAKU Co. Ltd.
SV	Supervision
SWM	Solid Waste Management
TCC	Traffic Control Center
TDDS	Tsagaan Davaa Dump Site

TECI	TEC International Co., Ltd.
TPD	Transport Police Department
TSL	Two Step Loan
UB	Ulaanbaatar
UBCAP	Ulaanbaatar Clean Air Project
UBCG	Ulaanbaatar City Government
UBED	Ulaanbaatar City Environment Department
UBPTSD	Ulaanbaatar City Public Transport Service Department
UBRDD	Ulaanbaatar City Road Development Department
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund
URD	Urban Redevelopment
USD	United States Dollar
USUG	Us Suvgiin Udirdah Gazar (Water Supply & Sewerage Authority of Ulaanbaatar City)
VCR	Vehicle Capacity Ratio
WA	Water Agency
WB	The World Bank
WG	Working Group
WRP	Water Reclamation Plant
WSF	Waste Service Fund
WtE	Waste to Energy

CHAPTER 1. INTRODUCTION

1.1 Background of the Survey

Ulaanbaatar City, the capital of Mongolia, has been facing enormous environmental challenges due to rapid population growth. The Government of Mongolia, in its top development policy paper, Vision-2050, Long-Term Development Policy of Mongolia (hereinafter referred to as “Vision-2050”), which was approved by the Mongolian Cabinet on May 13, 2020, states that Mongolia will enter the status of a developed country by the year 2050. This policy paper also sets nine (9) goals, including natural environmental protection, establishment of sustainable low-carbon society adapting climate change, natural environment-friendly, easy to live and human-oriented smart city development, mitigation of air pollution, and proper treatment and disposal of wastewater and solid waste. (Details of Vision-2050 are given in **Subsection 2.2.1**.

In the Country Assistance Policy for Mongolia by the Ministry of Foreign Affairs, Japan, December 2017, “Environment-Friendly and Balanced Economic Development” is given priority. High-quality environmental infrastructure development to address the urban environmental issues is highlighted under the “Development of Environment-Friendly Safe City” and a program of the “Development Project of Environment-Friendly Safe City”. Moreover, the Country Analysis Paper to Mongolia (September 2017) published by the Japan International Cooperation Agency (hereinafter referred to as “JICA”) analysed and recommended that JICA should focus on the urban environment issues affecting the quality of life to attain the status of Environment-Friendly Safe City.

Under the circumstances, it is imperative to realize the appropriate balance between economic growth and environmental protection by accelerating environmental investment to meet the growing global needs in addition to the assistance in institutionalizing the environmental impact assessment for better management of urban environment and development of the eco-friendly non-mining sector. This survey, therefore, will identify potentials of environmental investment to finance various assistance schemes by undertaking a review of the past project reports and analysing key challenges in the environmental sector of the country. When promising projects fundable by Japan’s Yen Loan scheme are identified in this survey, a separate mission for the preparation of a project(s) will be dispatched to Mongolia for further consultations and assessment.

1.2 Overview of the Survey

1.2.1 Objective of the Survey

The objective of the survey is to formulate and identify prospective projects which could be financed by foreign loan programs, such as Yen-loans, overseas investment loans, etc. To this end, the survey will review and analyse: 1) all the major environmental problems, 2) the government’s priorities and needs for infrastructure development, 3) the JICA Country Analysis Paper, and 4) the current status of assistance by other donors, including the Asian Development Bank and the World Bank. The possibilities of application of Japan’s technologies and know-how will be sought in the survey, with due consideration on JICA’s past assistance and potential in business development in relation to the environment by Japanese firms. It should be noted, however, that this survey is not intrinsically designed to indicate any commitment for further assistance by the Government of Japan.

1.2.2 Survey Site

The survey covers the whole area of Ulaanbaatar, including the Nalaikh, Baganuur, and Bagakhangai districts, as shown in the Location Map.

1.3 Survey Team and Survey Process

A joint venture composed of CTI Engineering International Co., Ltd. (hereinafter referred to as "CTII"), SUURI-KEIKKU Co., Ltd. (hereinafter referred to as "SUR"), and TEC International Co., Ltd. (hereinafter referred to as "TECI") started the survey in February 2020. However, due to the spread of the new coronavirus infection, all field surveys were cancelled, and the survey period scheduled for August 2020 was postponed to May 2021. It was also decided to set up a field survey team (employee) to carry out the field survey by remote (virtual communication).

Table 1.1 shows the list of survey team members (consultants and field survey teams), and **Figure 1.1** shows the survey processes.

Table 1.1 List of Survey Team Members

Name		Area of Responsibility	Affiliation*1
Survey member	Masakazu MAEDA (Mr.)	Team Leader/Infrastructure Development Plan	CTII
	Toru TABATA (Mr.)	Air Pollution Measures (1)/Climate Change Mitigation (1)	SUR
	Hajime ENDOU (Mr.)	Air Pollution Measures (2)	SUR (JCOAL)
	Fumihiko KUWABARA (Mr.)	Climate Change Mitigation (2)	SUR
	Akio OKAZAKI (Mr.)	Road Transport Infrastructure	CTII
	Haruki TAKAHASHI (Mr.)	Sewage and Drainage Facilities/Sewage and Sludge Treatment Facilities (1)	TECI
	Kouichi OGATA (Mr.)	Sewage and Drainage Facilities/Sewage and Sludge Treatment Facilities (2)	TECI
	Hirofumi MIYOSHI (Mr.)	Deputy Team Leader/Solid Waste Management Facilities	CTII
Field survey team (employee)	AMARJARGAL Nayanbaatar (Ms.)	Field Survey Team (Leader)	CTII
	KHISHIGJARGAL Altangerel (Mr.)	Field Survey Team (Air Pollution Measures/Road Transport Infrastructure)	Local employment
	MUNKHZAYA Mend-Ooyo (Ms.)	Field Survey Team (Climate Change Mitigation)	Local employment
	ALTANTUYA Chimeddorj (Ms.)	Field Survey Team (Sewage and Drainage Facilities/Sewage and Sludge Treatment Facilities)	Local employment
	ERDENEBAT Yadamsuren (Mr.)	Field Survey Team (Solid Waste Management Facilities)	Local employment

Note: *1 CTII: CTI Engineering International Co., Ltd., SUR: SUURI-KEIKAKU Co., Ltd., JCOAL: Japan Coal Energy Center, TECI: TEC International Co., Ltd.

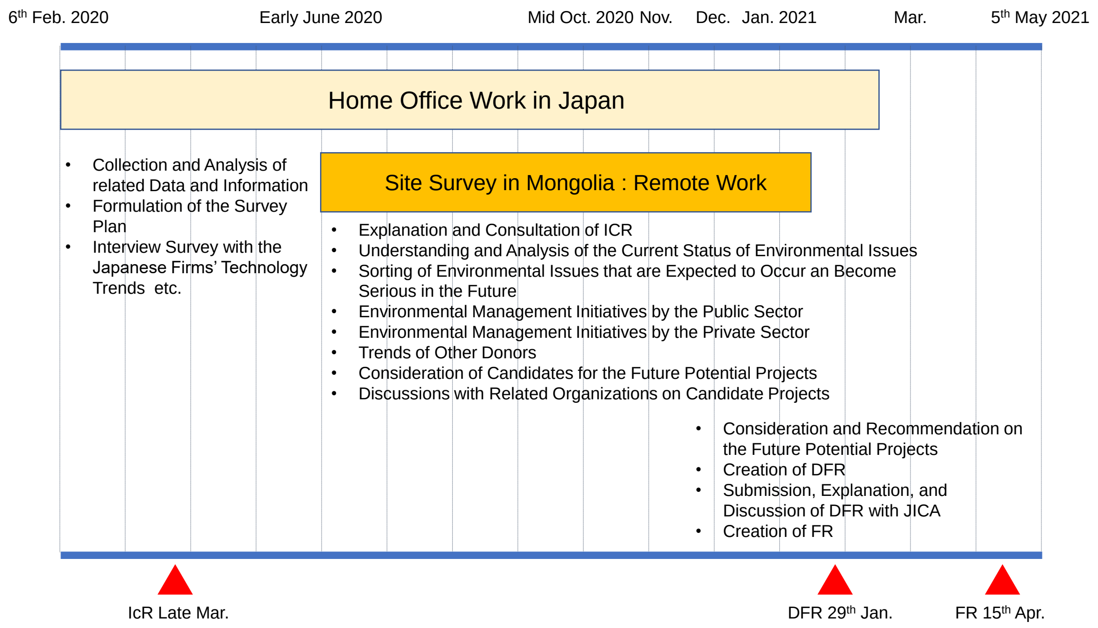


Figure 1.1 Survey Process

1.4 Survey Schedule

Table 1.2 shows the domestic survey schedule in Japan, and **Table 1.3** shows the field survey (remote) schedule in Mongolia.

Table 1.2 Domestic Survey Schedule (Visited Destination)

No.	Date and Time		Destination
1	18 February 2020 (Tue.)	9:00 - 10:00	Sapporo Waterworks Bureau
2		10:30 - 11:30	JICA Hokkaido
3		13:30 - 14:00	Ministry of Economy, Trade and Industry, Hokkaido
4		15:00 - 16:30	Hokkaido Mongolia Economic Exchange Promotion Study Group
5	19 February 2020 (Wed.)	9:30 - 10:40	Local private firm (Sewerage Works)
6		13:30 - 14:40	Asahikawa City Waterworks Bureau
7		14:30 - 15:40	Sapporo City Environment Bureau
8		16:00 - 17:00	Japan External Trade Organization (JETRO)/ Hokkaido Trade Information Center

Table 1.3 Field Survey (Remote) Schedule (Visited Destination)

No.	Date and Time		Destination (ministries, bureaus, interviewers)
1	27 August 2020 (Thu.)	15:00 - 15:30	Ministry of Energy (ME) Interviewer: Director, Ms. Davaasuren (Fuel Policy Implementation Coordination Department)
2	28 August 2020 (Fri.)	13:00 - 14:00	Department of Against Air Pollution of the Capital (DAAP) Interviewer: Director, Ms. Tsolmon, Manager, Davaajargal (Air Quality Control Division)
3	31 August 2020 (Mon.)	11:30 - 12:00	Ministry of Mining and Heavy Industry (MMHI) Interviewer: Mr. Ochir, Former PIU Leader, SNG production through coal gasification project

№	Date and Time		Destination (ministries, bureaus, interviewers)
4	2 September 2020 (Wed.)	13:00 - 14:00	Department of Against Air Pollution of the Capital (DAAP) Interviewer: Director, Ms. Tsolmon, Head Mr. Davaajargal (Air Quality Control Division), Officer, Mr. Nergui (Air Quality Control Division)
5		15:00 - 17:00	Ministry of Construction and Urban Development (MCUD) Public Facility Policy Implementation Coordination Department Interviewer: Director, Ms. Lkhagvatseden, Senior Officer, Mr. Nyam-Ochir, Head Mr. Altaibaatar (External Relations Division), Officer, Ms. Ariunjargal (Policy and Planning Department), Mr. Bolorchuluun (Central Sewage Treatment Plant Construction PIU leader)
6	4 September 2020 (Fri.)	10:00 - 10:30	Tavan Tolgoi Fuel company Interviewer: In charge of fuel development, Mr. Galymbek
7		11:00 - 12:00	Ministry of Foreign Affairs (MFA) Interviewer: Director of Investment Research Center, Mr. Gankhuyag
8	7 September 2020 (Mon.)	11:00 - 11:30	National Agency for Meteorology and Environmental Monitoring (NAMEM) Interviewer: Officer in charge of data analysis, Mr.Bayarmagnai (Environmental Analysis Division)
9	8 September 2020 (Tue.)	9:30 - 11:00	Environmental Pollution and Waste Management Division (EPMCD) Interviewer: Head, Mr. Ariguun
10		11:30 - 12:30	Ulaanbaatar City Road Development Department (UBRDD) Interviewer: Officer in charge of project and program, Mr. Khasbaatar (Administration and Finance Division), Senior Officer, Mr. Ankhbayar (Policy Implementation Division)
11		17:30 - 18:10	Ministry of Food, Agriculture and Light Industry (MOFALI) Livestock Industry Policy Implementation Coordination Department Interviewer: Officer in charge of Livestock Health, Ms. Saruultuya
12	9 September 2020 (Wed.)	10:00 - 11:00	Ministry of Construction and Urban Development (MCUD) External Relations Division Interviewer: Head, Mr. Altaibaatar
13		10:00 - 11:30	Ministry of Environment and Tourism (MET) Environment and Climate Fund Interviewer: In charge of JCM project, Ms. Otgontsetseg
14	10 September 2020 (Thur.)	15:30 - 16:30	Ministry of Road and Transport Development (MRTD) Road Transport Policy Implementation and Coordination Department Interviewer: Director, Mr. Jargalsaikhan, Officer, Khavidolda
15	11 September 2020 (Fri.)	9:00 - 10:00	Ministry of Road and Transport Development (MRTD) Policy and Planning Department Interviewer: Director, Ms. Gerelnyam (Policy and Planning Department), Head, Mr. Sereeter (Policy and Planning Department, Standards and Norma Division), Officer, Ms. Ulziijargal
16		10:00 - 10:45	Ministry of Food, Agriculture and Light Industry (MOFALI) Interviewer: Officer in charge of Leather Product Manufacturing, Ms. Tsend-Ayush (Light Industry Policy Implementation Coordination Department)

№	Date and Time		Destination (ministries, bureaus, interviewers)
17	11 September 2020 (Fri.)	11:00 - 13:00	Water Supply & Sewerage Authority of Ulaanbaatar City (USUG) Interviewer: Project Engineer, Ms. Munguntsooj (Engineering Policy Division)
18		11:30 - 12:00	Transport Police Department (TPD) Interviewer: Senior Officer in charge of information and research, Ms. Erdenechimeg (General Affairs Department)
19	14 September 2020 (Mon.)	10:00 - 10:30	Department of Against Air Pollution of the Capital (DAAP) Interviewer: Officer in charge of exhaust gas measurement, Mr. Jargalsaikhan (Air Quality and management coordination division)
20		13:30 - 14:45	Energy Regulatory Commission of Mongolia (ERC) Interviewer: Director, Mr. Atarjargal (Energy Efficiency and Conservation Department), Director, Mr. Tsedenjav (Licensing and Monitoring Department), Head, Mr. Jambaa (Energy Market Research and Cooperation Division), Officer, Ms. Enkhtuya
21	15 September 2020 (Tue.)	10:00 - 11:00	Ulaanbaatar City Environment Department (UBED) Interviewer: Officer in charge of Climate Change and Environmental Monitoring, Ms. Enkhee (Environment and Resources Division)
22		10:30 - 11:15	Leather Processing Industry Federation Interviewer: Staff, Mr. Bat-Ochir
23		15:45 - 16:30	City Landscaping and Cleaning Service Department (CLCSD) Interviewer: Director, Mr. Erdenebaatar
24	16 September 2020 (Wed.)	14:00 - 14:30	Ministry of Mining and Heavy Industry (MMHI) Interviewer: Ts.Bold (Heavy Industries and Oil Policy Implementation Coordination Department)
25	17 September 2020 (Thu.)	11:00 - 12:00	Ministry of Environment and Tourism (MET) Interviewer: Officer, Mr. Munkhbat (Environment and Natural Resources Management Department)
26		14:00 - 14:30	Ulaanbaatar City Public Transport Service Department (UBPTSD) Interviewer: Deputy Director, Mr. Bulgaa
27	23 September 2020 (Wed.)	10:30 - 11:10	Emeelt Light Industry Park Office Interviewer: Water and Sewage Engineer, Ms. Oyunchimeg, Engineer, Mr. Enkh-Amgalan
28		11:30 - 12:00	Central Sewage Treatment Plant PIU Interviewer: Officer, Mr. Ganbaatar
29	28 September 2020 (Mon.)	15:00 - 15:30	Ulaanbaatar City Road Development Department (UBRDD) Interviewer: Officer in charge of project and program, Mr. Khasbaatar (Administration and Finance Division)
30	12 October 2020 (Mon.)	14:00 - 14:30	Ulaanbaatar City Road Development Department (UBRDD) Interviewer: Officer in charge of project and program, Mr. Khasbaatar (Administration and Finance Division)
31		15:00 - 15:30	Ministry of Environment and Tourism (MET) Interviewer: Officer in charge of waste management, A.Oyun (Environment and Natural Resources Management Department)
32	14 October 2020 (Wed.)	10:00 - 10:30	UB Mayor's Office Geodesy and Water Facilities Department Interviewer: Engineer, Mr. Batsaikhan
33	23 October 2020 (Fri.)	14:30 - 16:00	Capital Governor's Office Development Policy and Planning Division Interviewer: Senior Officer, Ms. Erdenechimeg

№	Date and Time		Destination (ministries, bureaus, interviewers)
34	26 October 2020 (Mon.)	11:30 - 12:00	UB Mayor Office Engineering Facilities Department Interviewer: Officer in charge of Architectural and City Planning, Mr. Otgonbat
35	29 October 2020 (Thu.)	10:00 - 11:25	Leather Processing Industry Federation Interviewer: Chairman, Mr. Bayarsaikhan
36		14:30 - 16:00	National Development Agency (NDA) Interviewer: Head, Ms. Tumendelger (Research and Analysis Department), Senior Officer, Mr. Sugar
37	3 November 2020 (Tue.)	15:00 - 16:00	Traffic Control Center (TCC) Interviewer: Deputy Director, Mr. Battsooj
38	4 November 2020 (Wed.)	10:00 - 11:30	Khargia pretreatment plant Interviewer: Director, Mr. Bayarbileg
39	10 November 2020 (Mon.)	10:30 - 11:00	Ministry of Food, Agriculture and Light Industry (MOFALI) General Authority for Veterinary Services Interviewer: Deputy Director, Mr. Batsaikhan
40	7 December 2020 (Wed.)	15:00 - 17:00	Ministry of Environment and Tourism (MET) Interviewer: Officer in charge of waste management, A.Oyun (Environment and Natural Resources Management Department)
41	16 December 2020 (Wed.)	15:00 - 16:30	Environmental Pollution and Waste Management Division (EPWMD) Interviwer: Head, Mr. Ariguun
42	18 December 2020 (Fri.)	11:00 - 12:30	MCC Mongolia Office CEO of MCC, Mr. Sodontogos, Mr. Alex Russin, Resident Country Director of MCA, Downstream Wells Activity Team Head, Mr. Batsukh, Wastewater Recycling Activity Team Interviewer：Head, Mr. Khishigt, Water Sector Sustainability Activity Team Head, Ms. Unurjargal, Environmental and Social Performance Team Head, Mr. Dashzeweg
43	23 December 2020 (Wed.)	10:30 - 11:00	Ministry of Construction and Urban Development (MCUD) Public Facility Policy Implementation Coordination Department Interviewer: Director, Mr. Tsogtsaikhan, Senior Officer, Mr. Nyam-Ochir, Officer, Mr. Ganbaatar
44	24 December 2020 (Thu.)	14:00 - 16:00	Ulaanbaatar City Road Development Department (UBRDD) Interviewer: Officer in charge of project and program, Mr. Khasbaatar (Administration and Finance Division)
45	6 January 2020 (Wed.)	11:00 - 12:10	Korea International Cooperation Agency (KOICA)
46	8 January 2020 (Fri.)	10:00 - 12:30	Ministry of Construction and Urban Development (MCUD) Public Facility Policy Implementation Coordination Department Interviewer: Director, Mr. Tsogtsaikhan, Senior Officer, Mr. Nyam-Ochir, Officer, Mr. Ganbaatar Ministry of Food, Agriculture and Light Industry (MOFALI) Light Industry Policy Implementation Coordination Department Interviewer: Director, Mr. Dondogdorj, Officer, Ms. Tsend-Ayush National Development Agency (NDA) Research and Analysis Department Interviewer: Head, Ms. Tumendelger Water Supply & Sewerage Authority of Ulaanbaatar City (USUG) Engineering Policy Division Interviewer: Head, Mr. Odkhuu, Officer in charge of drainage, Mr. Javkhlan, PIU Manager, Mr. Purevjav, Engineer, Mr. Jargaldelger

№	Date and Time		Destination (ministries, bureaus, interviewers)
			Small and Medium Business Authority, Loan and Project Division Interviewer: Head, Mr. Dashkhuu
47	13 January 2020 (Tue.)	14:00 - 15:30	Ulaanbaatar City Road Development Department (UBRDD) Interviewer: Officer in charge of project and program, Mr. Khasbaatar (Administration and Finance Division), Senior Officer, Mr. Ankhbayar (Policy Implementation Division)
48	15 January 2020 (Fri.)	10:30 - 12:30	Ministry of Road and Transport Development (MRTD) Policy and Planning Department Interviewer: Director, Ms. Gerelnyam (Policy and Planning Department), Senior Officer, Mr. Odgerel, Officer, Mr. Ugtakhbayar
49	19 January 2020 (Tue.)	13:00 - 14:30	Ministry of Finance, Development Initiative and Infrastructure Project (DIIP) Interviewer: Deputy Coordinator, Mr. Batbold, Officer, Mr. Batzaya
50	4 March 2021 (Thu.)	15:00～16:00	Ministry of Environment and Tourism (MET) Environment and Natural Resources Management Department Interviewer: Director Mr. Batsansar, Officer in charge of waste management Ms. Oyun
51	9 March 2021 (Tue.)	15:00～16:30	Ministry of Construction and Urban Development (MCUD) Public Facility Policy Implementation Coordination Department Interviewer: Director Mr. Tsogtsaikhan Water Supply & Sewerage Authority of Ulaanbaatar City (USUG) Engineering Policy Division Interviewer: Head Mr. Odkhuu, Officer in charge of drainage Mr. Javkhlan, PIU manager Mr. Purevjav, engineer Mr. Jargaldelger, engineer Mr. Orgilt
52	12 March 2021 (Fri.)	14:00～15:00	Ministry of Food, Agriculture and Light Industry (MOFALI) Light Industry Policy Implementation Coordination Department Interviewer: Director Mr. Dondogdorj, Officer Ms. Tsend-Ayush

CHAPTER 2. BASIC INFORMATION ON ENVIRONMENTAL ISSUES, UNDERSTANDING THE CURRENT SITUATION AND ANALYZING ISSUES

2.1 Socio-Economic Situation

The population of Mongolia is about 3.3 million, and the population of Ulaanbaatar (hereinafter referred to as “UB”) City is about 1.54 million (2019, Population of Mongolia, National Statistic Office, updated data as of June 10, 2020). The population growth rate has been 3% on the national average since 2010, but the average for the five years up to 2018 reached 5.6%. The concentration has thus been increasing (from "Vision-2050").

The Mongolian economy first turned to positive growth in 1994 after the transition to a market economy in the 1990s. The economy has continued to develop steadily since then, but in 2008, it was affected by the global financial and economic crisis and it showed negative growth in 2009 (-1.3%). Then, in 2010, in addition to the steady development of the mineral resources field, the recovery of the international market for mineral resources supported the expansion of domestic demand. Therefore, the economic growth rate in 2010 was 6.4% and in 2011 it was 17.3%, achieving a V-shaped recovery. Although it continued to grow at a high rate of 12.4% in 2012 and 11.7% in 2013, foreign investment in Mongolia dropped sharply due to restrictive investment policies and legislation against the backdrop of resource nationalism. In addition, due to the economic slowdown in China and the impact of global resource depreciation, the mining industry, a major industry, became sluggish, and the economic growth rate fell to 2.3% in 2015 and 1% in 2016. In light of these difficult circumstances, the Mongolian government agreed in February 2017 with the International Monetary Fund (hereinafter referred to as “IMF”) to accept the Extended Fund Facility (hereinafter referred to as “EFF”). After that, while implementing the IMF-EFF, the price of mineral resources such as coal increased in 2017, and as a result of this benefit, industrial production, centerd on the mining industry which accounted for about a quarter of GDP, showed growth, and the GDP growth rate recovered to 5.3% in 2017. Economic growth has continued steadily since 2018, but GDP growth in the first quarter of 2020 was -10.7% year-on-year, and the total trade amount during the same period was -28.1% compared to the same period of the previous year. Then, the spread of the new coronavirus infection has had a great impact on the Mongolian economy in 2020 [Ministry of Foreign Affairs, Mongolian Basic Data].

The 2007-2009 JICA survey of the city planning master plan and urban development program in Ulaanbaatar, Mongolia, shows that there are 5 industries with high potential in UB City, namely; (1) Mining support and mining related industries; (2) Tourism and tourism related industries; (3) Cashmere processing industry; (4) Information and Communication Technology (hereinafter referred to as “ICT”) and Business Process Outsourcing (hereinafter referred to as “BPO”) industries; and (5) Agricultural food processing industry.

2.2 Policy and Plan

2.2.1 National Policy

(1) Vision-2050

The vision and development policy keywords shown in "Vision-2050", which is the long-term development policy of Mongolia, are as follows:

[Long-Term Development Vision]

By 2050, Mongolia will be a developed country in terms of socio-economic development, with sustainable protection of nature, language, borders, and culture.

[Development Policy Keywords]

Based on these visions and keywords, the following nine long-term development policy goals are set forth.

1. Common National Values: Growing as a nation with a deep sense of national identity sharing common values.
2. Human Development: Bringing Mongolia's Human Development Index value to 0.9 and to be ranked in the top 10 countries of the World Happiness Index.
3. Quality of Life and Middle-Class Society: Increasing the population share of the middle-income groups sustained by favorable living conditions up to 80 percent by 2050.
4. Economy: Stepping over the threshold of developed countries by growing the GDP by 6.1 times and GDP per capita by 3.6 times to 15 thousand USD.
5. Good Governance: Establishing a good governance with full respect for human rights and justice and zero tolerance for corruption.
6. Green Development: Promoting environmental sustainability combined with green growth.
7. Peaceful and Safe Society: Creating internal and external environment to protect the vital national interests.
8. Ulaanbaatar City and Satellite Cities: Building people-centerd cities with comfortable and environment-friendly living conditions.

(2) Five-Year Development Policy of Mongolia (2021-2025)

This five-year policy stipulates the development policy of Mongolia for 2021-2025 and was approved under the Circular No. 23 of the Diet on August 28, 2020. It consists of the following Six (6) items.

1. Five-Years Basic Development Policy of Mongolia
2. Evaluation index and achievement targets of Five-Year Basic Development Policy of Mongolia
3. Five-year investment program of Mongolia
4. Investment program indicators
5. List of projects and businesses that should solve the funding source
6. Feasibility Study (hereinafter referred to as "FS") survey, projects and business lists that require design creation

Of these, (2) Evaluation index and achievement targets of the Five-Year Development Policy of Mongolia, which are related to the environmental infrastructure in this work, are shown in **Table 2.1**. In addition, (3) Five-year investment program of Mongolia, which are related to the environmental infrastructure in this work, are shown in

Table 2.2. Furthermore, (5) List of projects and businesses that should solve the funding source, and (6) FS survey, projects and business lists that require design creation, which are related to the environmental infrastructure in these works, are shown in **Table 2.3** and **Table 2.4**.

Table 2.1 Evaluation Index of Five-Year Development Policy of Mongolia and Related Items in Achievement Goals

No.	Index	Unit	Base line	Achievement Goal (2025)	Explanation of Indicators	Frequency of Information Gathering	Institution in Charge
47	Households equipped with lifelines Percentage of total households supplied	%	25.3	33	Calculate the population that lives in your home compared to the total population. The 2015 interim survey results will be updated with the 2020 population and housing survey results.	Once every 5 years	National Statistics Committee

No.	Index	Unit	Base line	Achievement Goal (2025)	Explanation of Indicators	Frequency of Information Gathering	Institution in Charge
53	Percentage of GDP in the mining sector	%	24.3	30.6	Calculate the growth rate of each field by comparing it with GDP	Once a year	Cabinet meeting
54	Percentage of GDP in the processing industry	%	10.9	12	Calculate the growth rate of each field by comparing it with GDP	Once a year	Cabinet meeting
55	Percentage of GDP in the transportation and logistics fields	%	4.6	5.1	Calculate the growth rate of each field by comparing it with GDP	Once a year	Cabinet meeting
75	Percentage of population supplied with water sources that meet the standards	%	82.5	85	Base as of 2018	Once every 5 years	Ministry of Environment and Tourism (MET), Ministry of Construction and Urban Development (MCUD), National Statistics Committee
76	Percentage of the population supplied with sanitary facilities that meet the standards	%	69	70	Base as of 2018	Once every 5 years	MET, MCUD, National Statistics Committee
77	Greenhouse gas emissions	%	Base scenario	12.3	-	Once every two years	MET
78	Percentage of recycled waste	%	7.6	27	Calculate the percentage of total waste recycled in the year. Base as of 2018	Once a year	MET
79	Percentage of waste that is constantly refurbished in municipalities and treated in a manner that meets the standards	%	25.6	52	Base as of 2018	Once a year	MET, MCUD, Governor's office of District (prefecture) and the capital
80	Percentage of Government Green Procurement	%	-	10	-	Once a year	Ministry of Finance, Procurement Agency
85	Extension of new flood embankments, waterways, and drainage facilities	Kilo meter	432.5	636.9	Base as of 2019	Once a year	MCUD
87	Newly designed regional transportation and logistics center	place	-	4	The index refers to the new center and is displayed in total. The baseline starts at 0.	Once a year	Ministry of Road and Transport Development (MRTD)
88	Number of new agricultural industry and technology parks	place	-	10	The index is represented by the number of the newly established place. The baseline starts at 0.	Once a year	National Development Agency
89	Percentage of the powered population	%	-	95.5	Baseline as of 2015	Once a year	Ministry of Energy (ME)
90	New national highway extension	Kilo meter	-	2022	The index is the extension of the newly constructed road and is calculated in total. The baseline starts at 0.	Once a year	MRTD
93	Urban development index	index	0.504	0.572	1. Environment, 2. Infrastructure, 3. Standard of living, 4. Education, 5. Health, 6. Residents' safety according	Once a year	Governor's Office

No.	Index	Unit	Base line	Achievement Goal (2025)	Explanation of Indicators	Frequency of Information Gathering	Institution in Charge
					to UB City index calculation method		
94	Annual average of PM 2.5 in the atmosphere of UB City	μg/m^3	64	40	Baseline as of 2018	Once a year	MET
95	Annual average of PM 10 in the atmosphere of UB City	μg/m^3	141	88	Baseline as of 2018	Once a year	MET

Table 2.2 Five-Year Investment Program of Mongolia

No.	Project Name	Period	Budget Amount /Million MNT/	Funding Source	Institution in Charge
Income-Adaptive Housing					
33	1008 Household Condominium Project around Nogoon nuur	2019-2022	140,766.60	China Grant Aid	MCUD
			4,303.80	National budget	
34	Solongo-1 Housing Complex Development Project	2020-2023	410,271.60	Korean Soft Loan	MCUD
35	Solongo-2 Housing Complex Development Project	2020-2023	347,240.30	Korean Soft Loan	MCUD
36	Bayangol am rental apartment district construction project	2020-2023	325,662.00	Korean Soft Loan	MCUD
37	Green housing and adaptable city renewal project to match UB City income	2021-2024	170,355.00	ADB Soft Loan (Normal)	Governor's Office
		2021-2025	56,785.00	ADB Soft Loan (Special)	Governor's Office
		2021-2026	269,728.80	GCF Soft Loan (Normal)	Governor's Office
		2021-2026	141,962.50	GCF Grant Aid	Governor's Office
		2021-2026	8,517.80	Advanced technology fund Grant Aid	Governor's Office
38	Eco Yarmag-1 Ger District Redevelopment Project	2019-2021	206,865.60	Funding source unresolved	MCUD
			5,817.40	Direct investment / National Housing Corporation /	
39	Withdrawal and rebuilding of 58 dilapidated apartment buildings	2019-2021	110,950.00	Funding source unresolved	Governor's Office
			1,315.10	Capital budget	
Mining, Heavy Industry					
40	Oil processing factory construction	2016-2023	3,521,780.1	Indian EXIM Bank Soft Loan	Ministry of Mines and Heavy Industry (MMHI)
			250,000.00	Development bank loan	
Infrastructure: Energy					
65	1-4 turbo generator capacity expansion and improvement of No. 4 thermal power plant	2019-2022	246,450.00	Development bank	ME
69	Energy project 2	2017-2022	120,768.80	World Bank Soft Loan	ME
			35,206.70	World Bank Grant Aid	
71	Large-scale storage battery project used in energy networks	2021-2024	283,925.00	ADB Soft Loan	ME
72	UB City Heating Supply Improvement Project	2021-2023	117,621.80	World Bank Soft Loan	ME
73	UB City Central Heating Supply Project	2021-2023	14,196.30	EBRD Grant aid	ME
			28,392.50	EBRD	

No.	Project Name	Period	Budget Amount /Million MNT/	Funding Source	Institution in Charge
				Soft Loan	
74	Baganuur Thermal Power Plant Project	2015-2024	2,494,934.6	Concession contract, PPP	ME
Infrastructure: Roads, Transportation					
83	UB-Darkhan Road widening	2019-2023	397,495.00	EBRD Soft Loan	MRTD
Infrastructure: Construction, Urban Development					
91	UB Central Sewage Treatment Plant	2019-2023	708,604.70	China Soft Loan	MCUD
			34,860.30	National budget	
92	A project to stably improve the water supply of UB City over the long term	2021-2025	993,737.50	MCC Grant Aid	MCUD
			317,314.60	National budget	
93	Darkhan City Sewage Management Project	2016-2021	51,059.40	ADB Soft Loan	MCUD
94	Lifeline Improvement Project / Micro Subcenter / Phase 1	2021-2023	567,280.00	China	MCUD
95	Infrastructure Development Project /Darkhan-Uul, Selenge, Songinokhairkhan, Bayanzurkh/	2021-2022	39,031.70	Austrian Soft Loan	MCUD
106	UB City Solid Waste Treatment Facility Development Project	2020-2021	41,737.00	EBRD Loan	Governor's Office
107	Improvement of capacity of Natural Environment Research Center	2021-2024	42,562.00	Korean Soft Loan	MET
108	Tuul and Selbe River flow improvement, environmental improvement project	2021-2024	170,355.00	China Soft Loan	Ministry of Finance
			7,896.00	National budget	
		2019-2024	58,488.70	ADB Grant Aid	
110	Electricity / CNG public transport development project that is nature eco-friendly	2021-2030	638,759.10	Concession contract, PPP	MET
122	10 District (prefecture) Thermal power plant construction project	2019-2022	417,600.10	Korean Soft Loan	ME
123	Improvement of District Center sewage treatment facility	2021-2022	56,921.20	Polish Soft Loan	MCUD
140	UB Ger District Development Investment Support Program 2	2019-2022	84,971.00	ADB Soft Loan	Governor's Office
			105,336.10	ADB Soft Loan	
			162,632.00	EBRD Soft Loan	
141	UB Ger District Development Investment Support Program / 5 Subcenter Development /	2014-2023	234,123.30	ADB Soft Loan and Grant Aid	Governor's Office
			53,778.50	National budget	
142	Underpass project /Songinokhairkhan、Sukhbaatar, Bayanzurkh	2021-2024	113,570.00	China Soft Loan	Ministry of Finance
			5,264.00	National budget	
143	20.9km road construction project to Gachuurt-Nalaikh-Choir intersection	2019-2023	98,551.60	China Soft Loan	Governor's Office
			8,973.10	National budget	
144	UB City Clean Air Project-2	2021	34,071.00	World Bank Soft Loan	Governor's Office
145	Traffic police intersection flyover	2016-2023	120,327.50	China Soft Loan	Governor's Office
146	Introduced cable car to capital public transportation	2021-2023	197,435.20	France Soft Loan	Governor's Office
147	Baganuur Industrial and Technology Park Infrastructure Widening Project	2019-2025	161,158.20	Funding source unresolved	Ministry of Mining and Heavy Industries
			1,154.00	Capital budget	
148	Bagakhangai Light Industry / Technology Park	2019-2025	34,917.40	Funding source unresolved	Governor's Office
			2,768.60	Capital budget	

No.	Project Name	Period	Budget Amount /Million MNT/	Funding Source	Institution in Charge
149	Nalaikh Building Materials Industry / Technology Park Infrastructure Development Project	2014-2023	133,635.60	Funding source unresolved	Governor's Office
			18,675.10	Capital budget	
150	Tuul-1 collector and drainage pipe construction project	2007-2022	21,805.90	Funding source unresolved	Governor's Office
			14,072.40	Capital budget	

Table 2.3 List of Projects that Should Solve the Funding Source

No.	Project Name	Period /Year/	Budget Amount /Million MNT/
Infrastructure: Energy			
36	Widening UB City Amgalan thermal power plant as 50 MW heating and power plant	2021-2022	189,750.0
37	Widening the 3rd thermal power plant with 250MW	2021-2025	861,000.0
38	Widen the high-pressure part of the 3rd thermal power plant with 75MW	2022-2025	310,000.0
39	Widening of the second thermal power plant	2021-2025	795,000.0
Infrastructure: Road, Transportation			
45	Construction of UB City Railway International Passenger Central Station	2022-2024	200,000.0
53	Transportation and logistics center construction project in the eastern and western parts of UB City	2021-2024	77,500.00
Green Development			
58	Construction of a comprehensive facility for hazardous waste	2021-2025	308,000.0
UB City and Satellite City			
83	Widening of Nalaikh thermal power plant/Heating with advanced technology 185MW/	2020-2021	62,220.7
84	Tuul highway	2021-2024	618,495.9
85	Lifeline / Infrastructure development of Emeelt Light Industry / Technology Park	2021-2025	354,791.5
86	Public transport vehicle update	2021-2025	678,700.0
87	Flood embankment facility near Yarmag, rainwater drainage facility	2020-2022	32,128.1
88	Comprehensive evaluation of New Zuunmod and Maidar new cities, finalization of city area, detailed planning, start of maintenance business	2021-2025	46,348.5

Table 2.4 List of Projects Required for Feasibility Study and Design Drawings

No.	Project Name	Remarks
18	Hazardous waste comprehensive facility	FS update, design
24	Transportation and logistics center construction project in the eastern and western parts of UB City	design
27	Bogdkhan railway	Conducted FS survey
28	UB City Railway International Central Station Improvement	FS, design
29	A project that uses sunlight for heating supply	FS
31	Comprehensive evaluation of "New Zuunmod" and Maidar new cities, finalization of city area, detailed planning, start of maintenance project	design
32	New capital development in Orkhon valley	Preliminary survey, FS survey
36	Development of new power sources for increasing heating and power supply and demand in UB City	FS

No.	Project Name	Remarks
37	A gas station that operates as a coordinator based on the infrastructure of the second thermal power plant	FS
41	Baganuur-Nalaikh-Songino 150km aerial power line, substation	FS, design
47	110KW Substation / Dambadarjaa, Bayankhoshuu, Ikhnaran / newly established in UB City	design
59	Updated detailed plans around the airport and Yarmag	design
60	Central network update, new establishment, and scale expansion of UB City lifeline	design
63	Elevation map / Flood embankment, Khan-Uul, Songinokhairkhan, Bayangol district /	Design
64	Engineering maintenance measures MP	MP, design
70	Housing, lifelines and their use, services and water supply, water distribution business management and information digitization, comprehensive smart system development	Design
85	Improvement of the Baganuur thermal power plant	FS, design
90	FS update of Baganuur ward school city development project	FS update

(3) Public Investment Program (PIP)

Based on Article 28.1 of the Law on Budget, public investment of 30 billion MNT or more is included in the PIP (Public Investment Program). While the PIP is reviewed every year, the current PIP covers the four years 2018-2021, and the revised version was released in 2019, listing a total of 149 projects.

The following is an overview of businesses which financial resources have not been determined in the PIP business list of the target field.

a. Construction of a Comprehensive Facility for Hazardous Waste

In Baganuur district, there was a project plan to construct a comprehensive facility for hazardous waste, but it was postponed due to opposition from residents.

It is included in the revised version of the investment plan for 2018-2021, but it is in the form of "financial resources have not been decided". It is still planned as a "hazardous waste comprehensive facility" in Appendix "2.3. Project list requiring financial resources" and "2.4. Project list requiring FS and design" of the Five-Year Development Policy of Mongolia from 2021 to 2025.

b. Tuul River Expressway

As a part of measures to traffic congestion in UB City, Feasibility Study and the Detailed Design were carried out in 2014 by Ulaanbaatar City Government (hereinafter referred to as “UBCG”) under “the Street Project” with the initiative of the former Ministry of Economic Development.

Along the left bank of the Tuul River, the four (4) lane expressway which has a total length of 33 km including 3.0km of bridge section and 2.3km of box-culvert section was proposed to formulate the East-West Arterial Road that bypasses the urban area of UB City. The proposed cost estimate under the above-mentioned feasibility was 373 million USD. Two types of operation model such as toll-free road and tall road, have been studied under the feasibility study, however, the implementation plan including the operating model has not yet been progressed since then. The costs to mitigate an adverse environmental impact has been considered since it may pass through the environmental preservation area for water resource along the Tuul River.

It is stated in "2.3. Project list that requires financial resources" of the Five-Year Development Policy of Mongolia from 2021 to 2025 that the Project will be implemented in 2021-2024 with 618.5 billion MNT. It is also stated that the Project will be implemented by 2030 under the Mid-Term UBC Road Network Development Plan. According to the interview with the Ministry of National Development, overseas technical support as well as the financial investment will be required due to less experience in urban expressways in Mongolia.

c. Public Transportation Vehicle

Vehicles for public transport services have 12 years' lifespan after manufacture. However, the average lifespan of buses operating public transport services in Ulaanbaatar is 9.5 years. Some 1,200 public transport vehicles registered as of 2020, approximately 80% of all the vehicles are expected to be scrapped from 2020 to 2024 due to the age limitation.

Policy to introduce eco-friendly buses such as electric and CNG when purchasing new vehicles for public transportation, budget of national and Ulaanbaatar city, and other foreign loans are also expected to purchase them. Electric buses, double-decker buses and school buses were introduced in 2020. This project is included in "Appendix 2.3. List of projects requiring financial resources" of the Five-Year Development Policy of Mongolia from 2021 to 2025 (Period: 2021-2025, Budget: 678.7 billion MNT).

d. Flood Embarkment and Rainwater Drainage Facilities near Yarmag

This project is shown in Appendix "2.3. Project list that requires financial resources" of the Five-Year Development Policy of Mongolia from 2021 to 2025 (Period: 2020-2022, Budget: 32.1 billion MNT).

Large-scale housing construction is progressing in the new residential area Yarmag, and the new city hall is planned to be relocated here, but the risk of flooding due to heavy rain is high. Therefore, 290 million MNT was added to the budget for FY2020 as the cost of creating design documents for flood embankment facilities and rainwater drainage facilities for the purpose of reducing flood risk. The consultant company will be selected in the future.

The person in charge of the City Planning and Development Bureau plans to divide the project into multiple years and implement it with the national budget because the project cost is large, but he thinks that it can be developed in a short period of time with the support of foreign countries.

2.2.2 Subsector Policy

(1) Policy Related to Air Pollution Control

a. National Program on Reducing Environment Pollution

National Program on Reducing Environment Pollution approved by the Cabinet in March 2017 is shown in **Table 2.5**. National Program on Reducing Environment Pollution is composed of Five (5) targets and activity policies for measures to be undertaken by the Mongolian Government from 2017 to 2025 as shown below. The program is divided into the first step (2017-2019) and the second step (2020-2025).

Table 2.5 Goals and Action Plans of National Program on Reducing Environment Pollution

Goals		Action Plans	
Goal 1:	Appropriate policies for urban planning, and infrastructure development in the capital and central areas is implemented, capita city concentration is reduced through local development, air quality and environment in the capital and central areas is improved	1-1.	The comprehensive plan for population resettlement and development is developed and implemented, and concentration of population in the capital is improved through the development of industries and services, agriculture and livestock
		1-2.	For restricting migration to the capital city, the expansion of ger areas is stopped for reducing the number of stacks
		1-3.	Legal environment for migration and redevelopment is developed, and projects on freight train and highway are implemented
		1-4.	Examination and implementation issues for relocation of government agencies and universities to the suburbs
		1-5.	Investment inducement in rural areas, development of small and medium scale production projects, securement of employment opportunities, and implementing measures to improve the living standards of local residents. Promoting migration and resettlement to rural areas

Goals	Action Plans
	1-6. Technical conditions are developed to enable expansion of distribution system and substation capacity, and introduction of electric heaters with a capacity of 2.5-4 kW to households in ger areas 1-7. Long-term and low-interest loans to youth and low-income families are provided in order to improve infrastructure and strengthen residential conversion in the ger area for the development of individual single-family homes 1-8. Connection to regional engineering supply for consumers who cannot be connected to the central heating system in cities and center areas, construction of sub-centers, introduction of renewable energy technologies 1-9. Abolishment of hot water boilers in UB City, and connecting consumers to central heating system is gradually conducted 1-10. Improvement of sanitation facilities in ger areas to meet hygiene standards 1-11. Step by step movement of factories of leather, wool and cashmere processing, automobile market, building materials market from the city, intensive development of factories and production by green technology 1-12. Management activities for sand and gravel extraction and production is gradually restricted, and rehabilitation activities are implemented 1-13. Green facilities and small-scale park facilities are constructed, and park area per capita is expanded and increase to meet urban development standards with green facilities in the capital and resettlement areas 1-14. Rule of protection zones for rivers is issued, and households and private enterprises living in flood dams and protection zones are gradually moved
Goal 2: Pollution sources are reduced by introduction of environment friendly and efficient advanced technologies and innovations, pollutants emission is reduced	2-1. Update of air quality improvement zone, and develop and comply with a list of items prohibited from combustion and use for heating purposes 2-2. Except for heat stations and thermal power plants Gradually ban the use of raw coal 2-3. Supply of improved fuels that meet MNS standards, support and promotion of improved fuel production 2-4. Electricity 50-100% discount during nighttime for households with electricity meters with two rate formula functions in ger areas 2-5. Establishment of legal environment for supporting domestic production of highly efficient and advanced technology building materials 2-6. Implementation of projects for improving insulation and heat loss in ger and single-family homes 2-7. Expansion of heating supply and piping in urban and central areas, construction of new heating production sources is gradually implemented in order to reduce coal use and emission reduction based on technological updates 2-8. Introduction of environment friendly and efficient advanced technologies in the central sewage treatment plant in UB City, other urban and central sewage treatment plants, and factory pre-treatment facilities 2-9. Infrastructure facilities and heavy equipment for sorting, collection and transportation of combustion ash and solid waste from households in ger area are developed, in order to support waste reuse activities 2-10. Facilities for storage and treatment of hazardous wastes are constructed in order to improve the unmanaged condition of hazardous wastes 2-11. Establishment of incentive system for waste generators, importers, and sellers of used containers and bags, batteries, fluorescent lamps, used tires, waste oil, and other wastes to responsibly adjust their disposal and produce reusable products 2-12. Strengthening research on methane gas stocks and support for construction of coal processing plants and coal synthesis gas plants 2-13. Gradually switching to electric heaters for passenger train heating as part of the policies to repeal use of raw coal 2-14. Reduction of environmental pollution and waste from industrial and service operations, introduction of advanced technologies for the natural environment, and revision and compliance with standards for the conservation and efficient use of natural resources 2-15. Support for research and development of clean technologies and innovations to reduce air and environmental pollution and greenhouse gases. Increased funding sources, funding and assistance of international funds 2-16. Introduction and dissemination of energy-saving advanced technologies to reduce air and environmental pollution, and build exhibition facilities on "Environment friendly and efficient advanced technologies”

Goals	Action Plans
	2-17. Examination for establishment of "Green Lending Fund", support to purchase electric heater by individuals and private companies, and energy-saving products for reduction of reduction of air quality and environmental pollution and improvement of heat loss, and lending at low interest
Goal 3: Implementation of comprehensive measures to reduce emissions of pollutants from automobiles	3-1. Graduated ban on public transportation in UB that does not meet the emision gas standards 3-2. Support for the import and use of fuels that meet the EURO5 standards, graduated ban on the import, sale and use of fuels that do not meet the standards, and strengthening of fuel quality management system 3-3. Conversion of gas fuel and electricity for public transportation, introduction of technologies and public transportation with less negative impact on the natural environment and implementation of their experiments, graduated conversion of gas fuel for public transportation 3-4. Expansion of road network, introduction of traffic management smart systems, improvement of quality of service and maintenance of public transportation, and reduction of pollutant emissions from public transportation 3-5. Appropriate disposal of waste by sectors of road and transportation, management studies are conducted and reprocessing plants for obsolete automobile waste are constructed 3-6. Plan and construction of passenger service facilities and green service facilities along major roads 3-7. Planning and implementation of road drainage systems, cleaning with special road hoisting machines, melting snow and ice with substances that have less impact on public health and natural environment
Goal 4: Establishment of incentive system for administrative coordination, clarification of funding, and promotion of activities to reduce air and environmental pollution	4-1. Establishment of Air Pollution Control Fund, ensuring the concentration and management of budgets and funds for air pollution reduction measures 4-2. Strengthening of enforcement of laws and regulations, reduction of air, water, and soil pollution, clarification of roles and responsibilities of officers, individuals, private companies, and institutions related to regeneration issues, and enforcement of Natural Environment Law 4-3. Preparation and implementation of regional development policies, development of regional core centers and local centers 4-4. Improvement of legal environment for urban development and green facilities 4-5. Preparation and implementation of the National Program on Environmental Health 4-6. Preparation and implementation of the National Program on Energy Saving 4-7. Tax incentives for clean technology and equipment for production of value-added products 4-8. Preparation and compliance with the master plan on gas supply and related laws and regulations, and standards 4-9. Preparation and enforcement of legal environment for graduated import restriction of old age public transportation and for promotion of electric and gas-powered vehicles
Goal 5: Strengthening of public and private sector participation, roles and responsibilities to reduce environmental pollution, establishment of correction on living habits in the living environment, strengthening of air quality monitoring capacity, and expansion of research and analysis work	5-1. Public relations activities to publicize information on sources of air and environmental pollution, their damage and negative impacts, establishment of correction practices, conduction of training and public relations activities to introduce citizens to their duties 5-2. Strengthening the pursuit of responsibility for individuals, private companies and institutions that violate the laws and regulations of nature conservation 5-3. Implementation of "Air Pollution Control" monitoring activities in the ger area, combustion stop of waste, and implementation of measures targeting households with these policies 5-4. Encouragement of individuals, private companies and institutions that are actively working and supporting to reduce air and environmental pollution, maximization of promotion activities 5-5. Examination negative effects of air and environmental pollution on human health for long-term and short-term, introduction and establishment of risk prevention methods, and reduction of diseases incidences caused by air and environmental pollution 5-6. Submission and publicizing proposals for reduction and improvement of indoor air pollution such as gers 5-7. Update of natural environment central laboratories and local laboratories to meet international standards. Securement of highly sensitive analyzers and equipment

Goals	Action Plans
	for measuring volatile organic compounds and other hazardous substances, and heavy metals 5-8. Expansion of the air quality management monitoring network and human resource development 5-9. Increase number of air quality monitoring stations for air pollution control in UB City in order to ensure their continuous operation 5-10. Implementation of registration for air and environmental pollution sources and emissions, and digitization of registration database and update and maintain the database 5-11. Status survey of negative impacts such as noise and power wavelengths, and establishment of management system

Environmental measures based on the general budget of ministries and UB City are listed under the National Committee for Environment Pollution Reduction. The Committee deliberates on whether the measures are in line with the National Program on Reducing Environment Pollution, and decides whether to implement them or not, and how to prioritize them. The National Committee for Environmental Pollution Reduction is chaired by the Minister of the Ministry of Environment and Tourism (hereinafter referred to as "MET") and has 28 members, as shown in **Table 2.6**. The action plan of 2020 approved by the National Committee for Environment Pollution Reduction is shown in **Table 2.7**.

Table 2.6 Members of National Committee for Environment Pollution Reduction

First Exhibit of Decision No. 20/03 on September 4, 2020 of the National Environmental Pollution Abatement Commission

Chairman	Minister of MET
Members	Adviser to the President on Natural Environment, Agriculture and Livestock Development Policy, Adviser to the Prime Minister on Environmental Pollution and Social Affairs, Senior Adviser to the Deputy Prime Minister, Senior Adviser to the Secretariat of the Standing Committee on Natural Environment, Food, Agriculture and Livestock of the Grand National Assembly, Deputy Minister of Construction and Urban Development, Deputy Minister of Defense, Deputy Minister of Education and Science, Deputy Minister of Foreign Affairs, Deputy Minister of Roads and Transport Development, Deputy Minister of Finance, Deputy Minister of Culture, Director General of the National Police Agency, Director General of the National Audit Agency, Director General of the Emergency Situations Agency, Director General of the Land, Survey and Mapping Agency, Department of Against Air Pollution of the Capital City, Representative of the non-governmental organization "Mongolian Citizens Committee for Nature and Environment", Representative of the Non-governmental Organization "Anti-Smog Parents", Representative of the Non-governmental Organization "Breet Mongolia
Observer	UNICEF Mongolia Office
Secretary	Secretary General of the National Committee for Environment Pollution Reduction

Table 2.7 Reduction Activities for National Environment Pollution in 2020

Countermeasure Plan	Implementation Activities	Results	Responsible/ Cooperating Organization	Budget	
				Budget Source	Budget Million MNT
Discount for nighttime electricity in ger Area	Nighttime electricity discount for GER households is encouraged.	Ger households to be installed electricity meters of two kinds unit price will be encouraged to discount electricity fee during nighttime.	Ministry of Energy	National Budget	12,140.0
Gas dust collection filters for CFWH (Coaled Fire Water Heater) and HOB	Exhaust gas dust collection filters for hot water boilers are installed.	Exhaust gas dust collection filters of hot water boilers were installed,	The National Committee for Environment Pollution Reduction, City Office	National Budget	2,150.0

Countermeasure Plan	Implementation Activities	Results	Responsible/ Cooperating Organization	Budget	
				Budget Source	Budget Million MNT
(Heat Only Boiler) facilities are supported to install.		emissions are reduced.			
	Dust collection filters of HOB facilities in local areas are installed, emissions are reduced.	Exhaust gas dust filters of hot water boilers in 13 provinces are installed, emissions from the boiler are reduced.	The National Committee for Environment Pollution Reduction, MET	National Budget	3,000.0
Support and provide of improved fuel production is strengthened.	Production of improved fuel that meet the requirements is supported.	TTT's fuel production has been supported and stockpiles have been secured.	The National Committee for Environment Pollution Reduction, Ministry of Energy, City Office, TTT LCC	National Budget	10,000.0
	Construction of an improved fuel production plant in the eastern suburbs of UB City is supported.	Construction of TTT's eastern plant will be supported, the fuel stock is secured.		National Budget	13,000.0
Measures to prevent from transporting and transiting raw coal in air quality improved area are supported to implement.	Hauling and dropping of raw coal to the Heat Station Corporation in Naraiha District is supported.	Cost for supply and transportation of coal to Heat Station Corporation in Naraiha District is supported.	Naraiha Heat Station	National Budget	180.0
Air quality monitoring in the GEL area is implemented.	Reduction of waste and emissions, and use of improved briquette fuel is managed.	Audit teams conduct 6 central districts in UB for 6 months to prevent violations of laws and decisions.	City Office	National Budget, Local Government Budget	6,500.0
	For part of the implementation of the decision to ban use of raw coal, implementation of audits at entrance gates in UB is supported.	Transportation of raw coal for home heating into UB, transporting improved fuels out of the target area, and violating the law is prevented.	National Inspection Agency	National Budget	907.9
The heating supply of government institutions that are not connected to the central heating will be solved by introducing renewable energy and other efficient technologies.	Hot water boilers of in kindergartens, schools, and government public institutions in air quality improvement areas are replaced with energy efficient electric and gas boilers and heat pumps.	Electricity and heating supply for 20 buildings, kindergartens, schools, health centers, and government agencies, in the UB air quality improvement zone are solved, number of pollution sources is reduced.	MET, City Office	National Budget	2,600.0
Technical conditions for heating supply by electric heaters in ger areas are developed.	Establishment of technical conditions for electricity supply to ger households are arranged.	Land release and construction of sub-station facilities was conducted, technical conditions are improved.	Ministry of Energy	National Budget, Local Government Budget	2,000.0

Countermeasure Plan	Implementation Activities	Results	Responsible/ Cooperating Organization	Budget	
				Budget Source	Budget Million MNT
Advanced technologies to reduce air, water, and soil pollution advanced are supported and encouraged.	Techniques to reduce air and environmental pollution and experiment with technologies are introduced.	Environment friendly and efficient advanced technologies and techniques are being tested to reduce air and environmental pollution are conducted.	The National Committee for Environment Pollution Reduction, MET	National Budget	1,000.0
	Compression and packaging machines for plastic containers in rural areas is installed to support proper waste management.	Reduction and recycling of plastic container waste in 21 provinces is improved and strengthened.	MET, Local City Office	National Budget	800.0
	Research, study, and analysis of advanced technologies, machines, and innovations in air, water source, and soil pollution reduction is supported.	Surveys on environmental pollution and their reduction technologies and indicators have been developed.	The National Committee for Environment Pollution Reduction, MET	National Budget	100.0
	Test system for the collection and transportation of source-separated wastes is operated.	Waste segregation and waste management system is introduced.	The National Committee for Environment Pollution Reduction, MET, City Office	National Budget	500.0
Introduction of 3R, proper waste management, and recycling of waste to be incorporated into economic cycle.	Drawings for storage and storage warehouses for hazardous wastes is prepared and approved. Waste storage facilities in rural areas to meet standard requirements are constructed.	Development of a non-polluting environment and the recycling of waste materials is supported	The National Committee for Environment Pollution Reduction, MET	National Budget	2,000.0
	Purchase of scrap tires, recyclable and other waste materials, and recycling projects is supported.	Economic cycle is incorporated into preparation of status of situation where waste tires and other materials are not incinerated, and recycle promotion.	The National Committee for Environment Pollution Reduction, MET, City Office	National Budget	600.0
Air and environmental pollution reduction, energy conservation and green projects and initiatives is supported as part of green loans.	Support of green loan products and loan interest subsidies is granted.	Purchase of products such as electric heaters, heat insulators, eco-sanitary facilities and stoves that meet standard requirements, and use of products eligible for low-	MET, Bank	National Budget	1,000.00

Countermeasure Plan	Implementation Activities	Results	Responsible/ Cooperating Organization	Budget	
				Budget Source	Budget Million MNT
		interest loans is supported.			
Information and public relations activities for citizens to reduce air and environmental pollution	Information for the public, implementation of activities for training and public relations, and the information center is operated.	Citizens' knowledge, information, views and willingness to participate is improved.	The National Committee for Environment Pollution Reduction, MET	National Budget, Local Government Budget	500.0
	Guidelines, publicity and related materials are printed.	Public relations activities, distribution materials, control sheets, etc. are printed and used.	The National Committee for Environment Pollution Reduction, MET	National Budget	250.0
	The National Waste Management Enhancement Program is implemented and "Clean Mongolia without Garbage" campaign is developed.	As part of "Clean Mongolia without Garbage" campaign, good practices for whole Mongolia is introduced, training and publicity activities are conducted throughout the country to reduce waste.	MET, Local City Office, City Office	National Budget	2,000.00
Installation of automatic monitoring equipment for PM10 and PM2.5 in large cities, towns, and regional centers, strengthening of monitoring systems, and experimental agencies are conducted.	Two air quality monitoring stations in UB, strengthening of the monitoring system, and installation of PM10/PM2.5 monitoring equipment and other necessary devices in four provinces are installed.	Integrated management and continuous operation of the air quality monitoring system will be ensured.	The National Committee for Environment Pollution Reduction, MET, NAMEM	National Budget	1,900.0
Reduction of environmental pollution in rural areas is supported.	Measures to reduce waste in local centers are supported.	Collection, transportation, and management of waste in regional centers are improved.	Local City Office	National Budget, Local Government Budget	1050.0
	Measures to reduce air pollution in some local centers are supported.	Financial support for effective measures is provided.	Local City Office	National Budget, Local Government Budget	2,350.0
Electronic information technology for pollution sources is developed	The electronic registration system is improved by calculating pollution sources and emissions.	An electronic registration system for stationary sources based on a geographic information system will be developed.	MET, City Office	National Budget	130.0

Countermeasure Plan	Implementation Activities	Results	Responsible/ Cooperating Organization	Budget	
				Budget Source	Budget Million MNT
Measures to reduce exhaust emissions from public buses are implemented.	Exhaust emissions from public buses are reduced.	Buses are equipped with exhaust emission reduction devices, and experiment of fuel additives is conducted.	MET, City Office	National Budget	350
Unheated toilets in ger areas are renewed, and soil pollution are reduced.	Unheated toilets in ger areas are renewed.	Unheated toilets in ger areas are renewed based on standards of installation.	The National Committee for Environment Pollution Reduction, MET	National Budget	2,900.0
	Experimental project to incinerate and dispose of sludge from sanitation and treatment facilities in the ger area by environment friendly manner is implemented.	Special equipment has been procured, simulated experiments for waste disposal and soil pollution prevention is conducted.	The National Committee for Environment Pollution Reduction, MET	National Budget	2,500.0
	Water purification of wastewater from the central sewage treatment plant using biotechnological methods is conducted	Discharged water from the central sewage treatment plant can meet the drainage standard.	The National Committee for Environment Pollution Reduction, MET	National Budget	2,433.2
Operation cost of the National Committee for Environment Pollution Reduction	Implementation of the daily work of The National Committee for Environment Pollution Reduction and Secretariat is secured.	Continuity of operations of The National Committee for Environment Pollution Reduction and its secretariat ensured.	The National Committee for Environment Pollution Reduction	National Budget	380
				Total	**75,221.10**

b. Plan for Implementation of Measures of the National Program on Reducing Environment Pollution

The National Program on Reducing Environment Pollution (2017-2025) approved by the Cabinet in March 2017 decided on the following five goals and activity policies in order to reduce the air pollution in Mongolia, and these are currently being implemented.

Goal 1: Appropriate policies for urban planning, and infrastructure development are being implemented, and concentration in UB is reduced through local development.

Goal 2: Reduce pollutant emissions by reducing pollution sources through introduction of environment friendly and efficient advanced technologies and innovations, and the air quality and environment in the capital and central areas will be improved.

Goal 3: Comprehensive measures to reduce pollutant emissions from automobiles are being implemented.

Goal 4: Administrative coordination to reduce air and environmental pollution, clarification on funding, and promotion of activities to reduce air and environmental pollution are being developed.

Goal 5: Participation of public and private sector on environmental pollution reduction.

c. Ulaanbaatar Mayor's Four-Year Roadmap (2016-2020)

The air pollution-related policy in the Ulaanbaatar Mayor's Four-Year Roadmap (2016-2020) is reflected by "2. Urban Development and Infrastructure" and "3. Natural Environment and Green Development". In power supply improvement sub-item of "2.4 Stable Infrastructure", the development of new power sources in the ger district of Ulaanbaatar, satellites and newly developed areas, the introduction of advanced technology for large stoves for heating, and the improvement of efficiency are mentioned. In "3.1 Sustainable Development of the Environment", it is stated that the smoke-free Ulaanbaatar 2030 project will be implemented, and the air quality management capacity will be improved. "3.2 Environmental Pollution Reduction" states that green technology for air pollution reduction will be introduced, air pollution sources that affect human health will be identified and countermeasures will be taken, and the internal air quality of schools and kindergartens in the Ger district will be improved. From the perspective of improving roads and intersections, the formulation of medium- and long-term plans for improving the metropolitan road network, the construction of flyovers and underpasses that cross railways, and the development of grade separations is mentioned in "2.5 Congestion-free towns". Regarding public transportation, the renewal of public transportation vehicles and the introduction of eco-friendly vehicles that are friendly to the natural environment are described.

d. Ulaanbaatar Mayor's Four-Year Roadmap (2020-2024)

The air pollution-related policy in the Ulaanbaatar Mayor's Four-Year Roadmap (2020-2024), 02/10 approved by the notification of the city council, 4th December 2020, are reflected in "5. Green Development Policy" and "6. Capital and Regional Development Policy". In "5.2 Air and Environmental Pollution Reduction: Smoke-Free Cities" sub-item describes reducing the capital's air pollution to 80%, improving air quality management, and improving improved fuel supply for ger area by putting into operation the eastern factory. In addition, a policy will be implemented to reduce air pollutants derived from vehicles. In "6.3 Infrastructure: Electricity", there are plans to improve the power grid, construct a thermal power plant in the ger area subcenter, and widen/improve the heating trunk pipeline network. From the perspective of improving roads and intersections, "6.3 Infrastructure: Roads" describe the improvement of the UB City road network, the implementation of intersection improvement and grade separation, the construction of flyovers and underpasses that cross railways, the maintenance of parking lots and bicycle path construction on sideways is mentioned. Regarding public transportation, the renewal of public transportation vehicles and the introduction of high-volume public transportation are described.

(2) Policy Related to Water Pollution Control

a. Vision-2050 Long-Term Development Policy of Mongolia

In Vision-2050, Long-Term Development Policy of Mongolia, Step 1 (2021-2030) is to "reduce air pollution, polluted water, soil pollution and noise, and develop a clean environment with green facilities" in the section on people-friendly living environment, and "reduce air, soil and environmental pollution by introducing environmentally friendly and advanced technologies and reducing pollution sources" in the section on environment-centerd city, i.e., UB City. The following activities have been identified for implementation in the period 2021-2030.

Table 2.8 Vision-2050 Long-Term Development Policy of Mongolia 2021-2030 (Water Pollution)

Goal	Activities
Goal 2.5: Healthy and comfortable environment	Improve and expand using advanced environmentally friendly technologies. - Central Wastewater Treatment Plant (hereinafter referred to as “CWWTP”) and sewage facilities of other municipalities - Pre-treatment plant for industrial wastewater
Goal 6.3 Prevent shortage of water resources and provide sufficient supply to meet demand	Increase the percentage of the population that can use sanitation facilities that meet standards by increasing and building new sewage treatment plants. Disposal of sludge generated in sewage treatment plants and sanitation facilities in ger districts in an environmentally friendly manner.
Goal 9.2 Living in a healthy and safe environment for Ulaanbaatar residents	Carry out an environmental assessment of environmental pollution caused by household simple toilets and artificial factors, and improve the legal environment for collecting environmental pollution charges, and implement projects to improve sanitary facilities in the ger area in stages.
Goal 9.3 Growth as a metropolitan city with appropriate space planning and housing system in Ulaanbaatar	Construct new CWWTP in Ulaanbaatar City. Build a trunk pipeline to treat sludge and reuse treated water. In the urban redevelopment project, a central network, cluster type and independent lifeline will be established in the ger area, and renewable energy will be used.

Source: Vision-2050 Long-Term Development Policy of Mongolia

b. National Water Program

The National Water Program (National Assembly Notification No. 24 of 2010) defines the activities, the roles of the agencies in charge, and the expected effects for protecting water resources, preventing water scarcity, and ensuring water resources meet appropriate water use and sanitation conditions until 2021.

c. Ulaanbaatar Mayor’s Four-Year Roadmap (2016-2020)

Water pollution control measures are reflected in the Ulaanbaatar Mayor's Four-Year Roadmap (2016-2020) as water pollution control measures in "2. Urban Development and Infrastructure" and "3. Natural Environment and Green Development". The implementation of the Ulaanbaatar City Water Supply Safety Program and the Tuul Collector Project, the technical upgrade of CWWTP, and the construction of a small wastewater treatment plant in the new settlement and ger area are listed in the Water Supply and Sewage Improvement sub-item "2.4 Stable Infrastructure. Policies related to rainwater drainage include the widening of rainwater drainage facilities and the construction of flood embankments in some areas such as Bayankhoshuu. In "3.2 Environmental Pollution Reduction," it is stated that water supply will be improved, and its proper use will be promoted.

In addition, "2.2 Planning and Transparent Land Relations" includes the formulation of a lifeline master plan for the city, and "1.1 Comprehensive Development of Industry and Innovation" includes the development of the Emeelt Light Industry and Technology Park.

d. Ulaanbaatar Mayor’s Four-Year Roadmap (2020-2024)

As measures against water pollution in the Ulaanbaatar Mayor's Four-Year Roadmap (2020-2024) is in "5. Green Development Policy" and "6. Capital and Regional Development Policy". In "5.3 Reduction of Environmental Pollution by Promoting Environmental Conservation and Regeneration", improvement of drinking water conservation, reduction of groundwater use, improvement of surface water storage and availability, etc. are planned. In "6.3 Infrastructure: Levee/Gutter Development", it is said that a dike facility will be constructed to improve drainage networks for general and trunk roads. Similarly, in "6.3 Infrastructure: Water and Sewerage

Related", the western water source of UB City will be improved, and the wastewater from the central sewage treatment plant will be treated and reused at the thermal power plant and there are plans to widen and improve the existing water and sewage network, including water supply in the Tolgoit District. Operation of the central sewage treatment plant and sludge drying facility in UB City and sewerage work in the Buyant-Ukhaa District are planned.

In "3.2 Science and Technology/Innovation", there is also an item to improve the infrastructure of Emeelt Light Industry/Technology Park.

e. Organizations and Action Plans related to Factory Wastewater Measures

The main organizations involved, and their roles are as follows:

MCUD (Ministry of Construction and Urban Development)

- Decision making, planning, legal system, development of standards
- Creating an inventory on industrial wastewater

MOFALI (Ministry of Food, Agriculture, and Light Industry)

- Promotion of green industry, providing information to companies, guidance/advice, etc.

MET (Ministry of Environment and Tourism)

- Setting and monitoring of effluent quality of wastewater treatment plant and factory
- Implementation of EIA at new factory and permission to set up a new factory, etc.

GASI (General Agency for Specialized Inspection)

- Monitoring of industrial wastewater quality, water quality analysis, guidance/advice, penalty

Ulaanbaatar City including USUG (Water Supply and Sewerage Authority of Ulaanbaatar City)

- Construction, operation, and maintenance of wastewater treatment facilities
- Sewage sludge treatment and disposal, monitoring of disposal site
- Creating an inventory on industrial wastewater
- Relocation of leather factories to Emeelt Area

Under the understanding that measures for industrial wastewater connected to the sewerage are issues to be solved in collaboration with related organizations and the city of Ulaanbaatar, a memorandum of understanding was concluded between ministers of MCUD, MOFALI, and the Mayor of Ulaanbaatar, who also serves as the Governor of the Capital on October 7, 2019, and a concrete "plan" was created to implement the MOU. The main planning items are shown below.

<u>Minister of MCUD</u>

- Completion of new Central Wastewater Treatment Plant project in Ulaanbaatar
- Specific study on composting of sewage sludge and sludge treatment disposal / incineration
- Cooperation for MCC Project (use of treated sewage)
- Support for compliance with effluent quality standard for discharging into sewer (MNS 6561)

<u>Minister of MOFALI</u>

- Guidance on the installation of pre-treatment facilities for factories to comply with the effluent quality standards (MNS 6561)
- Support for starting construction of the Emeelt Light Industry Park
- Support for reconstruction of Khargia Industrial Wastewater Treatment Plant

Mayor of Ulaanbaatar, who also serves as the Governor of the Capital

- Normal and stable operation management of wastewater treatment plants
- Implementation of facility reconstruction of Khargia Industrial Wastewater Treatment Plant
- Cooperation for starting construction of Emeelt Light Industry Park
- Specific consideration of a sewage sludge treatment and disposal project on a dedicated site in Songino Khairkhan District
- Guidance on the installation of pre-treatment facilities for factories to comply with the effluent quality standards (MNS 6561)
- Regulatory guidance for factories that do not comply with the effluent quality standard (MNS 6561)

In addition, to meet the preconditions imposed on the Mongolian government for the implementation of the MCC-supported project (see 4.1.4 MCC and MCA for details) (i.e., to reduce the water quality of industrial wastewater flowing into the treatment plant to the level of 2013 by the time the new CWWTP in UB City comes to commence), MCA proposed the Mongolian government to prepare an Industrial Pre-treatment Plan (IPP). The relevant agencies of the Mongolian government prepared the IPP, which was approved by the Cabinet of Ministers on March 3, 2021.

The IPP covers about 60 sub-items in seven (7) major categories that are organized as follows:

1) Identify the sources and quality of industrial wastewater entering CWWTP and establish a database;
2) Review the operation status of each factory and update technology;
3) Support the installation of pre-treatment facility at each factory;
4) Operate Khargia Industrial Wastewater Treatment Plant normally until factories are relocated;
5) Create conditions for the relocation of leather factories to industrial and technological park;
6) Amend laws and regulations regarding wastewater rates, reduction of wastewater pollution load, wastewater reuse, and management and coordination; and
7) Conduct awareness-raising and educational activities for residents, factories, and companies.

(3) Policy Related to Solid Waste Management (SWM)

a. Mongolian Solid Waste Management Strategy and Action Plan 2017-2030

For the dramatically increasing amount of waste, the "Mongolian Solid Waste Management Strategy and Action Plan 2017-2030" (hereinafter referred to as "Solid Waste Management Strategy") was formulated in 2017 to show the goals, strategies and action plans for SWM as presented in **Table 2.9**. Among these, promotion of "maintenance of final disposal site/collection and transportation equipment", "intermediate treatment (incineration facility, recycling)", and "hazardous waste treatment" are listed as important measures for SWM.

Table 2.9 Goals and Strategies of the Mongolian Waste Management Strategy

Goal	Strategy
Goal 1: Development of legal system for sustainable waste management	Promotion of sorting/3R, clarification of responsibilities of manufacturers/importers, establishment of legal system for hazardous waste management, improvement of resource circulation monitoring technology, nationwide expansion of waste management plan
Goal 2: 30% reduction in final disposal amount	Development of recycling collection system, promotion of entry of private companies, implementation of waste business by utilizing PPP
Goal 3: Building a comprehensive hazardous waste management system	Construction of hazardous waste inventory, establishment of hazardous waste management system (collection, transportation, recycling, detoxification treatment)
Goal 4: Reduction of waste generation by educational activities for waste separation	Implementation of waste education, enlightenment activities for businesses and organizations, enlightenment activities by the media, public enlightenment on waste separation and waste management

Goal	Strategy
activities	
Goal 5: Reduction of global warming gas by improving final disposal site	Environmental improvement by improving waste dumps, reduction of waste by recycling activities, reduction of global warming gas emissions in the waste sector, introduction of final disposal site facilities nationwide
Goal 6: Establishing a sustainable management system and finances	Securing finances by building a sustainable waste management system, polluter pays principle, and a fee collection system based on the principle of extended producer responsibility

Source: Mongolia Waste Management Strategy / Action Plan 2017-2030

b. Ulaanbaatar Mayor's Four-Year Roadmap (2016-2020)

In the Ulaanbaatar Mayor's Four-Year Roadmap (2016-2020), it is reflected in "3. Natural Environment and Green Development" as a waste policy, and the purpose is to make UB City that conforms to world standards and has a green development philosophy, and to create a comfortable environment for residents to live. In "3.3 Urban Development, Green Facilities" on the roadmap, as a concrete waste policy, comprehensive management related to waste transportation, sorting, treatment and purchase was established in each ward, improvement of waste management through infrastructure development of eco-park for waste recycling, promote the cleaning of valleys and drains in the ger area, which leads to environmental pollution, by promoting the participation of residents, gradually implement measures to reduce waste emissions, cleaning of public spaces, improve the capacity of the final disposal site. The goals to be achieved by the above measures are to reduce pollution of air, water and soil in Ulaanbaatar, secure economic growth that supports production based on green development and create a comfortable environment for residents' lives.

c. Ulaanbaatar Mayor's Four-Year Roadmap (2020-2024)

The Governor of the Capital and Mayor of Ulaanbaatar waste management-related policies in the 2020-2024 activity plan are shown in "5. Green Development Policy". There are plans to introduce comprehensive and advanced technology for waste classification and transportation in Ulaanbaatar within the "5.2 Reduction of Air and Environmental Pollution: Cities without Soil and Environmental Pollution", reduce the amount of waste landfill by promoting recycling facilities, gradually regenerate the final waste disposal site, improve the waste rate system and collection system. Regarding hazardous waste, it is said that a system for registering, classifying, transporting, temporarily storing, and treating hazardous waste will be introduced. There is also a statement that it will treat food waste and build a facility capable of producing 2,000 kg of fertilizer a day.

d. Waste-Related Projects

A list of waste-related projects was obtained from the Ministry of Environment and Tourism (MET) and shown in **Table 2.10**. According to this table, there are 13 projects underway and planned to be implemented, recycling (4 projects * duplicated), final disposal site (2 projects), waste incineration power generation (3 projects * with duplication), improvement of SWM capacity (4 projects * duplicated), and other (1 project).

Regarding recycling, MRTD and UB City are promoting recycling in collaboration with private companies, but it is confirmed that the projects are being promoted with KOICA financial support. Both are in the FS stage, and specific activities are planned.

Regarding final disposal site, the construction of the Moringiin Davaa final disposal site and construction of waste separation facility supported by EBRD is underway in Khan-Uul district and is planned as the next final disposal site in UB City. This facility will be the center of UB City SWM in the future.

Regarding improving SWM capacity, this is being carried out by the Federal Republic of Germany (FRG), Swiss Development Cooperation (SDC), Asian Development Bank (ADB), and Japan Fund for Poverty Reduction (JFPR).

Regarding waste incineration power generation, FS has already been implemented at the suggestion of a foreign company, but none of them have started construction of facilities. The reason for this is that the waste purchase price and the electricity selling price have not been decided.

Table 2.10 List of Waste-Related Projects

No.	Classification	Project Name	Source of Funding, Amount	Period	Institution in Charge	Project Purpose
1	Recycling	Auto Recycling Park	Investment by private companies (Mongolian Waste Recycling Federation) About 100 million USD Creating FS	2019-2023	Idea: Ministry of Road and Transport Development Implementation: Mongolian Waste Recycling Federation	Establishment of a waste recycling park for used vehicles and the use of vehicles. Location: 30 ha at Kharzatyn khotgor, 13th Hollow, Hanall District
2	Recycling	Used Car Resource Recycling Center	Funding by KOICA, in the final stage of project FS, KOICA: 1,354,000 USD Private: 1,430,000 USD	2019-2024	Ministry of Road and Transport Development, Implementation by "Mongolian Auto Recycling" Limited Liability Company	Established a used car resource recycling center at the Building Materials Manufacturing Technology Park in Nalaikh, which is funded by KOICA and is being implemented by the Mongolian Auto Recycling Limited Company, a member company of the Mongolian Waste Recycling Federation.
3	Other	Liquid waste cleaning facility renovation project by Ulaanbaatar Railway Corporation	Funding source is uncertain: 500,000 USD	2 years	Ulaanbaatar Railway Corporation	Renovation of facility to clean liquid waste according to standards by Darkhan and Sainshand station factories
4	Recycling	Eco park	Regional budget: 247 billion MNT	2016-2020	UB Mayor's Project, Mongolian Waste Recycling Federation	Recycling of solid waste generated in UB City
5	Final disposal site	Moringiin Davaa Final Disposal Site Construction / Construction Waste Separation Project	EBRD: 16.7 million USD	2019-2021	UB Mayor's Project Waste Management Regulation Division	Construction of waste recycling facilities by construction and demolition of buildings, construction of solid waste landfill facilities.
6	Improvement of waste management capacity	Waste and climate change project	Federal Republic of Germany Ministry of Environment, Nature Maintenance, Construction and Reactor Safety, United Nations Environment Program World Conservation Monitoring Center, 2.5 million USD	July 2017-July 2021	UB Mayor's Project, Mongolian Waste Recycling Federation	Greenhouse gases emitted from waste, reduction of short-lived climate pollutants that affect climate change, formulation of comprehensive national and urban waste strategies and technologies for reduction, capacity building of related organizations.
7	Final disposal site	Waste field incineration reduction project under the Stockholm	Grant aid from the World Wildlife Fund, 1.3 million USD	2016-2020	UB Mayor's Project, Mongolian Waste Recycling Federation	Construction of ash landfill facility at Tsagaan Davaa final disposal site to reduce the adverse effects of waste on the

No.	Classification	Project Name	Source of Funding, Amount	Period	Institution in Charge	Project Purpose
		Convention on Persistent Organic Pollutants				natural environment.
8	Improvement of waste management capacity	UB City Household Waste Collection and Transportation Management Project	Swiss Development Cooperation, 3.85 million Swiss francs	April 2019-March 2023	UB Mayor duties, Mongolian Waste Recycling Federation	Providing a clean and healthy living environment for residents of the UB City ger district by improving the efficiency and cost reduction of waste collection and transportation management, and by considering all parties concerned and ensuring that services are provided.
9	Waste incineration power generation	Darkhan-Uul District Waste Incineration Power Plant FS Survey	Domestic and foreign investment, 9.12 million USD	Approved by the Science and Technology Council of the Ministry of Energy in 2015, not approved by the Electricity Regulatory Commission	"Sektech group" Limited liability company, Ministry of Energy Policy Planning Bureau	Plans to construct a 2.5mW output power generation facility that does not adversely affect the natural environment using solid waste. Construction work has not started.
10	Waste incineration power generation	Khentii District Waste Incineration Power Plant FS survey	Domestic and foreign investment, 9.12 million USD	Approved by the Science and Technology Council of the Ministry of Energy in 2015, not approved by the Electricity Regulatory Commission	"Sektech group" Limited liability company, Ministry of Energy Policy Planning Bureau	Plans to construct a 2.5mW output power generation facility that does not adversely affect the natural environment using solid waste. Construction work has not started.
11	Recycling, Waste incineration power generation	FS of Ulaanbaatar City Eco Park and WtE Facility Project	Korea, 84.3 million USD	Permit by the Electricity Regulatory Commission has been obtained, and the period is 3 years from August 29, 2019.	"Three S Solution" Limited liability company, XXK, Ministry of Energy Policy Planning Bureau	Plans to construct a 15.4 mW output power generation facility that does not adversely affect the natural environment using solid waste. Construction work has not started.
12	Improvement of waste management capacity	Mongolia Construction Sector Resource Effectiveness and Clean Manufacturing Support Project	European Union Switch Asia-2 Project, Funding by the project	2016-2020	Ministry of Construction and Urban Development	Funding sources for medium- and long-term waste reserve funds for waste cleaning, collection, separation, transportation, recycling, disposal, landfill and recycling projects in the construction sector, review, and evaluation of

No.	Classification	Project Name	Source of Funding, Amount	Period	Institution in Charge	Project Purpose
						the results of surveys conducted in UB City, formulation of related regulations
13	Improvement of waste management capacity	District Solid Waste Management Project (Darkhan-Uul, Govi-Altai, Sukhbaatar, Uvurkhangai, District)	Asian Development Bank, Japan Fund for Poverty Reduction-2 million USD, Government of Mongolia-0.2 million USD	2020-2022	Ministry of Construction and Urban Development Public Service Policy Implementation Coordination Bureau	Improvement of solid waste management and waste separation and recycling system at each District Center, thereby promoting employment

Source: Ministry of Environment and Tourism (MET)

(4) Policy Related to Climate Change

a. MET Policies, etc.

Regarding results of research interviews for the Ministry of Environment and Tourism (MET), there are few projects directly related to the Greenhouse Gas (hereinafter referred to as “GHG”) emission reductions. However, the target of Nationally Determined Contribution (hereinafter referred to as “NDC”) was submitted to the United Nations Framework Convention on Climate Change (hereinafter referred to as “UNFCCC”) in October 2020, and the policies and measures have been considered in accordance with the NDC.

Mongolia sets a new target of reducing its GHG emissions by 22.7% by 2030, compared to the business as usual (BAU) scenario. The updated NDC includes additional sectors that were not previously considered, such as agriculture, waste, and several industrial sectors. The GHG emission reductions of energy sector (energy production) are approximately 8340 (Gg CO2-eq), the energy sector (energy consumption) are approximately 2924 (Gg CO2-eq), IPPU (Industrial Process and Product Use) sector are approximately 234 (Gg CO2-eq), agriculture sector are approximately 5283 (Gg CO2-eq), waste sector are approximately 106 (Gg CO2-eq), and total emission reductions target are set as 16888 (Gg CO2-eq).

The GHG emission reduction measures supposed in energy production of energy sector are introduction of renewable energy, reducing electricity and heat transmission and distribution grid losses, and the improved efficiency of energy production, etc. The measures supposed in energy consumption of energy sector are the improvement of fuel quality, the improvement of heat insulation for buildings, and the switch of the coal export transportation to rail transport from auto transportation, etc. the measures supposed in agriculture sector are the regulation and reduction of the livestock number and the improvement of the livestock manure management. The measures supposed in IPPU sector are the usage of waste heat from cement plants, and the usage of fly ash in cement production, etc. The measures supposed in waste sector are the reduction of waste volume for landfill and the increase of the share of the population with access to improved sanitation and hygiene facilities.

The projects such as fuel shift from coal to pellet for coal-fired boilers, introduction of renewable energy, energy conservation as a result of improvement of building insulation material, are measures directly related to GHG emission reductions. On the other hand, the first priority purpose of these measures is not GHG emission reductions, but implementation of these measures has become the GHG emission reductions as a result. Since there is no sufficient development for quantification method of the GHG emission reductions such as MRV (Measurement, Reporting, and Verification) method, the quantification of the GHG emission reductions has not been carried out yet at a sufficient level.

As for the Long-term Vision-2050, the target value of the GHG emission reduction is set, but there is a lack of description of concrete measures. However, since under the Paris Agreement every country has to upgrade the target of GHG emission reduction, it is supposed that the Mongolian Government is continuously going to carry out the policy-making for GHG emission reductions in the future. There are some descriptions such as the waste sector activities as climate change mitigations and the financial support for projects, but there is no description on the energy sector, and agriculture and livestock sector, which are large GHG emission sources.

b. Ulaanbaatar Mayor's Four-Year Roadmap (2016-2020)

The climate change policies are reflected in "2. Urban Development and Infrastructure" and "3. Natural Environment and Green Development". The legal environment arrangement for energy saving and eco-housing construction technical support will be implemented in "2.1 Legal Environment Arrangement", and the project on insulation loss reduction for apartment houses will be implemented in "2.3 Comfortable Housing and Living". The 'Promoting the gas use for households in remote areas not connected to central heating (district heating), and improving the social environment situation for conversion to gas heating', 'Energy saving, energy loss reduction and implementation of new technology introduction projects', and 'Construction of renewable energy sources in the Ulaanbaatar city, well-balanced development of renewable energy' are mentioned in "2.4 Stable Infrastructure: Improving Electric Supply".

In "3.1 Sustainable Development of the Environment", the following items are mentioned: 1) Green Development Project will be implemented with the support of the International Green Development Fund; 2) Energy conservation policies of national organizations will be implemented through the supply of environmentally friendly technologies and renewable energy; and 3) Climate change action plan will be implemented.

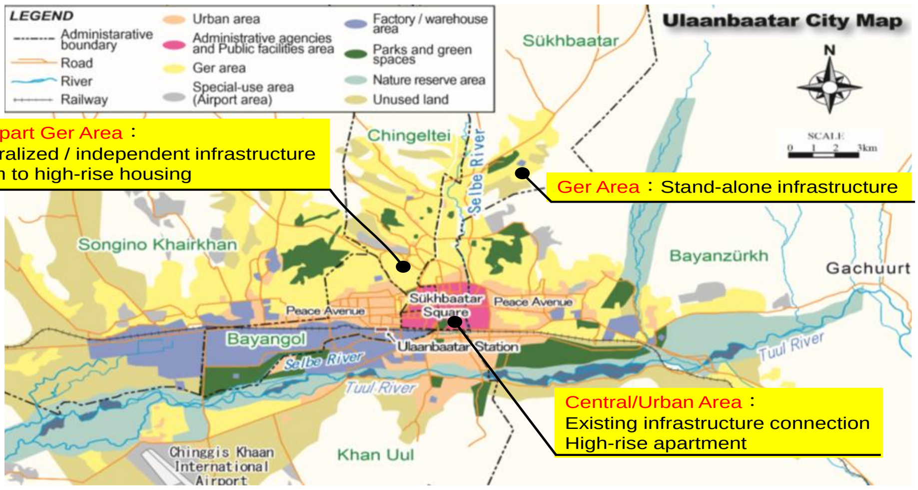
c. Ulaanbaatar Mayor's Four-Year Roadmap (2020-2024)

The climate change related policies in the action plan from 2020 to 2024 by Capital Governor and UB Mayor are reflected in "5. Green Development Policy" and "6. Capital and Regional Development Policy". In "5.2 Reduction of air and environmental pollution: City without smog", the introduction of electric stove with a night-time heating storage system in the ger area and the improvement of heating loss of buildings in the ger area are mentioned. In "6.3 Infrastructure: Electricity", there is a plan to build a 500 MWh power storage batteries station.

2.2.3 Policy/Plan of Ulaanbaatar City

(1) Ulaanbaatar 2020 Master Plan, Development Approaches for 2030

Of the total 380,600 households in UB City, 43% (164,600 households) live in apartments and the remaining 57% live in the ger district (216,000 households) (2017). About 60% of the UB City's population lives in the ger district, which has an undeveloped lifeline, which causes many problems. This redevelopment project in the ger area is being promoted according to the "Ulaanbaatar 2020 Master Plan (hereinafter referred to as "MP"), Development Approaches for 2030", the redevelopment policy is established by dividing the ger district into three zones, "central ger area", "middle ger area", and "fringe ger area" according to the distance from the city center (see **Figure 2.1**).



Source: JICA Survey Team (Hereinafter, JICA Survey Team created tables and figures unless otherwise specified in this report.)

Figure 2.1 Classification and Development Policy of Ger District

"Ulaanbaatar 2020 Master Plan (MP), Development Approaches for 2030" consists of the following four volumes.

- Volume 1-Survey on the Current State of Ulaanbaatar City, and Its Results
- Volume 2-Ulaanbaatar City Development Policy and Trends by 2030
- Volume 3-2020 MP Amendment
- Volume 4-Summary

"Volume 1-Survey on the Current State of Ulaanbaatar City, and Its Results" describes the current state and problems of the environment of UB City and the current state of infrastructure and lifelines.

Regarding air pollution, the status of air pollution sources such as ger areas and thermal power plants and SO_2 is summarized. Regarding the current state of infrastructure, in addition to the current state of road networks and transportation networks, it describes the need to ensure the safety of road facilities and sidewalks, and to make intersections three-dimensional.

In terms of water pollution, the status of water sources, the water source sanctuary, the pollution status of the Tuul River, and the pollution by the central sewage treatment plant are described. Review land ownership around the reserve to protect the water source reserve, Relocate nearby gas stations, leather processing factories, pharmaceutical factories, etc. Furthermore, a new central sewage treatment plant will be constructed as soon as possible. This is needed to treat wastewater from the ger area and use it as medium water. Regarding water and sewage and water supply, there are some issues such as 98% of UB City's clean water comes from groundwater, and water sources other than groundwater will be secured immediately, enlighten the proper use of water and water saving, and the lack of pre-treatment facilities at the leather and cashmere factories are described.

Issues of floods and road drainage facilities include aging drainage facilities and insufficient consideration of drainage when constructing new roads and buildings.

Regarding waste, the current status and problems of general and hazardous waste, the impact on the natural environment and health and hygiene identified by the results of research and reports by related organizations, in particular, problems such as soil pollution caused by general waste in the ger area and groundwater pollution have been pointed out. In addition, the hazardous waste generated by companies and factory facilities is not known in detail, and it is necessary to establish a responsibility system.

In terms of climate change, the status and issues of heating and power supply lifelines (aging of heating pipes, heating and power loss, air pollution by heating channels, development of new power sources, etc.) are summarized.

In **"Volume 2-Ulaanbaatar City Development Policy and Trends by 2030"**, building a policy and legal environment with a positive impact on the natural environment, and also policies and measures are planned to make the city an Eco-friendly city with the health and safety of residents and a comfortable living environment.

Regarding air pollution, the goal is to create an environment where people can live in an environment free of air pollution, and the contents such as reducing air, water quality, and soil contamination by green development (fuels used in renewable energy formats such as solar power and wind power and waste, biofuel, gas, etc.) of the ger area is described. In addition, automobile emission measures are planned as measures to reduce air pollution sources other than the ger area.

In water source management, the goal is to "protect the water source and properly manage water saving", and the policy is to use groundwater and surface water in a well-balanced manner, construction of a reservoir, storing rainwater for agriculture and household use, and to reuse the water treated at the sewage treatment plant. As a measure against water pollution strengthening pollution source management, strengthening sewage treatment plant standards, and renewal of water supply lifeline are mentioned. Regarding sewage treatment, treatment and reuse by advanced sewage technology (bio, nano), strive to save water, increase efficiency, sufficiently treat and reuse sewage from processing plants, education and enlightenment activities related to the protection of water resources and water conservation are mentioned.

The purpose of SWM is defined as "eliminating the factors that affect the natural environment and the health of residents." Acceleration of waste disposal, detoxification, complete disposal without leaving residue, etc., establishment of recycled/reused resource system, and construction of waste treatment and disposal facilities have been made to enhance SWM properly. Specifically, primary treatment facilities and disposal sites have been set up in each area of UB City, reflecting the establishment of high-heat waste final disposal sites in Narangiin Enger. Furthermore, in the building waste treatment facility, a facility that treats coal ash and non-organic powdery waste from buildings and factories to manufacture building materials such as lightweight blocks, Hazardous waste treatment facility, Waste oil treatment facility, the installation of E-waste treatment facilities, etc. are described.

The goal in the field of climate change is to "strengthen the world's climate change capacity, ensure sustainable development and increase the use of renewable energy", widening existing energy facilities to provide increasing heating and electricity demand, development of new power source, new heating pipe, construction of a cluster-type heating system is indispensable.

"Volume 3-2020 MP Amendment" summarizes the policy reconfirmation and detailed methods planned in Volume 2.

Regarding air pollution reduction, improved power supply, the policy of housing in the ger area, and the introduction of clean coal technology and improved stoves, a plan to promote the use of renewable energy and gas are described. Specifically, the air pollution load will be reduced to 70% by introducing efficient heating technology, from coal to liquid fuel, and switching to gas and renewable energy are expected.

In terms of water and sewage, groundwater is used only for clean water purposes, develop water intake facilities by conducting FS survey of water intake facilities on the Tuul and Terelj rivers, store rainwater and reuse it in fields and homes, use reclaimed water and surface water recycled in general households, factories, agriculture and livestock, construction fields, etc. establish new small sewage treatment plants in each ward, predict water use and assume future (30 to 50 years ahead) water source for UB City, improving supply, and to enact a law on water in UB City are stated.

As for waste, reconfirmation of waste facilities planned in Volume 2, as a method and mechanism for implementing "SWM," will be implemented in two stages. The first stage will be implemented with the amendment of the 2020 MP, it is declared that the second stage will be implemented in line with the MP up to 2030, furthermore, formulating a two-stage MP, building a new system for SWM in UB City, and changing related laws and regulations are planned. In this volume, the first stage upper target (2012-2020) of the new SWM system is set, and the policy of the project to be implemented in the first stage is reflected. Specifically, the following are listed.

- Formulation of UB City Waste Management MP
- Formulation of UB City Hazardous Waste MP, Hazardous Waste Treatment and Disposal Site established
- Installation of WtE (Waste to Energy) power generation facility for high heat treatment of waste at Narangiin Enger Disposal Site

Waste separation, collection, and transportation according to a specific schedule, construction, and maintenance of an environment for a new system such as storage in dedicated trash cans installed in houses, workplaces, stores, restaurants, etc. Installation of high-tech facilities for wastewater and solid waste treatment in remote wards and satellite cities, etc. The results (2012-2020) achieved by the projects implemented in the first stage are also set.

In the area of climate change, develop new power sources to supply increasing power demand, repairing, widening and improving aging facilities, build a clustered system in addition to the central network, introducing environmentally friendly technology, build a power network using hydropower and wind power, and will proceed with research on solar, wind, and biomass utilization for users with low demand are stated.

(2) Capital Development Policy 2021-2025

It stipulates the capital development policy 2021 to 2025 and was approved by the Circular 02/09 of the city council on December 4, 2020. Capital Development Policy Formed from the 2021-2025 medium-term plan and its realization monitoring indicators. Capital Development Policy Regarding "6. Green Development" and "9. Ulaanbaatar City and Satellite City" from 2021 to 2025, those related to the environmental infrastructure in this project are shown in **Table 2.11** below.

Table 2.11 Evaluation Indicators and Related Items in Achievement Goals of the Capital Development Policy 2021 to 2025

No.	Index	Unit	Base Line	Achievement Goal (2025)	Explanation of Indicators	Frequency of Information Gathering	Institution in Charge
6. Green Development							
Environment							
Goal 6.2 Reduction of Environmental Pollution and Environmental Load							
6.2.1 Providing improved fuel to households in the ger area and reducing air pollution							
188	Number of hollows for which improved fuel is provided	Pieces	99	114	Base as of 2019	Once a year	DAAP
189	PM2.5 average value	μg/m^3	64	40	Base as of 2018	Once a year	DAAP
190	PM10 average value	μg/m^3	141	88	Base as of 2018	Once a year	DAAP
6.2.2 Improved air quality management							
191	Number of Air Pollutant Survey Comprehensive Lab	Pieces	0	1	Base as of 2020	Once every two years	DAAP
192	Number of Atmospheric Environment Measurement Bureau	Pieces	6	9	Base as of 2019	Once a year	DAAP

No.	Index	Unit	Base Line	Achievement Goal (2025)	Explanation of Indicators	Frequency of Information Gathering	Institution in Charge
6.2.3 Reduction of landfill volume at final disposal site by introducing comprehensive and advanced technology for waste separation and collection and transportation in Ulaanbaatar City, and promoting recycling facilities							
194	Increase in separated and recycled waste	%	11.4	50	Base as of 2019	Once every three months	Mayor's office
195	Reduction of the amount of waste landfilled at the final disposal site	%	85	75	Base as of 2019	Once a year	Mayor's office
6.2.4 Improve the final disposal site and gradually regenerate the area reclaimed for several years							
196	Regenerated area	ha	12	56	Base as of 2019	Once a year	Mayor's office
6.2.5 Online waste rate system and collection system							
197	Collection of waste charges for companies and organizations	%	50	100	Base as of 2019	Once a year	Mayor's office
198	Collection of waste fees for apartment households	%	90	100	Base as of 2019	Once a year	Mayor's office
199	Collection of waste fees for households in the ger district	%	60	100	Base as of 2019	Once a year	Mayor's office
6.2.6 Registration, separation, transportation, temporary storage, and establishment of treatment system for hazardous waste							
200	Managed company, organization	%	5	100	Base as of 2019	Once a year	Mayor's office
201	Number of hazardous waste temporary storage facility	Pieces	0	1	Base as of 2019	Once a year	Mayor's office
202	Managed waste volume	%	5	100	Base as of 2019	Once a year	Mayor's office
9. Ulaanbaatar and Satellite Cities							
Goal 9.8 Renovation of Apartment Houses, Maintenance of Healthy and Comfortable Living Environment							
Housing Policy							
9.8.4 Insulation work for apartment houses							
289	Building where heat insulation work was carried out	Pieces	73	375	Base as of 2020	Once a year	Mayor's office
9.8.5 Renewal of old pipe, connection to the camera monitoring system of the water and heating distribution station, installation of pre-filter device, reduction of maintenance cost							
290	Number of existing 535 water and heating distribution stations that need to be connected to a vehicle-controlled Scada system	Pieces	5	25	Base as of 2020	Once a year	Housing and Public Facilities Agency
291	Number of existing 535 water and heating distribution stations that require immediate pre-filter installation	Pieces	1	21	Base as of 2020	Once a year	Housing and Public Facilities Agency
292	Extension of the existing 213.9km sewer pipe that needs to be widened and repaired	km	0.3	0.3	Base as of 2020	Once a year	Housing and Public Facilities Agency
Power Supply							
Goal 9.10 Ensuring Stable Power Supply by Improving Power Efficiency, Widening Infrastructure, and Updating Technology							
9.10.1 Securing power for households with unstable electric services by improving the power grid and capacity							
298	Electric stove Number of households with	Pieces	42,000	122,000	Base as of 2020	Once a year	Mayor's office

No.	Index	Unit	Base Line	Achievement Goal (2025)	Explanation of Indicators	Frequency of Information Gathering	Institution in Charge
	technical conditions available						
9.10.2 New maintenance of power storage station							
299	Number of 50MWpower storage	Pieces	0	1	Base as of 2020	Once a year	UB Urban Development Bureau
Heating Supply							
Goal 9.12 Securing Heating Capacity to Meet Domestic Demand							
9.12.1 Improvement of thermal power plant capacity and main pipeline heating supply capacity							
302	Thermal power plant	Pieces	1	4	Base as of 2020	Once a year	UB Urban Development Bureau
303	Extension length of newly constructed trunk heating pipe	km	379.5	396.9	Base as of 2020	Once a year	UB Urban Development Bureau
304	Extension length of the existing 379.5km heating pipe that needs to be widened and improved	km	15.1	15.1	Base as of 2020	Once a year	UB Urban Development Bureau
9.12.2 Connection to the central heating network of state-owned boilers due to widening and improvement of Amgalan and No. 3 thermal power plants							
305	Number of boilers required to connect to the central network	Pieces	557	432	Base as of 2020	Once a year	Mayor's office
9.12.3 Construction of CNG fuel heating source							
306	Number of CNG fuel heating source	Pieces	0	5	Base as of 2020	Once a year	UB Urban Development Bureau
9.12.4 Conversion of solid fuel boilers to CNG for companies that cannot connect to the central heating network							
307	Number of companies and organizations that have switched from solid fuel to CNG	Pieces	20	70	Base as of 2020	Once a year	UB Urban Development Bureau
Engineering Maintenance Measures							
Goal 9.14 Engineering Maintenance Text and Design Creation							
9.14.2 New construction, widening and improvement of flood embankment and gutter network							
313	Extension length of new road drainage network	km	187	223.1	Base as of 2020	Once a year	Mayor's Office, UB Road Development Bureau, UB Urban Development Bureau, Land Coordination Bureau, Surveying and Water Facilities Bureau
Water and Sewage							
Goal 9.15 Improvement of Water Source, Reduction of Water Loss, Continuation of Old Pipe Renewal Project							
9.15.1 New water source development in western Ulaanbaatar, wastewater treatment from central sewage treatment plant, reuse at thermal power plant							
317	UB City Water Source Improvement Project Implementation	%	0	100	Base as of 2020	Once a year	Governor's Office, Mayor's Office, UB Urban Development Bureau, Land Coordination Bureau, USUG
Goal 9.16 Improving Water Supply by Constructing and Widening Reservoirs and Pipelines in UB City							
9.16.1 New reservoir and pipeline							
323	Percentage of population supplied with clean water that meets the standards	%	99.5	99.8	Base as of 2020	Once a year	UB Urban Development Bureau, Land Coordination Bureau

No.	Index	Unit	Base Line	Achievement Goal (2025)	Explanation of Indicators	Frequency of Information Gathering	Institution in Charge
324	Khujirbulan Reservoir Construction Results	%	0	100	Base as of 2020	Once a year	UB Urban Development Bureau, Land Coordination Bureau
325	Buyant-Ukhaa 2 area Reservoir construction record	%	0	100	Base as of 2020	Once a year	UB Urban Development Bureau, Land Coordination Bureau
326	Construction results of reservoir around Tolgoit and Ikh naran	%	0	100	Base as of 2020	Once a year	UB Urban Development Bureau, Land Coordination Bureau
327	Extension length of new water pipe	km	586	597.4	Base as of 2020	Once a year	UB Urban Development Bureau, Land Coordination Bureau, USUG
328	Extension length of new drainage pipe	km	236	266.2	Base as of 2020	Once a year	UB Urban Development Bureau, Land Coordination Bureau, USUG
9.16.2 Widening and improving existing reservoirs and pipelines							
329	Widening capacity of East-North Reservoir	m^3	6000	30000	Base as of 2020	Once a year	UB Urban Development Bureau, Land Coordination Bureau, USUG
330	Nalaikh district Reservoir, Pump Station, Pipeline Renewal Rate	%	0	100	Base as of 2020	Once a year	Governor's Office, UB Urban Development Bureau, Chanmani Naliakh Corporation
331	Extension length of the existing water supply 586km that needs to be widened and improved	km	7.6	7.6	Base as of 2020	Once a year	Mayor's Office, USUG, UB Urban Development Bureau
332	Extension of the existing 236km drainage pipe that needs to be widened and improved	km	1.4	1.4	Base as of 2020	Once a year	Mayor's Office, USUG, UB Urban Development Bureau
9.16.3 Implementation of non-excavation renewal projects, connection to the central network of water supply kiosks, installation of smart equipment							
333	Number of kiosks not connected to the central network (after the connection, smart equipment will be equipped.)	Pieces	376	317	328 kiosks already connected to the central network	Once a year	Mayor's Office, Capital Governor's Office, USUG, Chanmani Naliakh Corporation, UB Urban Development Bureau
334	Extension length of water pipe renewal	km	7.8	22	Base as of 2020	Once a year	USUG
Goal 9.17 New Construction of Sewage Treatment Plant, Technical Update of Existing Facilities							
9.17.1 Construction of central sewage treatment plant and sludge drying facility in UB City							
335	Construction progress of central sewage treatment plant	%	10	100	Base as of 2020	Once a year	Governor's Office, UB Urban Development Bureau

No.	Index	Unit	Base Line	Achievement Goal (2025)	Explanation of Indicators	Frequency of Information Gathering	Institution in Charge
336	Number of sludge drying facility	Pieces	0	1	Base as of 2020	Once a year	Mayor's Office, Urban Development Bureau
9.17.2 Buyant-Ukhaa district sewage treatment plant external heating work							
337	Buyant-UkhaaSewage treatment plant external heating work results	%	10	100	Base as of 2020	Once a year	Governor's Office, UB Urban Development Bureau, USUG
Road, Public Transport							
Goal 9.19 Improvement of Roads, Bicycle Paths and Sidewalks, Widening and Improvement of Main Roads and General Roads, Development of Road Network by New Construction							
9.19.1 Widening of road network extension							
339	Extension length of road network	km	1,135	1,425	Base as of 2019	Once a year	UB Road Development Bureau, UB Transportation Planning Coordination Bureau, Land Coordination Bureau, Urban Development Bureau
9.19.2 Widening and improvement of trunk lines and general roads							
340	Extension length of idening and improving road	km	29.7	129.7	Base as of 2020	Once a year	UB Road Development Bureau, UB Transportation Planning Coordination Bureau, Land Coordination Bureau, Urban Development Bureau
Goal 9.20 Reduction of Traffic Congestion by Proper Planning of Road Traffic							
9.20.1 Implementation of comprehensive traffic congestion policy, improvement of average vehicle speed in the center							
343	Average speed of the vehicle	km/h	10	25	Base as of 2020	Once a year	UB Road Development Bureau, UB Transportation Planning Coordination Bureau
Goal 9.21 Planning of Various Appropriate Means of Transportation, Implementation of Projects							
9.21.1 Formulation of public transportation MP (Master Plan)							
345	Elimination ratio of duplication of public transportation routes	%	0	50	Base as of 2020	Once a year	UB Public Transportation Service Bureau
Goal 9.22 Maintenance of Public Transportation Vehicles and Bus Stops that Ensure Safety and Comfort							
9.22.1 Update of public transport vehicles							
348	Number of eco-friendly buses	Racks	12	931	Base as of 2020	Once a year	UB Public Transportation Service Bureau
9.22.2 Maintenance of charging points for electric vehicles							
349	Number of electric bus charging station	Pieces	3	10	Base as of 2020	Once a year	UB Public Transportation Service Bureau
350	Number of electric car charging station	Pieces	6	11	Base as of 2020	Once a year	UB Public Transportation Service Bureau

2.2.4 JICA Projects

(1) The Project on Capacity Development in Urban Development Sector in Mongolia (MUGCUP 1)

JICA carried out this project to promote redevelopment of ger districts from year 2010 to 2013.

(2) The Project on Capacity Development in Urban Development Sector in Mongolia, Phase 2 (MUGCUP 2)

In connection with Urban Redevelopment (hereinafter referred to as “URD”) issues, a technical cooperation project was conducted to formulate an action plan of the master plan (MP) and promotion of URD. The project is composed of two (2) sub-projects: formulation of an action plan of the UB MP covering from 2016 to 2020 and its monitoring (Sub-Project 1: The Project for Improvement of Capacity for Implementation of Ulaanbaatar Master Plan) and enhancement of implementation of URD (Sub-Project 2: The Project on Capacity Development in Urban Development Sector in Mongolia, Phase 2 [MUGCUP 2]).

(3) Capacity Development Project for Air Pollution Control in Ulaanbaatar City (Phases 1-3)

The Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 1 was implemented from March 2010 to March 2013, and the Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2 was implemented from December 2013 to June 2017. The two phases of the Projects were comprised of strengthening the air quality monitoring system, identifying sources of air pollution, implementing the boiler registration and management system, updating and expanding the system of the counterpart working group (CP-WG) members such as the Air Pollution Reduction Agency of the Capital City (APRD, currently DAAP), analyzing particulate matter (PM10, etc.) components and source contribution analysis, and developing standards for air pollutant emissions. There are still issues remaining related to improving the capacity to implement air pollution control measures.

Under such circumstances, "Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 3" has been implemented since November 2018 in order to support the "implementation of effective pollution control measures" and "collaborative emphasis system between APRD and relevant agencies at the national and city level".

(4) UB City Water and Sewage Master Plan Survey

In UB City, a master plan for water and sewage (hereinafter referred to as 2013 water and sewage MP) was formulated with the goal of 2030.

(5) Waste Related Projects

Since 2004, JICA has been proceeding in three stages of development Survey, Grant Aid, and Technical Cooperation for the drastic improvement of SWM in UB City, and also plans for SWM in the city, introduction of facilities and equipment, technical guidance, and contributed to the overall improvement of human resource development.

On the other hand, unclear division of roles due to lack of finance for SWM projects and lack of legal system is raised as an issue. In addition, in this survey, it was confirmed that issues such as aging SWM facilities, illegal dumping problems, and proper treatment of hazardous waste still remain.

a. Development Survey: SWM Survey for Ulaanbaatar City in Mongolia (2004-2007)

Phase1: Survey on the actual situation of SWM and formulation of the MP in UB City

Phase2: Feasibility Study for Priority Projects and Implementation of Pilot Projects

Phase3: Monitoring and follow-up of the projects

b. Grant Aid: SWM Improvement Plan for Ulaanbaatar City in Mongolia (2007-2008)

Construction of final sanitary landfill site (Narangiin Enger Disposal Site [NEDS]), provision of garbage collection and transportation vehicles, providing vehicle maintenance equipment, other equipment was provided, and individual technology was instructed by soft components through grant aid project.

c. Technical Cooperation: Strengthening the Capacity for SWM in Ulaanbaatar City (2009-2012)

Local technical guidance, human resource development, training in Japan, public awareness and dispatch of senior volunteers were carried out by the technical cooperation project.

d. Study on the Strategic Planning for Water Supply and Sewerage Sector in Ulaanbaatar City in Mongolia (2013)

Ulaanbaatar’s master plan for water supply and sewerage targeting the year 2030 was developed in this study.

2.3 Legal System

2.3.1 Legal System: Urban Development

(1) Urban Redevelopment (URD Law)

Following the activities of MUGCUP1, it was approved by the Diet in June 2015. Based on the law, UB City has established its own regulations for the implementation of URD projects and has been implementing URD projects through private businesses since 2013. However, due to insufficient system development, there are various issues.

The URD law has five business methods (1) Urban redevelopment in the city as an urban redevelopment project, (2) Removal, reconstruction of buildings, facilities (aging buildings) that do not meet the usage standards, (3) Land reorganization in the ger area (land readjustment in the ger area and Land Readjustment (hereinafter referred to as “LR”) project), (4) Land replanning and construction in the ger area (apartment in the ger area), (5) Redevelopment of public land.

The LR project aims to preserve the hygienic, safe, and comfortable living environment of the residents of the ger area and improve land use. It is a project to reorganize the land owned or occupied by individuals and corporations to secure land for earthwork, infrastructure facilities, social service facilities and public facility development. It is possible to consolidate the land provided by the "reduction" method from each of the residents' plots, secure land for public facilities such as roads and parks, and "reservation land" for raising project costs. By the right conversion, the landowner acquires the right of the land after the maintenance instead of the conventional land right. Through the project, when the rights are converted, the area will be changed by reducing the number of steps, the land will be reshaped and relocated, and the land interests will be re-established.

The ger district apartment conversion project is for the purpose of building an apartment in the ger district. This is an apartment construction and infrastructure development project that uses the conversion of rights from land to apartment floors. The landowner in the project area will acquire the right to the apartment floor after maintenance instead of the previous land right. In addition, the enforcer can secure a part of the apartment floor after construction as a "reserved floor" and use the profit from the sale for the project cost.

2.3.2 Legal System: Air Pollution Control

(1) The Air Law and the Air Payment Law

The Air Law and the Air Payment Law were revised in May 2017 in accordance with the revision of the Violation Law, which is a higher law in the hierarchy. The revised Violation Law is changed in a way that if there is a violation at the facility in question, a decision will be made only after getting an approval from the agency within the Audit Agency (Inspection Agency).

A summary of the Air Law is shown as follows. The Air Law stipulates that specialized agencies shall conduct evaluations on the use and licensing of pollution source facilities. Human resource development for air pollution control in the government agencies and UB City has already been specified. In 2018, some provisions of the Air Law on air pollution control fund, and the clean air fund were repealed.

According to the Air Payment Act, taxation is based on the amount of coal mined, the amount of volatile organic compounds (fuels) manufactured or imported, and pollutants emitted into the atmosphere from vehicles and large sources.

Outline of the Air Law

Chapter 1 Purpose, Laws, and Terminology
Article 1 Purpose of the Law
Article 2 Laws and regulations related the atmosphere
Article 3 Definitions of legal terms
Chapter 2: Powers of the state and local governments on air pollution control, and powers and responsibilities of private companies, institutions and individuals
Article 4 Powers of the state grand council
Article 5 Powers of the President of Mongolia (This article has been repealed)
Article 6 Cabinet authority
Article 7 Powers of the central organs of state administration with jurisdiction over natural environment issues
Article 8 Authority of local governments and local administrative organs
Article 9 Rights and obligations of enterprises, institutions and individuals
Chapter 3 Air quality management and information
Article 10 Professional organizations
Article 11 Audit and analysis of air quality
Article 12 Information on air quality
Chapter 4 Air pollution control measures
Article 13 Air pollution reduction activities, basic principles
Article 14 Role of individuals for air pollution reduction, encouragement
Article 15 Air quality improvement areas
Article 16 Prohibited matters in air quality improvement areas
Article 17 Limits of air pollutants and physical effects
Article 18 Permission to Use Large-scale stationary sources
Article 19 Measures against serious increase in air pollution and negative physical impacts
Article 20 Emission of air pollutants, control of negative physical impacts
Article 21 Air pollution control requirements for building construction, production and service industries
Article 22 Air pollution control requirements in the establishment of resettlement areas
Article 23 Installation of equipment for large scale stationary sources
Article 24 Adaptation to climate change, reduction of its negative impacts
Article 25 Protection of the ozone layer
Chapter 5 Others
Article 26 Audit system
Article 27 National comprehensive registration of air pollutant emissions, physical negative impacts and their sources
Article 28 Intentional impact on atmospheric conditions and meteorological phenomena
Article 29 Air pollution fee

Article 30 Clean air fund
Article 31 Liability for violators of laws and regulations related to air quality

(2) Improved Fuel Quality Standard

The draft Mongolian National Standard (MNS5679-2019) on measurement and emission standards for improved fuels (MNS: Mongolian National Standard) was approved as the Order No. C/16 on May 14, 2019 by the Mongolian Agency for Standardization and Metrology. The standard became effective on May 15, 2019.

(3) Government Special Fund

Decision No. 87 on February 27, 2019 of the Government "Measures for Government Special Funds" decided to repeal the Air Pollution Control Fund, and the amendment of the Law on Government Special Funds was approved on November 13, 2019.

Natural Environment and Climate Fund was established by the amended law, and the air pollution fee revenues provided for in Article 3.1.14 of the Air Law will be allocated to this Fund. Currently, there is no move to consolidate the Fund and it will be managed directly by the Minister of MET. In accordance with the action plan approved by the National Committee for Environment Pollution Reduction, air pollution reduction measures are being implemented by relevant agencies that are members of the National Committee for Environment Pollution Reduction.

(4) Ban on the Use of Raw Charcoal in Ulaanbaatar (Cabinet Decision 62)

Meeting on the revision of the 62nd Cabinet Decision to ban the use of raw coal was held on February 28, 2018, and the proposed Air Pollution Improvement Zone was approved by the City Council on February 13, 2020. After that, the proposed Air Pollution Improvement Zone proposal was submitted to the MET on March 4, 2020, the MET approved the revision on October 12, 2020, and revision of the Air Pollution Improvement Zone was renewed by the Ministerial Decree of MET. According to this revision, the use of raw coal is allowed in five khoroo in six districts (Bayanzurkh, Khan-Uul, Chingeltei, Bayangol, and Songinokhairkhan) in UB City due to their distance from the UB City center, and the ban on the use of raw coal has been updated in all six districts in the UB City center. In these six districts, the use of raw coal is for small coal-fired water heaters (CFWH) of less than 100kw, which will also be banned.

In the winter from 2021 to 2022, the use of raw coal will be banned in the entire city, including Naraiha, Baganuur, and Bagahangai district, which are satellite districts of Ulaanbaatar City on the outskirts of the city center. Prior to this, during the winter of 2020, use of raw coal was banned, and improved fuel was sold in some ger districts khoroo in Naraiha District on a trial basis.

(5) Free Midnight Electricity in the Ger Area

In order to reduce the use of improved fuels in ger areas, free electricity in ger areas was supplied at midnight during the winter of 2019-2020; for the winter of 2020-2021, free electricity will be provided to private companies and all households in the country, except for state-owned companies, up to the electricity price of the same period one year ago.

(6) Measures for Automobiles

In January 2019, the National Committee for Environment Pollution Reduction issued a decision on the division of roles among relevant agencies in regards to several measures to reduce pollutants emitted from automobiles. The Minister of Road Transport and Development issued a decree establishing a working group in November 2019 to audit and measure automobile emissions, and to study and evaluate emission reduction measures.

(7) Priority of the Air Pollution Control

Air pollution in Ulaanbaatar is namely caused by PM and SO_2 emissions. The impact of the improved fuel emissions is huge, and measures to ban the use of raw coal and the promotion of improved fuel have a high priority. As the SO_2 concentration is increasing in 2020, in addition to the promotion of improved fuels, the priority of measures for automobiles is increasing.

2.3.3 Legal System: Water Pollution Control

Table 2.12 shows the legal system related to water pollution control in Mongolia.

Table 2.12 Legal System: Water Pollution Control

Law Name	The day of Promulgation	Outlines of Law
Mongolian Constitution	January 13, 1992	Mongolians "have the right to enjoy a healthy and safe environment and be protected from environmental pollution and ecosystem incongruity."
Law on Environmental Protection	March 30, 1995 January 31, 2008 (Revised)	A basic law for environmental protection and defines the purpose of environmental protection such as land, underground resources, mineral resources, water, air, animals, and plants from a legal point of view.
Law on Water	April 13, 1995 April 22, 2004 (Revised) May 17, 2012 (Revised) August 17, 2012 (Revised)	This law stipulates the protection of water resources and river basins, proper use and restoration, and the authority of relevant government agencies.
Law on Natural Resource Utilization Tariff (revised)	May 17, 2012 (Revised)	The Water and Mineral Water Usage Fee Law (May 22, 1995) and other laws concerning the use of natural resources have been revised together in this law. This law stipulates rules regarding usage fees for water, mineral water and other natural resources, and payment procedures.
Law on Environmental Impact Assessment	January 22, 1998 May 17, 2012 (Revised)	This law is a law for conducting environmental impact assessment and defines the target business and procedures. Development projects and infrastructure projects that use natural resources, and renovation and expansion of existing projects, etc. are targeted.
Law on Sanitation	May 7, 1998	This law stipulates the obligations of the national government, local governments, and businesses to maintain a healthy and safe environment.
Law on the use of city / village water and sewage	October 6, 2011	This law stipulates the ownership and use, responsibility and authority of water and sewage facilities.
Law on water pollution tariff	May 17, 2017 May 2, 2019 (Revised)	This law stipulates the charges imposed on citizens and businesses that exclude sewage into rivers, etc. to reduce the adverse effects on the environment.

In addition, various wastewater standards related to water pollution regulation in public water areas are as follows.

- Effluent quality standards of wastewater treatment plant for discharging into public waterbody (MNS 4943: 2015,
- **Table 2.13**)
- Effluent quality standards of factory for discharging into the sewer (MNS 6561: 2015, **Table 2.14**)

- Effluent quality standards of leather factory for discharging into Khargia Industrial Wastewater Treatment Plant (MNS 5582: 2006)
- Calculation method of moisture and ash content of sewage sludge（MNS 5667: 2006）

Table 2.13 Effluent Quality Standards of Wastewater Treatment Plant for Discharging into Public Waterbody (MNS4943:2015)

№	Parameters	Measuring unit	Maximum allowable level
1.	Water temperature	℃	20
2.	pH	-	6-9
3.	Odour	senses	odourless
4.	SS	mg/l	30
5.	BOD	mg/l	20
6.	COD	mg/l	50
7.	Permanganate oxidation	mg/l	20
8.	Dissolved salts /mineralization/	mg/l	1000
9.	Total nitrogen	mg/l	15*
10.	Total phosphorus	mg/l	1.5*
11.	Hydrogen Sulfide /H_2S/	mg/l	0.5
12.	Residual chlorine /Cl_2/	mg/l	1
13.	Barium /Ba/	mg/l	1.5
14.	Beryllium /Be/	mg/l	0.001
15.	Boron /B/	mg/l	0.5
16.	Vanadium /V/	mg/l	0.1
17.	Copper /Cu/	mg/l	1
18.	Cadmium /Cd/	mg/l	0.03
19.	Cobalt /Co/	mg/l	0.02
20.	Manganese /Mn/	mg/l	0.5
21.	Molybdenum /Mo/	mg/l	0.5
22.	Mercury /Hg/	mg/l	0.001
23.	Nickel /Ni/	mg/l	0.2
24.	Selenium /Se/	mg/l	0.02
25.	Strontium /Sr/	mg/l	2
26.	Total iron /Fe^{2+3}/	mg/l	1
27.	Uranium /U/	mg/l	0.05
28.	Lead /Pb/	mg/l	0.1
29.	Total chromium /Cr/	mg/l	0.3
30.	Hexavalent chromium /Cr^{6+}/	mg/l	0,01
31.	Aluminium /Al/	mg/l	0.5
32.	Arsenic /As/	mg/l	0.01
33.	Zinc /Zn/	mg/l	3
34.	Tin /Sn/	mg/l	0.05
35.	Total cyanide /CN/	mg/l	0.05
36.	Free cyanide /HCN/	mg/l	0.005
37.	Phenol /C_6H_5OH/	mg/l	0.05
38.	Benzo (a) pyrene /$C_{20}H_{12}$/	mg/l	0,005
39.	Fat	mg/l	5

Source: Study on Progressing Situation and Management System: UB Industrial Wastewater (Feb. 2019)

Table 2.14 Effluent Quality Standard of Factory for Discharging into Sewer (MNS 6561:2015)

№	Chemical element names	Measuring unit	Allowed maximum amount
1	Temperature	^0C	+30
2	Water conditioning, pH	-	6-9
3	SS	mg/l	400
4	BOD	mg/l	400
5	COD	mg/l	800
6	Ammonium ion	mg/l	15
7	Total nitrogen /TN/ $NH_3+NO_2+NO_3+N_{org}$	mg/l	30
8	Chloride /Cl/	mg/l	1000
9	Sulfate /SO_4^{2-}/	mg/l	700
10	Sulfide /H_2S, HS, S^{2-}/	mg/l	5
11	Copper /Cu/	mg/l	1
12	Soft white / Cadmium /Cd/	mg/l	0.05
13	Cobalt /Co/	mg/l	0.1
14	Mercury /Hg/	mg/l	0.005
15	Nickel /Ni/	mg/l	0.5
16	Selenium /Se/	mg/l	0.1
17	Total iron /Fe^{2+3}/	mg/l	3.0
18	Lead/Pb/	mg/l	0.2
19	Aluminium /Al/	mg/l	0.5
20	Total chromium /Cr/	mg/l	1.0
21	Chromium /Cr^{6+}/	mg/l	0.05
22	Arsenal /As/	mg/l	0.1
23	Zinc /Zn/	mg/l	5.0
24	Cyanide /CN/	mg/l	0.1
25	Total Phosphorus	mg/l	5.0
26	Phenol /C_6H_5OH/	mg/l	0.5
27	Surfactant	mg/l	10.0
28	Fat	mg/l	25.0
29	Mineral oils	mg/l	5.0
30	Total Chlorinated Hydrocarbons	mg/l	0.3

Source: Study on Progressing Situation and Management System: UB Industrial Wastewater (Feb. 2019)

2.3.4 Legal System: Solid Waste Management (SWM)

(1) Overview

The "Law of Mongolia on Household and Industrial Waste" that came into effect on November 28,2003 became invalid from May 17,2012 and the revised "Law of Mongolia about Waste" came into effect on May 12,2017. The purpose of this Law is to reduce and prevent the harmful effects of waste on human health and the natural environment, introduce waste into the economic circulation, save natural resources, and improve the knowledge of residents about waste. And waste reduction, separation, collection, transportation, storage, reuse, recycling, renewal, disposal, export, import of hazardous waste, and prohibition of domestic passage.

Law of Mongolia about Waste

Chapter 1 General Provisions
Article 1. Purpose of the Law
Article 2. Legislation on Law of Mongolia about Waste
Article 3. Scope of Law
Article 4. Legal term definition
Article 5. Right of Ownership to Waste

Chapter 2 Powers of the State and Local Administrative Bodies and Common Rights and Duties of Individuals, Economic Entities and Organizations
Article 6. Powers of the State Great Khural
Article 7. Posers of the Government
Article 8. Powers of State Administrative Central Body
Article 9. Powers of Khurals of Citizens' Representatives and the Capital city, aimag, soum and district Governors
Article 10. Common Rights and Responsibilities of Individuals, Economic Entities and Organizations about waste

Chapter 3 Waste Information Database, Expert Committee, Audit
Article 11. Information integrated database
Article 12. Waste Expert Committee
Article 13. Audit for waste-related activities

Chapter 4 Cleaning, Collection and Transportation of Waste, Reuse, Recycling, Disposal, Landfill
Article 14. Waste Cleaning, Collection and Transportation
Article 15. Requirements for waste storage boxes
Article 16. Reuse, Recycling, Disposal, Landfill of Waste
Article 17. Requirements for Reuse, Recycling, Disposal and Landfill Facilities of Waste
Article 18. Landfill of Waste at the Disposal Site
Article 19. Closure of Landfill
Article 20. Regulations at waste disposal sites

Chapter 5 Hazardous Waste Storage, Temporary Storage, Transportation, Collection, Storage, Recycling, Disposal
Article 21. Registration of Hazardous Waste Generators and Transportation, Collection, Storage, Recycling, Disposal Companies
Article 22. Hazardous Waste Containment
Article 23. Temporary Storage at the source of Hazardous Waste
Article 24. Transportation of Hazardous Waste
Article 25. Requirements for Storage, Recycling and Disposal of Hazardous Waste
Article 26. Management of Hazardous Waste Collection, Storage, Recycling and Disposal Business
Article 27. Acceptance of Hazardous Waste
Article 28. Activity Record
Article 29. Report
Article 30. Implementation of Audit Monitoring
Article 31. Facility Closure
Article 32. Post-closure Audit Monitoring
Article 33. Additional Requirements for Hazardous Waste Storage
Article 34. Additional Requirements for Landfill Disposal at Hazardous Waste Disposal Sites
Article 35. Additional Requirements for Incineration of Hazardous Waste
Article 36. Requirements for Emissions Management System for Storage, Recycling and Disposal of Hazardous Waste
Article 37. Permits to Transportation, Collection, Storage, Recycling, and Disposal of Hazardous Waste
Article 38. Hazardous Waste Export
Article 39. Prohibition of Import and Domestic Passage of Hazardous Waste

Chapter 6 Economic Adjustment of Waste
Article 40. Introduction of Waste into Economic Circulation
Article 41. Supply of Waste Service Fees, Fees and Business Funds

Chapter 7 Education on Waste
Article 42. Implementation of Waste Education

Chapter 8 Miscellaneous Rules
Article 43. Penalties

(2) Hazardous Waste

The definition of hazardous waste in the Law of Mongolia about Waste (hereinafter referred to as "LMW") is shown below.

- The definition of hazardous waste is "explosive, flammable, chemical reaction waste, hazardous gas generated by reaction with air and water, infectious waste, waste that has a short-term and long-term harmful effect on humans and animals, waste that has a harmful effect on the natural environment, waste that generates harmful substances after landfill disposal", but there is no specific item, and it is recognized as a general item that shows harmfulness. [LMW Article 4 1.2].
- Hazardous waste generators, transportation, collection, storage, recycling and disposal companies are registered, and permission is required for the waste handling method and period [LMW Article 12].
- When disposing of hazardous waste in landfill, specifications to prevent contamination of soil, groundwater and surface water, creation of layout map of type, position, quantity, depth, etc. of hazardous waste in landfill, obligation to record, the requirements for closure and the implementation of post-closure audit monitoring are stipulated. Landing of flammable and reactive wastes, unsterilized medical wastes, uncontained liquid wastes, and chemical substances for which health effects have not been specified is prohibited. It is possible to landfill waste that uses liquids and containers as a unit, such as batteries and storage batteries [LMW Article 34].
- Penal provisions for illegal dumping are stipulated in Article 43 "Responsibility to Violators of the Law", and specific penal provisions are stipulated in the National Civil Service Law and the Criminal Law or the Violation Law. On the other hand, in reality, illegal dumping is increasing, and it is possible that there is a lack of related provisions and regulations to ensure compliance with the law [LMW Article 43].

(3) Law of Mongolia about Waste Related Ordinance

The following ministerial ordinances have been issued regarding Law of Mongolia about Waste related laws.

- Regulations on cleaning, collection, separation, transportation, recycling, reuse, treatment and landfill of construction waste (Minister of Construction and City Planning Ordinance No. 48, 2020): Defines the project from collection to treatment of waste related to the construction of buildings, lifelines, roads and greening facilities, and waste related to the sale and manufacture of building materials.
- Regulations on the National Integrated Database for Waste (Minister of Natural Environment and Tourism Ordinance 2018 A/248): Define database construction for SWM, roles of related organizations and information disclosure.
- Regulations on separation, collection, storage, transportation, and treatment of hazardous waste from medical institutions (Minister of Insurance Ordinance No. 505, 2017)

(4) Ulaanbaatar City Waste Ordinance

There are no waste-related laws and regulations specific to UB City, but various regulations have been formulated and put into effect by the heads of relevant ministries and administrative units in accordance with the Law of Mongolia about Waste (LMW).

2.3.5 Legal System: Climate Change Mitigation

Mongolia joined the UNFCCC in 1993, the Kyoto Protocol in 1999, and the Paris Agreement on Climate Change in 2016. Mongolia developed Mongolia's Nationally Determined Contribution (NDC), which was adopted by the Government Decree No. 407 on November 2019, with the aim to contribute to the Paris Agreement. In the NDC, Mongolia enhanced its mitigation effects with policies and measures to be implemented in key economic and natural resource management sectors by 2030. The mitigation target of Mongolia's NDC will be 22.7% reduction in total of national GHG emission by 2030, compared to the projected emission under "business as usual" scenario.

Since Mongolia relies on the coal fuel for heat and electricity production, the average CO_2 emissions per capita is 4.33 (ton CO_2/capita), which is higher than the world average. Due to this situation, GOM has several plans and programs where the share of renewable energy sources in the total installed power capacity for the domestic supply will be 20% by 2023 and 30% by 2030, and there will be improvement of insulation for the existing buildings and implementation of new energy-efficient standards for new buildings. The GOM plans to cover some part of the required budget for their implementation through foreign loans. The related laws for climate change mitigation in Mongolia are shown in **Table 2.15**.

Table 2.15 Related Laws for Climate Change Mitigation

Relevant Laws	Outline
Law of energy (1 February 2001)	It stipulates energy production and distribution, maintenance of related buildings, appropriate use and suitable energy fee system, etc.
Law of renewable energy (11 January 2007)	It stipulates renewable energy production and appropriate fee system for renewable energy, etc.
Law of energy conservation (26 November 2015)	It stipulates authority of relevant organization and users, roles of responsible organizations to promote energy conservation and efficiency usage.
Policy by GOM on Energy from 2015 to 2030 (Circular Notice by the 'State Great Hural of Mongolia', number 63 of year 2015)	It sets priority for energy policies up to 2030, ensuring stable supply and safety, improving energy efficiency, sustainability of the natural environment and green development. It sets strategies and targets for implementation of these contents.
National Program on Energy conservation (Cabinet Approval, number 274 of year 2017)	It is a program for promoting policies based on the Law of energy conservation and policies related to energy, and it defines activities and evaluation method, financial sources and operation system in order to achieve the goals.
National Program on Climate Change (Circular Notice by the 'State Great Hural of Mongolia', number 2 of year 2011)	It stipulates measures against climate change and strategic targets for 2021, implementation activities and the roles and responsibilities of relevant organizations.

Climate change mitigation is treated as a very important element in the latest national strategy. Vision-2050, which is the long-term development policy of Mongolia, consists of the first stage (from 2020 to 2030) with the building of the green technology and green economy, the second stage (from 2031 to 2040) with construction as basis for green development, and the third stage (from 2041 to 2050) with the establishment of sustainable green development.

In the first stage, the GHG emissions from the electricity sector, agriculture and livestock sector, building sector, transportation sector, and waste management sector are reduced and the target is set for the increasing trend on the amounts of CO_2 absorption. In the second stage, the objective is adaptation of the Paris Agreement, GHG emission reductions and for the increasing trend on the amounts of CO_2 to decline. In the third period, the objective is the implementation of the climate change mitigation, the balance of emissions and absorptions of GHG, and the realization of virtual zero emissions. In the Stage 1 objective, in close collaboration with the Green Climate Fund of UNFCCC and with the support of foreign donors, the implementation of measures such as business loans, renewable energy program for solar power plants in Govisümber aimag, and eco-houses and renewable energy project in the UB City will be planned to reduce GHG emissions. It has been estimated that the projects will cover 9.4 million CO_2 tons out of 16.9 million CO_2 tons which is equivalent to 22.7% emission reduction as the target of NDC.

In addition, according to the interview research for MET, the concrete measures are currently being planned to achieve the target for CO_2 emission reductions of NDC. The role of MET on the climate change mitigation field is the organization through which the strategy of basic policy is decided. Concrete measures will be implemented by the relevant organizations, and MET will play the role of coordination and management organization for implementation. The actions under the policy are carried out in each local area under the relevant organization.

From the above, it is considered that energy conservation measures and promotion of renewable energy introduction are focused on the efforts for climate change mitigation measures as a high priority.

2.4 Understanding the Current Status of Environmental Issues and Analyzing Issues

2.4.1 Understanding the Current Status of Environmental Issues related to Air Pollution Countermeasures and Analyzing Issues

(1) Overview of Energy Source in UB City

a. Current Status of Air Pollution

Photo 2.1 shows an example of a ger area while **Photo 2.2** shows a typical winter morning scene in a ger area. The thin stripe between the residential area and the mountains in the distance is the smog from the smoke from stoves.

Source: JCOAL

Photo 2.1 An Example of a Ger Area, with Gers Spreading Up the Mountainside

Source: JCOAL

Photo 2.2 Situation in the Ger Area in the Morning (February 2018)

Figure 2.2 shows the average concentration (µg/m^3) of PM2.5 measured at seven measurement stations in UB City from January 2017 to February 2018. Based on this figure, the pollution level is high during the six months of winter, from January to March and October to December. The red line, 50 µg/m^3, indicates the 24-hour average ambient air quality standard value in Mongolia. As a basis for the preparation of the National Program on Reducing Environment Pollution, which was approved by the Cabinet of Ministers in 2017, it was stipulated that 80% of the air pollution in UB City originates from ger stoves and 3,200 HOBs in the ger area, 10% from 400,000 cars driving through the city, 5-6% from thermal power plants, 4% from ash landfills of thermal power plants and wind-blown dust from roads, as well as other sources such as dumped wastes.

Source: 2018 NAMEM Annual Report published in 2018

Figure 2.2 Annual Trend in PM2.5 Concentrations (Jan. 2017 - Feb. 2018)

b. Current Status of Energy Sources

As Mongolia is blessed with abundant coal resources, the dependence on coal for energy is extremely high. As shown in **Table 2.16**, in regard to primary energy sources, coal is used mostly for power generation. On the other hand, under the National Energy Policy for 2015-2030, the Mongolian government has set a goal of increasing the share of renewable energy to 20% by 2023, and 30% by 2030.

Table 2.17 shows the domestic heat sources and housing types in UB City, where the temperature can drop below -30° C during severe winters. The housing types can be divided into two groups: apartments and public facilities with central heating, and gers and small houses without central heating. The ger in this category refers to the tent-type mobile homes that nomads carried with them when they migrated, which in turn is one of the reasons for the increase in population. The area occupied by gers and small houses is called the ger area, where coal is used exclusively as a heat source. A large number of low-income households also characterizes the ger areas.

Table 2.17 also shows HOBs (hot water supply boilers) scattered in each district, and **Table 2.18** shows the ratio between residential districts and ger districts. A house in this context includes small houses and villas built afterwards. Some 57% of the total number of households are located in ger districts. A household owns one stove; therefore, around 220,000 stoves are in use. The consumption of propane gas has also been increasing. Traditionally, it has been general households, mainly restaurants, but since 2020, it is also being used in HOBs, schools, and other public facilities due to government policy.

Table 2.16 Primary Energy Ratio in Mongolia (in ktoe, 2017)

Item	Coal	Crude Oil	Oil Products	Gas	Electricity	Renewable Energy	Hydro	Total
Domestic Production	23,919	1,052				172	5	25,148
Export	19.322	1,037						20,359
Import	1		1,282		135			1,418
Inventory, others	1,080	15						1,095
Domestic supply	3,518	0	1,282	0	135	172	5	5,112
Primary energy ratio	69%	0%	25%		3%	3%	0%	100%

Note: Unit: ktoe, Renewable energy includes solar, wind, biomass, and waste power.
Source: IEA Energy Balances of Non-OECD Countries (2017).

Table 2.17 Heat Source in UB City

Fuel	Combustion equipment	Supplies	Apartments and public facilities			Gels and small houses		
			For heating	For cooking	For other appliances	For heating	For cooking	For other appliances
Coal	Power Station	Electricity	○	○	○	△	△	○
Coal	Power Station	Hot water supply	○			×		
Coal	HOB	Hot water supply	○			×		
Coal	Coal Stove for Home Use	Heat source	×	×		○	○	
LPG	Stove	Heat source	○	○		△	△	

Legend: ○; usable, △; usable but at high cost and low usage, ×; not usable
Source: JCOAL

Table 2.18 Housing Types in UB City (2016)

Item		UB City Total	Residential District			Gel District			
			Apartment	House	Non-Residential	House	Small House	Gel	Non-Residential
Population		1,380,792	582,159	5,957	66	7,419	415,211	369,469	511
		100%	42.2%	0.4%	0.0%	0.5%	30.1%	26.8%	0.0%
Number of Households		380,828	163,141	1,630	36	2,022	109,327	104,462	210
		100%	42.8%	0.4%	0.0%	0.5%	28.7%	27.4%	0.1%
		100%	43.3%			56.7%			

Source: Statistical Data, UB City

(2) Overview of Air Pollution in Ulaanbaatar City

a. Effects of Improved Stoves and Fuels on Air Pollution Control

Improved fuels began to be considered as air pollution control measures in Mongolia sometime around 2008, and a semi-coke plant was constructed at the No. 2 power plant by remodeling the existing boiler with the Russian technology, and in addition, a briquette manufacturing plant was constructed.

However, the semi-coke production failed and the production was discontinued. Subsequently, there was a disagreement within the government on how to compensate for the price difference between raw coal and improved fuel, and measures were taken to replace traditional stoves with improved stoves through the support of the World Bank and the Millennium Challenge Corporation (MCC). As of 2018, 52,000 stoves, or stoves in 27% of the total number of households, have finally been replaced. Although replacing coal-only stoves was a step forward, it was difficult for

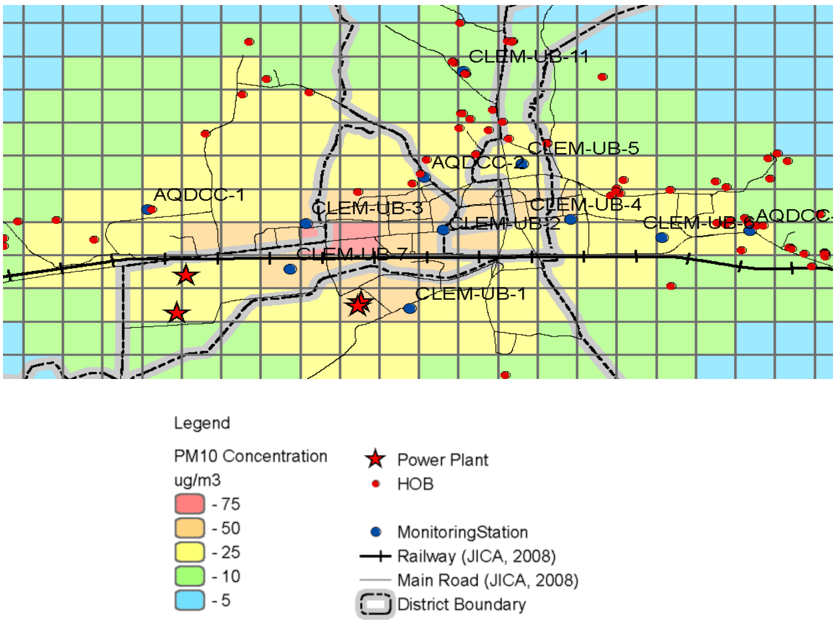
Mongolia to accept these stoves due to their usage issues, and the air pollution reduction benefits were quite low.

As a result, a decision to switch fuels was reached in the National Program for Air and Environmental Pollution Reduction on May 15, 2019, leading to a ban on the use of raw coal. In the winter of 2019-2020, public-owned and newly established TTT company started the production of coal briquettes, resulting in a significant reduction in PM10 and PM2.5 emissions compared to previous years.

b. Air Pollution near Intersections due to Traffic Congestion

PM10 and NOx concentrations of vehicles sources by simulation from November 2015 to February 2016 is shown in **Figure 2.3** and **Figure 2.4**. The maximum values of PM10 concentration and NOx concentration is 72 μg/m^3 and 124 μg/m^3 respectively near the west intersection of Peace Street, indicating that the concentrations are high in the central area of UB City, mainly on Peace Street.

The traffic volume survey results for 2010 and 2019 are shown in **Figure 2.5**. Compare with traffic volume in 2010 in UB City, maximum traffic volume in 2019 is 3.8 times higher and average traffic volume is approximately 1.4 times higher. As for travel speeds in 2019, in the center of the city, travel speeds near intersections in the morning and evening are mostly between 5 and 10 km/h, which is approximately 5 km/h lower than in 2010. These are believed to be due to increase number of registered vehicles and congestion caused by commuter rush, etc.



Source: Preparation from calculation results of "Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2"

Figure 2.3 PM10 Concentration from Vehicle Emission Sources (Year 2016)

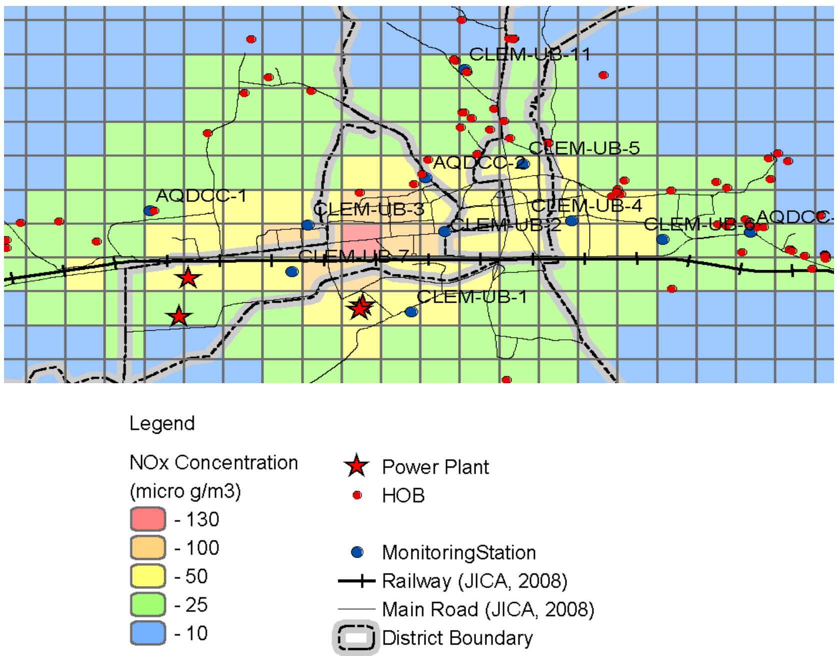
Although the emission factor per speed is lower due to increase of import of newer regulated vehicles, but emissions near intersections are approximately twice as high in 2019 compared to 2010 because of lower travel speeds caused by congestion and traffic volume increase.

As shown in **Table 2.19**, when importing vehicles into Mongolia, vehicles tariffs imposed in four categories (0-3 years, 4-6 years, 7-9 years, and 10 years or more) based on manufacture year. The tariffs are higher according to manufacturer year, especially 10 years or more imported vehicles are highest tariff. As a result, number of vehicles registered after 10 years of manufacture has been decreasing year by year. Although emission factor is accordingly lower, the contribution from reduced travel speed due to traffic congestion and increased traffic volume, so that the emissions near the intersection in 2016 are approximately twice as high as in 2010, and air pollution near the intersection by vehicles is becoming more serious throughout the year. In addition, air pollution caused by traffic congestion is expected to become more serious, as the number of registered vehicles in 2019 increased more than 1.2 times compared to the number of vehicles registered in the period covered by the simulation from November 2015 to February 2016.

Table 2.19 Tariffs on Imported Gasoline and Diesel Vehicles

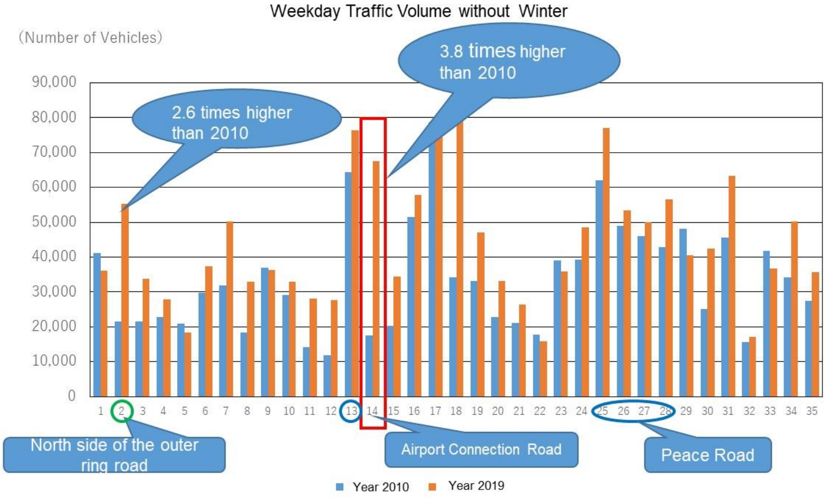
Engine Displacement	Age from Year of Manufacture and Tariff Amount (MNT)			
	0 to 3 years	4 to 6 years	7 to 9 years	10 years and more
1500 cc under	750,000	1,600,000	3,350,000	10,000,000
1501 cc to 2500 cc	2,300,000	3,200,000	5,000,000	11,700,000
2501 cc to 3500 cc	3,050,000	4,000,000	6,700,000	13,350,000
3501 cc to 4500 cc	6,850,000	8,000,000	10,850,000	17,500,000
4501 cc and over	14,210,000	27,200,000	39,150,000	65,975,000

Source: https://customs.gov.mn/duty



Source: Preparation from calculation results of "Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2"

Figure 2.4 NO_2 Concentration from Vehicle Emission Sources (Year 2016)



Source: Survey Results of "Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 3"

Figure 2.5 Comparison of Traffic Volume Results in 2010 and 2019

(3) Air Pollution Control Measures

a. Introduction of Improved Coal-Fired Hot Water Supply Boiler

Section 4.1.9 of measures to be implemented as part of the Chapter 4 of National Program on Reducing Environment Pollution approved on March 20, 2017, stipulates that "Termination of hot water boiler use in UB City and the connection of consumers to central and district heating supply systems is implemented in phases". The central heat supply area has expanded with the expansion of thermal power plants. As a result, 30-40 HOBs are taken out of use every year, and as of March 2020, only 406 HOBs are being used. It is difficult to install new small and medium-size hot water boilers in UB City. With this policy of reducing HOBs every year, the introduction of new HOBs is not expected to have a significant effect on air pollution control. In addition, from November 2020, the existing HOBs will shift from using raw coal to using improved fuels. If there is no progress in improving the situation with the air pollutants by using the improved fuels, the introduction of a large-scale coal-fired hot water boiler is not expected to have a significant effect on air pollution control.

b. Central Heating using Renewable Energy, Incineration Equipment, etc.

Trends in quantities of electricity generated by fuel types such as renewable energy are shown in **Table 2.20**. Solar power generation has increased rapidly after new installations in the recent years. As for the solar power plants in the JCM project, Farmdu Corporation is implementing projects for 2.1 MW and 8.3 MW, and Sharp Corporation is implementing projects for 10 MW, 15 MW, 20 MW, and 21 MW. 2019-2020.

Table 2.20 Electricity Generated by Types of Power Plants in UB City

Types of Power Plants	2013	2014	2015	2016	2017	2018
Coal-fired power plant	5,014.0	5,191.3	5,415.8	5,555.9	5,826.9	6,152.4
Diesel power plant	5.4	8.2	6.0	3.8	3.7	3.7
Solar power plant	-	0.6	0.5	0.3	19.7	51.1
Hydroelectric power plant	59.9	66.3	59.3	84.7	84.5	78.7
Wind power plants	52.9	125.4	152.5	157.5	154.4	339.0
Total	**5,132.2**	**5,391.9**	**5,634.2**	**5,802.4**	**6,089.2**	**6,624.8**

Source: Statistics on Energy Performance in 2018 (Latest version)

Renewable energy sources that can be expected in UB City and its suburbs include wind, hydro, solar, and geothermal sources.

(i) Wind Power

The wind farm is located in Tsogtzezi District in the Umnugobi Province. It has a generation capacity of 50 MW, with 25 installed wind turbines of 2000 kW, and its annual power generation capacity is approximately 200 million kWh. This project is JICA's first dollar-denominated project, financed with overseas investment and loans for the field of renewable energy, and the first power generation project in Mongolia for SB Energy and Softbank Group.

However, the wind farm requires at least an average wind speed of 6.0 m/s. In UB City, the average wind speed is very often around 10 m/s during the springtime, but during the wintertime, the average wind speed is very low. There are only few places where the average wind speed is high throughout the year, and the possibility of installing a wind farm in UB is low.

(ii) Hydroelectric Power

Mongolian water resources are, an average of 30.6 cubic kilometers per year from internal water resources, and 34.6 cubic kilometers of total water resources if the external water resources are included. In UB City, there are Tula and the Selbe rivers, but there are not many suitable sites for hydroelectric power plants to be constructed, because of the low water resources and the large impact of the hydroelectric power plant construction on the ecosystem.

(iii) Solar Power

Solar power generation is being implemented through a JCM project about 14km southwest of the "New Ulaanbaatar International Airport". The longer the distance between the power plant and the facility that uses the electricity, there is more power loss. For this reason, the plant is located near the new airport and it supplies electricity to the new airport and UB City. The solar power generation system generates around 23,134MWh/year with around 16.4MW-dc solar modules, contributing to the reduction of greenhouse gas emissions of around 18,438tCO_2/year. At the same time, air pollutants such as SO_2, PM, and NOx from the use of coal for power generation have been reduced.

(iv) Geothermal and Incineration Facilities

Geothermal heat pumps are used for geothermal energy utilization, and this will be described in the field of climate change because of their significant effect on the CO_2 reduction.

As for incineration facilities, details have been provided in the section on waste, the construction of combustion facilities is being considered, but the central heating using waste heat has yet not been planned.

c. Improvement of Heat Sources by Introducing Production Plants for Fuels Alternative to Coal

Alternative fuels for household use include gas, oil and electricity generated from coal and renewable energy sources. Of these, only electricity is produced domestically, whereas gas and oil are currently imported, and the amount of electricity that is short in the supply is imported.

(i) Electricity

Electricity is the most practical way to replace coal in Mongolia, take aside the level of the cost. An estimated 95% of households in the ger areas are connected to the electricity distribution network. However, the current network capacity is inadequate, and the load is limited by the capacity constraints during the peak load times (6am-9am and 4pm-9pm). In recent years, the use of electric heating in the GEL region has expanded significantly, and the transmission system of 40,000 households has been upgraded to accommodate the higher loads associated with electric heating, allowing for the supply of 4kw electric heaters.

In addition, a number of heat pump pilot tests have been conducted from the viewpoint of power saving, but the cost of power generation, including the capital investment, is still high.

(ii) Gas

As for the production of alternative fuels to coal, the government and private companies have completed F/S for the production of SNG (synthetic natural gas) through coal gasification and DME (dimethyl ether) liquefaction, but have not yet reached the stage of a plant construction.

On the other hand, in the 2020-2024 Government Action Program, it is stated that "3.5.2 Complete the FS study of the CNG (Compressed Natural Gas) pipeline project from Russia to China through the Mongolian territory, and carry out preparatory work for construction", but there is no mentioning of its use in Mongolia. The content is being analyzed, but there is no clear response from the government at this stage, as it involves many sensitive issues.

Furthermore, "3.5.1.8 A gas power plant will be started in PPP form based on the facilities of No.2 thermal power plant in UB City for the purpose of meeting the increasing demand for electricity and heating in UB City, as well as a stable energy supply. This shows that the FS has already been completed. On the other hand, 36 tons of liquefied natural gas (LNG) has been imported from Russia by railroad wagons in November 2019.

In addition, "3.6.3.1 Introduce electric and CNG vehicles for public transportation in the capital city UB and develop an electric and CNG refueling station network". Therefore, it can be said that there is a movement to switch to natural gas as a fuel.

(iii) LPG

The state-owned Mongolian Refinery is currently constructing an oil refinery in Altanshiree District, Dornogvi Province, which is scheduled to start the operation in 2023. With an annual processing capacity of 1.5 million tons, the refinery will be able to produce 43,000 tons of LPG (liquefied petroleum gas), which as understood will almost meet the current demand. As the plant can do the refining domestically, instead of exporting domestically produced crude oil to China, as it was the situation until now, it is expected to expand in the future, including lowering the cost of products.

d. Construction of Improved Fuel Production Plants

It is estimated that the amount of improved fuel used in the winter of 2019-2020 will be around 400,000 tons. The amount of conventional raw coal used is assumed at 1.2 million tons based on calculations, but the actual used amount is unknown. Since the conversion to improved fuels, the government has been using a card system to record the sales volume, and this has started to reveal the actual usage, so the actual winter usage in 2020-2021 is expected to reveal the actual situation. For example, if the amount used is 1.2 million tons, the amount of improved fuel consumed during the winter of 2019-2021 should be about 1/3. It is true that the calorific value of the existing improved fuel is higher than that of raw coal, but the questionnaire completed by the users indicates that this does not change the amount that they use. This shortfall is mainly due to the use of electricity as an alternative energy source, and one of the reasons for the decrease in air pollution in the winter of 2019-2020 can be attributed to the reduced consumption of improved fuels. Therefore, we predict that the air pollution situation in the winter of 2020-2021, when more improved fuels will be used, will be very problematic.

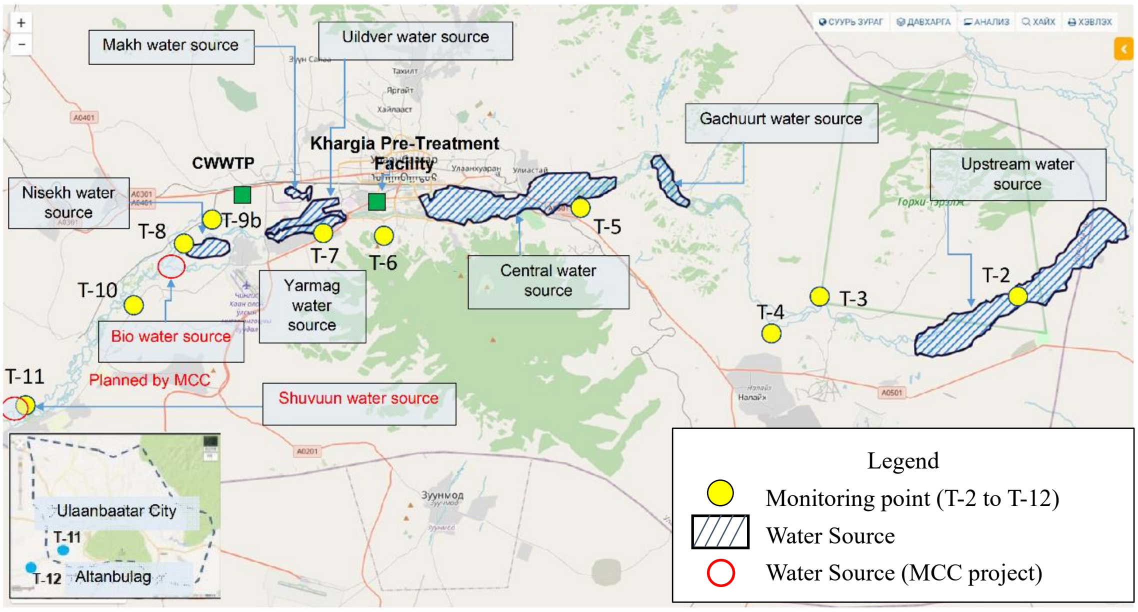
On the other hand, low-income residents in the ger areas using HOBs will continue to be forced to use improved fuels. As a result, the government will consider further improvement of the improved fuel, and it is hoped that a technology will be developed for this purpose. In the "Capacity Development Project for Air Pollution Control in Ulaanbaatar City (Phase 3)", which is currently being implemented as a JICA technical cooperation project, the content of technological development is being studied while verifying the effectiveness of the improvement. Since the improvement process can be applied to the existing and newly improved fuel production plants, it is expected to have a significant effect on reducing air pollution and production cost, with a relatively small investment.

2.4.2 Understanding the Current Status of Environmental Issues Related to Water Pollution Countermeasures and Analyzing Issues

(1) Current Status and Issues of Living Environment due to Inadequate Sewerage Facilities

a. Current Status and Issues of Water Pollution on Tuul River

Countermeasures against water pollution on the Tuul River have been a long-standing issue for UB City. The water quality monitoring points and water quality measurement results of Tuul River are shown in **Figure 2.6** and **Table 2.21**. The monitoring points upstream of the CWWTP (T-2, T-5, and T-6) meet the water quality environmental standards (MNS4586:98), while Songino (T-10), downstream of the central sewage treatment plant, and Altamborag (T-12) (outside Ulaanbaatar City), further downstream, do not meet the water quality environmental standards. This water pollution of the Tuul River is since the treated water at the CWWTP does not comply with the Effluent Quality Standards of Wastewater Treatment Plant for Discharging into Public Waterbody (MNS4943: 2015).



Source: USUG and Water Supply and Sewerage Master Plan, 2013

Figure 2.6 Water Quality Monitoring Positions along Tuul River

Table 2.21 Measurement Results of Tuul River (April 2019)

Parameter (mg/l)	DO	BOD	Potassium Permanganate Consumption	NH_4-N	NO_2	T-P
Water Quality Standards (MNS4586:98)	4<	3	10	0.5	0.02	0.1
Altamborag (T-2)	9.09	2.5	3.7	0.02	0.003	0.007
Near Bayanzurkh Bridge (T-5)	9.55	2.2	1.9	0.03	0.002	0.003
Near Zaisan Bridge (T-6)	9.09	2.6	1.8	0.03	0.002	0.004
Songino (T-10)	**2.16**	**91**	**16.0**	**9.25**	**0.173**	**0.765**
Altanbulag (T-12)	7.77	**33.2**	**21.0**	**19**	**0.105**	**0.536**

Source: USUG, NAMEM and Water Supply and Sewerage Master Plan, 2013

b. Living Environment Conditions and Issues

Sewer pipes (trunk and branch sewers) are constructed in the urban area of UB City, and the collected sewage is mainly treated at CWWTP and treated sewage is charged into Tuul River. On the other hand, the water and sewerage infrastructure are underdeveloped in ger area, which have expanded in a disorderly manner. The toilets used by the residents of ger area are of poor-quality pit dug by themselves, and groundwater, surface water, and soil are becoming contaminated, which is problems. Therefore, it is necessary to construct branch sewers to ger area.

To construct branch sewers in ger area, it is first necessary to construct trunk sewers of downstream of gel area. Construction of trunk sewers of about 50 km is planned in the Water Supply and Sewerage Master Plan formulated in 2013.

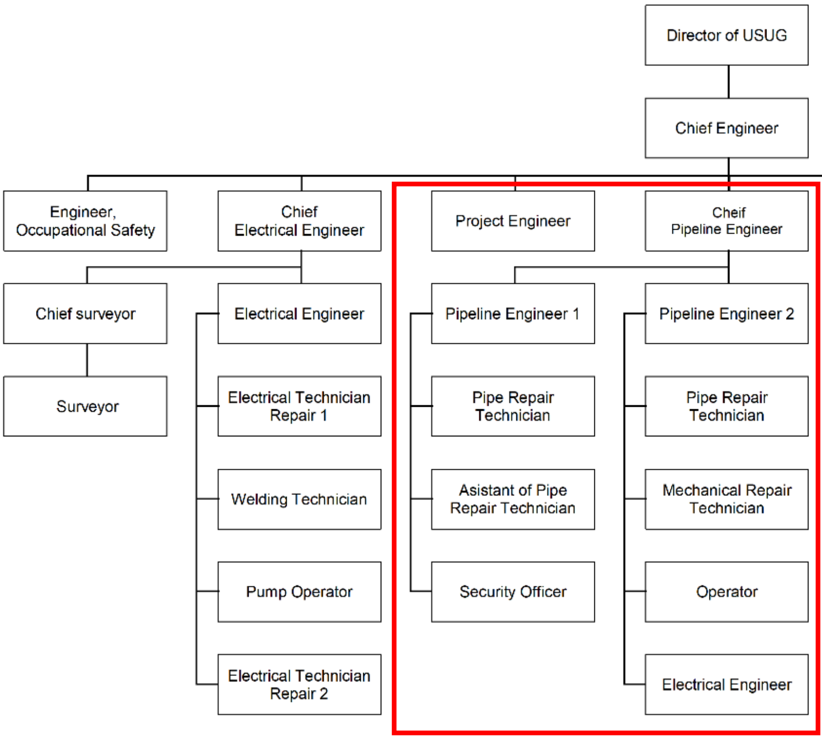
c. Sewer Pipe Installation Technology used in Ulaanbaatar City

New sewer pipes in UB City are constructed by the open-cut method only.

(2) Actual Conditions and Issues of Operation and Maintenance of Sewerage Facilities

a. Organization for Operation and Maintenance of USUG

The maintenance of water and sewer piped is handled by the Pipeline Maintenance Department of USUG. The department has 129 employees, 54 of whom are involved in the maintenance of sewer pipes. **Figure 2.7** shows the organizational chart of the Pipeline Maintenance Department. The department surrounded by the red line conducts maintenance of existing pipelines such as TV camera surveys.



Source: USUG

Figure 2.7 Organizational Chart of Pipeline Maintenance Department of USUG

b. Pipe Maintenance Technology of USUG

The maintenance department of USUG conducts the maintenance of the sewage pipeline. Since 2004, USUG has been maintaining and managing pipelines using equipment such as TV camera cars. The pipeline maintenance facilities owned by USUG are shown below.


Crane


TV camera


Sewer investigation


TV camera image

Source: USUG

Photo 2.3 Sewer Maintenance and Investigation Equipment

c. Issues

In Ulaanbaatar (UB) City, there are aged sewer pipes that were laid in the 1960s and have been used for more than 50 years. According to in-pipe surveys conducted by USUG, cracks, breakages and blockages have been confirmed. In addition, asbestos pipes also remain, and the pipes deteriorate quickly over time and their strength tends to decrease, so they need to be replaced immediately using pipes made of different material. Reconstruction plan by construction year, diameter, and pipe material related to aged pipes proposed in the Water Supply and Sewerage

Master Plan formulated in 2013 is shown below. The pipes that need to be totally renewed are about 30 km, mainly ceramic pipes and asbestos pipes constructed more than 50 years ago. In addition, the length of pipes that require partial repair is about 60 km.

Table 2.22 Reconstruction Plan by Construction Year, Diameter, and Pipe Material

Material	Diameter	Year									
		～1960	1961～1965	1966～1970	1971～1975	1976～1980	1981～1985	1986～1990	1991～1995	1996～	total
Ceramic	D≦349	731.5	11,777.8	4,226.1	869.2	541.4	6,780.1	3554.8	0.0	262.7	28,743.6
	350≦D≦600	0.0	728.6	0.0	0.0	387.7	1,005.9	0.0	0.0	0.0	2,122.3
	601≦D≦900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	901≦D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Asbestos	D≦349	0.0	188.1	1,505.2	0.0	263.4	972.6	0.0	0.0	286.7	3,216.0
	350≦D≦600	0.0	4,123.5	4,650.0	0.0	0.0	5,996.5	2,623.7	129.2	3,075.3	20,598.0
	601≦D≦900	0.0	0.0	0.0	0.0	0.0	403.0	0.0	0.0	0.0	403.0
	901≦D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Castiron	D≦349	0.0	393.0	0.0	0.0	0.0	0.0	0.0	0.0	2,355.4	2,748.5
	350≦D≦600	0.0	4,649.8	433.2	0.0	0.0	0.0	232.6	0.0	0.0	5,315.7
	601≦D≦900	0.0	0.0	8,227.2	0.0	0.0	0.0	0.0	0.0	0.0	8,227.2
	901≦D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RC	D≦349	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	350≦D≦600	0.0	2,506.5	0.0	0.0	0.0	80.8	552.3	0.0	0.0	3,139.6
	601≦D≦900	0.0	5,388.2	0.0	0.0	1,378.1	1,515.0	2,796.7	0.0	517.7	11,595.7
	901≦D	0.0	8,027.1	0.0	0.0	216.6	2,052.4	15,506.9	0.0	6,774.1	32,577.0
PVC	D≦349	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,914.5	1,914.5
	350≦D≦600	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,438.0	1,438.0
	601≦D≦900	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,299.8	1,299.8
	901≦D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**D≦349**	731.5	12,358.9	5,731.3	869.2	804.9	7,752.7	3,554.8	0.0	4,819.2	36,622.6
	350≦D≦600	0.0	12,008.4	5,083.2	0.0	387.7	7,083.2	3,408.6	129.2	4,513.3	32,613.5
	601≦D≦900	0.0	5,388.2	8,227.2	0.0	1,378.1	1,918.0	2,796.7	0.0	1,817.5	21,525.7
	901≦D	0.0	8,027.1	0.0	0.0	216.6	2,052.4	15,506.9	0.0	6,774.1	32,577.0
	total	**731.5**	**37,782.6**	**19,041.7**	**869.2**	**2,787.3**	**18,806.2**	**25,266.9**	**129.2**	**17,924.1**	**123,338.7**

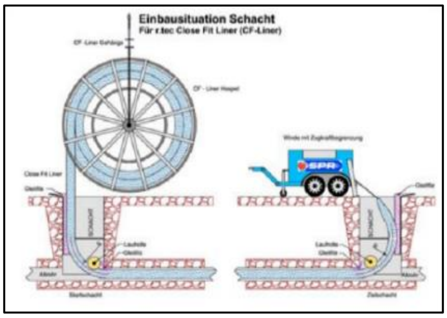
Legend:
:Due to deterioration necessary reconstruction
:Necessary a part of rehabilitation or reinforcement
:Good condition

Source: Water Supply and Sewerage Master Plan, 2013

There are two types of reconstruction technology for old pipes: open and non-cutting. There is a rehabilitation method as one of the reconstruction technologies by non-cutting, and USUG has adopted the following two rehabilitation methods to renew the aged water supply pipeline (see **Figure 2.8**). However, USUG has no experience of rehabilitation of sewers.

- Cured-in-Place Pipe (CIPP) Method
- Close Fit Method

Cured-in-Place Pipe Method



Close Fit Method

Source: USUG

Figure 2.8 Rehabilitation Method Implemented by USUG in Water Supply Pipes

(3) Actual Conditions and Issues Regarding Factory Wastewater Management

a. Actual Management of Factory Wastewater at Factories

UB City has established effluent quality standard of factory for discharging into sewer (MNS 6561) and receives it into the sewerage system. However, as a matter of fact, each factory does not comply with this standard and discharges wastewater that exceeds the standard to sewer. At CWWTP of UB City, high-concentration factory wastewater puts a heavy pollution load on the sewage treatment process, and the quality of treated water significantly exceeds the Effluent Quality Standards of Wastewater Treatment Plant for Discharging into Public Waterbody (MNS 4943), which results in water pollution of the Tuul River.

USUG has contracts with 270 offices (including about 200 factories) for receiving wastewater into sewers. If the water quality (analysis result) of the wastewater exceeds the standard (MNS 6561: 2015), the contract can become invalidated and the water supply to the office/factory can be stopped (wastewater is not accepted into sewer). USUG management engineers monitor each office/factory 2-3 times a month. Inspect drainage pipes, settling tanks, sand, oil, etc., and submit any indications if any violations are committed. Once a quarter (3 months) (4 times a year), the above wastewater is sampled and analyzed in the test room of CWWTP.

In addition, the General Agency for Specialized Inspection (hereinafter referred to as “GASI”) is an organization that monitors various rules and standards to prevent environmental pollution and ensure the health and safety of citizens. GASI and the Ulaanbaatar City Inspection Bureau (organization under GASI) have the authority to take measures such as taking fines if the quality of wastewater exceeds the effluent standard.

Table 2.23 shows the number of factories that the sewerage system in Ulaanbaatar accepts factory wastewater by type. Of the total of 266 factories, there are 116 car wash services and 150 factories such as meat products and leather factories. Of these, only 10 factories have pre-treatment facilities.

Table 2.23 Number of Factories by Type that Discharge Wastewater into Sewers

No.	District	Type of Factory						Sub-Total	Car Washing	Total
		Leather Processing	Wool Cashmere	Offal Meat Processing	Meat Processing	Dairy Products	Alcohol Products			
1	Bayangol	3	4	3	12	2	5	29	24	53
2	Songino-Khairkhan	0	6	12	26	5	2	51	17	68
3	Bayanzurkh	0	0	1	12	1	1	15	24	39
4	Chingeltei	0	0	0	0	1	1	2	10	12
5	Sukhbaatar	0	0	0	0	0	1	1	20	21
6	Khan-Uul	25	14	1	4	3	5	52	21	73
Total		28	24	17	54	12	15	150	116	266
Factories Installing pre-treatment facility		2	5	0	1	1	1	10	—	10

Source: USUG, MCUD (Processed by Survey Team)

Table 2.24 shows water quantity and quality of factory wastewater discharging into sewer of UB City by factory type. The water quality of wastewater from factories significantly exceeds the effluent standard. Each factory needs to set up pre-treatment facility to properly treat each wastewater and comply with the effluent standards.

Table 2.24 Water Quantity and Quality of Factory Wastewater received by Sewerage System

Category	Wastewater Quantity (m^3/d)		Water Quality				
			pH (-)	SS (mg/l)	COD (mg/l)	Sulfide (mg/l)	Total Chrome (mg/l)
Leather Processing	Ave.	22	8.8	3,036	4,811	46	24
	Max.	78	12.1	15,800	13,688	157	67
	Min.	0.1	2.4	6	417	1	1
Wool, Cashmere Processing	Ave.	73	7.2	1,335	3,173	11	-
	Max.	575	11.1	6,660	17,453	108	-
	Min.	2	5.3	13	112	0	-
Offal Meat Processing	Ave.	7	6.1	512	3,457	115	-
	Max.	12	6.5	1,108	7,080	262	-
	Min.	2	5.8	135	868	2	-
Meat Processing	Ave.	16	6.3	10,653	8,589	-	-
	Max.	367	9.0	273,486	39,303	-	-
	Min.	0.1	0.5	95	140	-	-
Dairy Products	Ave.	156	5.8	805	1,697	-	-
	Max.	509	8.6	5,401	8,186	-	-
	Min.	6	1.9	2	18	-	-
Alcohol Products	Ave.	222	6.6	704	4,077	-	-
	Max.	519	8.2	2,643	18,223		-
	Min.	11	5.0	90	380		
Effluent Standards Discharging into Sewer (MNS 6561:2015)			**6-9**	**400**	**800**	**5**	**1**

Source: USUG, MCUD (Processed by Survey Team)

b. Khargia Industrial Wastewater Treatment Plant

In the Khargia area, there is the Khargia Industrial Wastewater Treatment Plant (hereinafter referred to as "KIWWTP"). Factory wastewater from the industrial area is not treated individually at each factory but is collectively treated at the plant and discharged into sewer. The plant started operation in 1972 and was privatized in 1993. It has been aging for more than 30 years, so renovation work was carried out in 2010. The plant was transferred to UB City in 2013 and has since been managed by USUG.

Currently, the plant receives wastewater from 25 leather factories and, three wool and cashmere factories. The national standards have been reviewed since 2018, and as part of this, it has been decided that MNS5582 will be invalid after January 1, 2021, and factories that discharge wastewater to KIWWTP are required to comply with MNS 6561. As a result, water supply to factories discharging wastewater to KIWWTP was stopped from June 2020, and the operation of the Plant was stopped. After that, as of September 2020, six (6) leather factories restarted, and the Plant resumed operation. Subsequently, five leather factories have applied for resumption of operations.

Subsequently, at the end of 2020, the implementation of MNS 5582 invalidation after January 1, 2021 was withdrawn, and by the end of March, a review of effluent quality standards of factory for discharging into KIWWTP (MNS 5582) was to be considered.

Table 2.25 shows changes in the amount of influent of the plant over the last 5 years (2015-2019), **Table 2.26** shows the effluent quality standards of factory for discharging into Khargia Industrial Wastewater Treatment Plant (MNS 5582: 2006), and **Table 2.27** shows the water quality data of some monitoring points of the plant for two years (2018-19). The quality of treated water of the plant (drainage to sewer) significantly exceeds the effluent standards discharging into sewer.

Table 2.25 Influent of KIWWTP Over the Last Five Years (2015-2019)

Year	Inflow Wastewater
2015	892,203 m^3/year（2,444 m^3/d）
2016	576,473 m^3/year（1,579 m^3/d）
2017	506,038 m^3/year（1,386 m^3/d）
2018	685,610 m^3/year（1,878 m^3/d）
2019	506,236 m^3/year（1,387 m^3/d）

Source: USUG

Table 2.26 Effluent Quality Standards of Factory for Discharging into KIWWTP (MNS 5582: 2006)

No.	Water Quality Parameter	Unit	Water Quality Standard Value
1	pH	-	9.0
2	SS	mg/l	5,500
3	BOD	mg/l	6,000
4	COD	mg/l	6,200
5	Sulfite	mg/l	150
6	Chromium	mg/l	100

Source: USUG

Table 2.27 Water Quality of Some Monitoring Points of KIWWTP for Two Years (2018-19)

Year	Sampling Point	Water Quality（mg/l）				
		pH	SS	COD	Sulfide	Total Chrome
2018	Receiving point of Chrome Treatment Line	10.2	2.910	5,456	53.1	5.5
	Receiving Point of Sulfide Treatment Line	11.0	3,385	7,359	64.5	9.4
	Pit of Treated water	10.5	1,187	4,224	28.2	1.0
2019	Receiving point of Chrome Treatment Line	9.7	5,124	6,867	95.9	21.4
	Receiving Point of Sulfide Treatment Line	9.8	4,246	6,906	74.6	17.5
	Pit of Treated water	9.5	835	3,520	21.0	9.1
Effluent Quality Standards of Factory for Discharging into KIWWTP (MNS 5582: 2006)		**9.0**	**5,500**	**6,200**	**150**	**100**
Effluent Quality Standards of Factory for Discharging into Sewer (MNS 6561: 2015)		**6-9**	**400**	**800**	**5**	**1**

Source: USUG

c. Relocation Plan of Leather Factories in Khargia Area to Emeelt Industrial Park

Since the Khargia Industrial Wastewater Treatment Plant is surrounded by residential areas and environmental problems such as the generation of foul odors have become apparent, a plan to relocate leather factories and wool and cashmere factories to the Emeelt Industrial Park have been considered. According to Emeelt Project PIU, the progress of the Emeelt Industrial Park, is as follows. However, no progress has been seen in the project since 2018.

- MOFALI has approved 160 ha of land.
- Of the 15 related infrastructure projects, eight have been designed.
- The preliminary survey of the Emeelt Industrial Park was conducted in 2011 and needs to be reviewed.

d. Darkhan and Khovd Industrial Technology Park Development Project

One of the action programs of the Government of Mongolia is to promote the manufacture and export of livestock products, and the 5-Year Development Plan of Mongolia (2021-2025) includes the establishment of industrial technology parks in Darkhan and Khovd provinces. Currently, the government is developing the Darkhan Light Industrial Park for the leather and wool and cashmere industries, and the same kind of plan is underway in Khovd Province.

The Darkhan Light Industrial Park has been developed mainly by the private sector since 2019, with 22.9% progress by the end of 2020, but now the government will take the lead in developing the park. According to the 185-cabinet decision on November 18, 2020, the government will establish a public corporation to proceed with the Darkhan leather factory development project. The regulations of the corporation will be established by No. 223, and the president of the corporation will be appointed. To promote relocation to the Darkhan Light Industrial Park, the government is considering comprehensive support policies, including the provision of soft loans, duty exemptions on equipment imports, housing construction and human resource development.

The government is also planning to be involved in the development of the Industrial Technology Park in Khovd Province, but the development has been postponed due to the Corona disaster in 2020.

e. Issues

The Mongolian government said that measures for factory wastewater connected to sewerage are not only a problem for Ulaanbaatar City, but also a problem to be solved in cooperation with related national organizations (Ministry of Construction and Urban Development, Ministry of Food, Agriculture and Light Industry, etc.). These related organizations have signed a memorandum of understanding (MOU) on cooperation (October 7, 2019), established a working group (February 5, 2020), and made a concrete plan (action plan) to implement the MOU. The plan to implement the MOU is a concrete and detailed plan that comprehensively covers the measures including the conventional plan and clearly states the implementation period and the roles and divisions of related organizations. In addition, the Cabinet approved the Industrial Pre-treatment Plan (IPP) on March 3, 2021.

Regarding the installation of the abatement facility, the MOU states that "To have the target factories, companies and institutions install pre-treatment facilities in order to meet the standards for wastewater discharged to Central Wastewater Treatment Plant in Ulaanbaatar City."

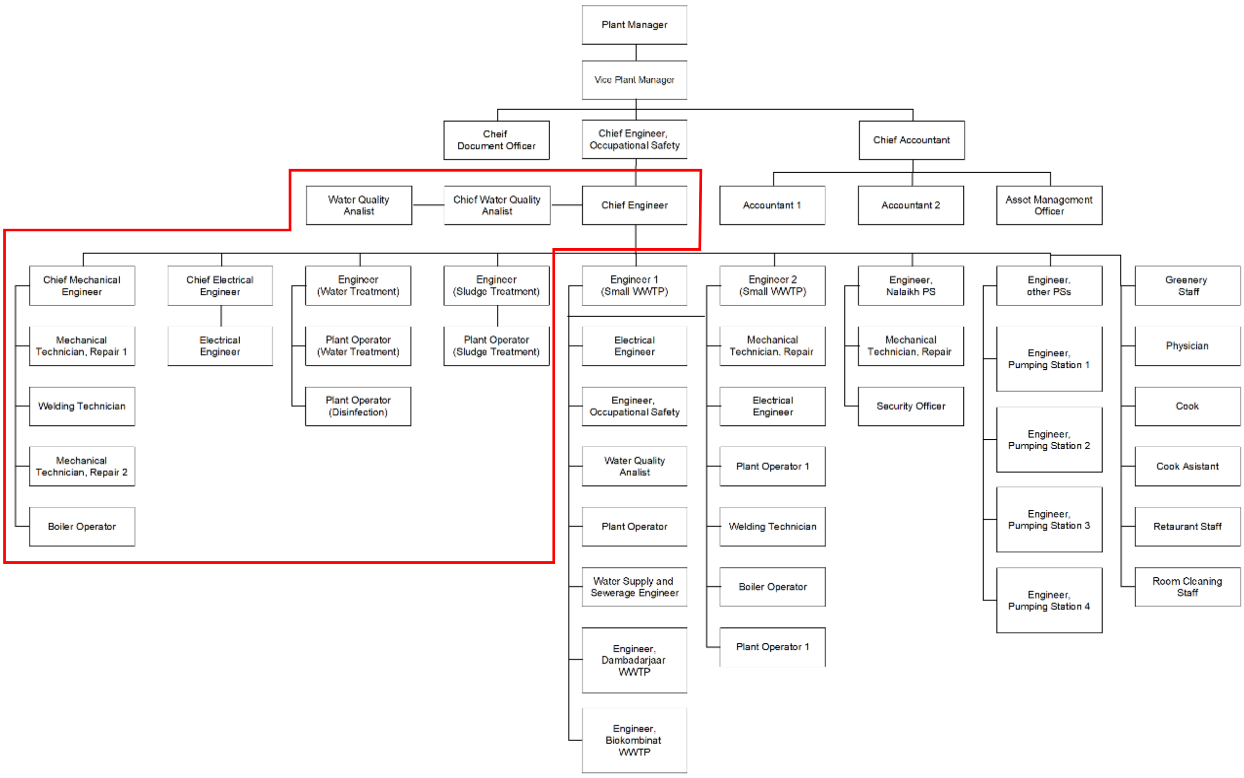
However, although it is stated that the financial resources of this MOU implementation plan are based on the national budget, own funds, etc., it is important that the feasibility of these is guaranteed. It costs not a little to set up a pre-treatment facility (abatement facility) for each factory, or to move the factory to the Darkhan Light Industrial Park and the Emeelt Light Industrial Park, that is, to build a new factory. Many small and medium-sized enterprises run leather factories in the Khargia industrial area, and the leather industry has been sluggish in recent years. If the leather industry is an important industry in Mongolia, support with public funds seems essential.

On the other hand, other than penalties, there is no system in place to encourage businesses to comply with laws and regulations, such as a support system for businesses to establish seif-control wastewater treatment systems (e.g., water quality control manager system) or a support system to motivate businesses to implement wastewater treatment measures (e.g., subsidies, low-interest loans).

(4) Management Status and Issues of Central Wastewater Treatment Plant

a. Management Organization of USUG

The operation and maintenance of the Central Wastewater Treatment Plant (CWWTP) is carried out by USUG, with 137 employees. **Figure 2.9** shows the operation and maintenance organization of CWWTP. The departments within red line are mainly in charge of the operation and maintenance of the Plant. Other departments are responsible for operation and maintenance of other small-scale treatment plants and pumping stations. The laboratory at the Plant analyzes the water quality of each treatment process and water quality of wastewater sampled at factories.



Source: USUG

Figure 2.9 Organizational Chart of Central Wastewater Treatment Plant

b. Wastewater Treatment Method and Operation and Maintenance

The water treatment system of CWWTP is the conventional activated sludge process, which is secondary treatment level (refer to **Photo 2.4**). The operation and maintenance of the plant is carried out by USUG staffs. The operation and maintenance include equipment operation management, facility maintenance and inspection, water quality analysis services, and building maintenance. The operation and monitoring system consist of one PC at the administration building, one Program Logic Controller (hereinafter referred to as "PLC") at influent pumping station for industrial wastewater line, one PLC at the blower building, one PLC at the primary settling tank sludge pump room, and one PLC at the return sludge pump room, and is a simple system interconnected via RS485 interface.

Primary Settling Tanks

Wastewater Treatment Facility

Source: USUG

Photo 2.4 Central Wastewater Treatment Plant

c. Issues

At present, CWWTP receives about 170,000 m^3/day of sewage, compared to the planned treatment capacity of 207,000 m^3/day on average (230,000 m^3/day on daily on maximum) (refer to **Table 2.28**). On the other hand, influent water quality is much higher than the planned water quality (refer to **Table 2.29**). In addition, water quality of treated wastewater exceeds the regulation values for all water quality parameters except pH and is discharged into the Tuul River, leading to the water pollution of the river (refer to **Table 2.30**).

The facilities and equipment of the plant have become old and need to be reconstructed, so the construction of New Central Wastewater Treatment Plant, supported by China, is currently underway and is scheduled to be completed in August 2023. After the completion of the new plant, the existing CWWTP will continue to be used by renovating its facilities.

Table 2.28 Influent Flow of CWWTP

	2015	2016	2017	2018	2019
Influent Flow (m^3/day)	153,053	164,312	167,540	177,834	165,727

Source: USUG

Table 2.29 Influent Water Quality of CWWTP

	Planned Quality	2015	2016	2017	2018	2019
SS (mg/l)	250	1,140	1,354	1,368	967	997
COD (mg/l)	500	1,631	1,813	1,772	1,385	1,515
BOD (mg/l)	300	721	646	607	428	594

Source: USUG

Table 2.30 Effluent Water Quality of CWWTP

	Effluent Standard	2015	2016	2017	2018	2019
pH	6 - 9	7.6	7.5	7.3	7.4	7.3
SS (mg/l)	30	78.1	118.3	123.4	139.1	171.6
COD (mg/l)	50	411.7	395.0	393.2	406.9	424.3
BOD (mg/l)	20	188.2	145.7	144.1	131.1	141.1

Source: USUG

(5) Sewage Sludge Disposal Status and Issues

a. Condition of Sewage Sludge Disposal

Central Wastewater Treatment Plant generates 1,100 to 1,300 m^3 of sewage sludge (moisture content 70-75%) per day, but due to the lack of an appropriate disposal site, the sewage sludge is piled up in a sludge yard (sun-dried floor) of 44 plots of about 10 ha adjacent to the plant (refer to upper part of **Photo 2.5)**. The total amount of sludge piled up is estimated to be 785,000 m^3, which has become a problem because of bad odor it generates. Eco Taihi LLC, a Japanese Mongolian company, worked with the MCUD from 2018 to 2020 to test the use of some sludge as sludge compost by mixing it with sawdust.

Sludge Yard 1

Sludge Yard 2

Removal of Accumulated Sewage Sludge

Source: USUG

Photo 2.5 Sludge Drying Beds of Central Wastewater Treatment Plant

b. Sludge Treatment Facilities

Primary sludge of the plant is thickened in gravity sludge thickener. After that, it is dewatered by a dewatering machine and transported to the sun drying beds. There are 44 sun drying beds in this plant. (see **Photo 2.6**). The primary sludge that exceeds the capacity of the dewatering machine sludge are directly sent to the sun drying beds. Excess sludge is sent directly to the sun drying bed without thickening process.


Gravity Sludge Thickener


Sludge Dewatering Machine

Source: USUG

Photo 2.6 Sludge Treatment Facilities

c. Issues

The problem is to prevent the bad odor from the sludge accumulated in CWWTP. The Mongolian government is currently securing 22 ha of land in the suburbs for sludge treatment and disposal as a measure to deal with sewage sludge. To make effective use of this land, it is necessary to reduce the amount of sludge disposal through effective use of sludge and incineration, as well as to consider the operation of a controlled disposal facility.

The introduction of anaerobic digestion of sludge is considered as an effective way to utilize sewage sludge. There are many advantages such as utilization of digestion gas (fuel, power generation), reduction of sludge volume, sterilization of pathogenic bacteria, etc. However, it is necessary to take economical and effective measures for heat retention and heating during the severe winter season.

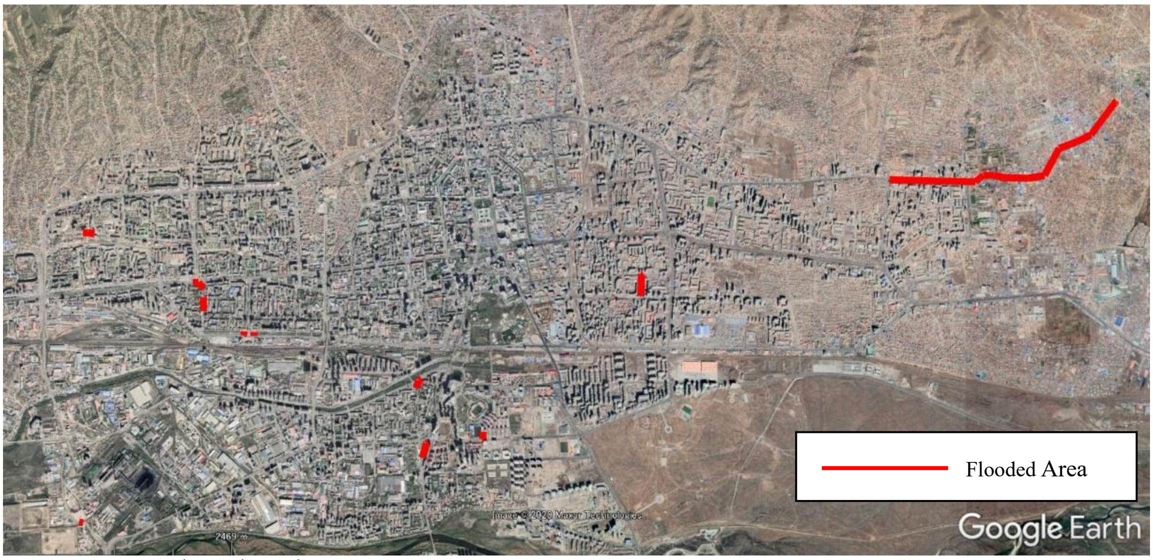
(6) Flooding Condition and Issues in Urban Areas

a. Flooding Condition

According to GUBBG, approximately 171 km of storm water drainage pipes have been constructed in Ulaanbaatar City (storm water drainage pipe drawings are not yet available). Heavy rains and snowmelt has caused flood damage (especially road flooding) from April to October. (see **Photo 2.7**) The main locations of flooding are roads without drainage facilities such as rain drains and drainage gutters, apartment areas, and slopes in ger er area (see **Figure 2.10**). In the past, there have been cases of outbreaks of waterborne diseases in ger areas due to overflowing latrines caused by flooding following heavy rains.

Source: GUBBG

Photo 2.7 Flooded Roads in Ulaanbaatar City



Source: GUBBG and Google Earth
Note: Flooded area as shown in this figure is based on information from GUBBG as of June 2020.

Figure 2.10 Flooded Area in Center of Ulaanbaatar City

Geodesy Hydraulic Facility Agency (hereinafter referred to as "GUBBG") is the agency responsible for the maintenance of river flood prevention facilities and dams, rainwater drainage and flood control. It regularly cleans stormwater drainage facilities every spring and fall, and after heavy rains, as needed. It also measures the water level of the Tuul River.

b. Issue

GUBBG receives requests for assistance from citizens during heavy rainfall but is unable to respond adequately due to lack of staff and equipment. The following are possible causes of flooding damage.

- Existing drainage facilities such as rainwater pipes were designed based on the urban planning survey of 1970-1980, but their capacity is insufficient.
- During rainfall, mud and debris from gel areas flow into the rainwater pipes, causing blockages in the pipes and overflow from the manholes.
- Expansion of ger areas to slope areas.
- 70% of the roads in ger area are not equipped with drainage systems.

2.4.3 Understanding the Current Status of Environmental Issues Related to Solid Waste Management and Problem Analysis

(1) Status and Issues Related to SWM

According to an interview with CLCSD, which is in charge of cleaning activities in UB City, heavy machinery such as bulldozers used for final disposal site maintenance and waste collection and transportation equipment are aging. The equipment purchased with the government budget is cheap and small due to budget constraints, so it seems that there is a chronic shortage of equipment. On the other hand, with the concentration of population in urban areas, the amount of waste generated in UB City is increasing, making urban SWM even more difficult.

According to interviews with MRTD and EPWMD, the number of scrapped home appliances and automobiles is increasing due to changes in social conditions, and proper treatment has become an issue. Penalties for illegal dumping in the city are provided in the Law of Mongolia about Waste, but the problem is expanding due to lack of thorough operation and lack of treatment methods for hazardous waste.

In addition, according to interviews with MOFALI and GAVS, the problem of proper treatment of livestock carcasses and livestock chemicals that died from livestock infectious diseases has become apparent.

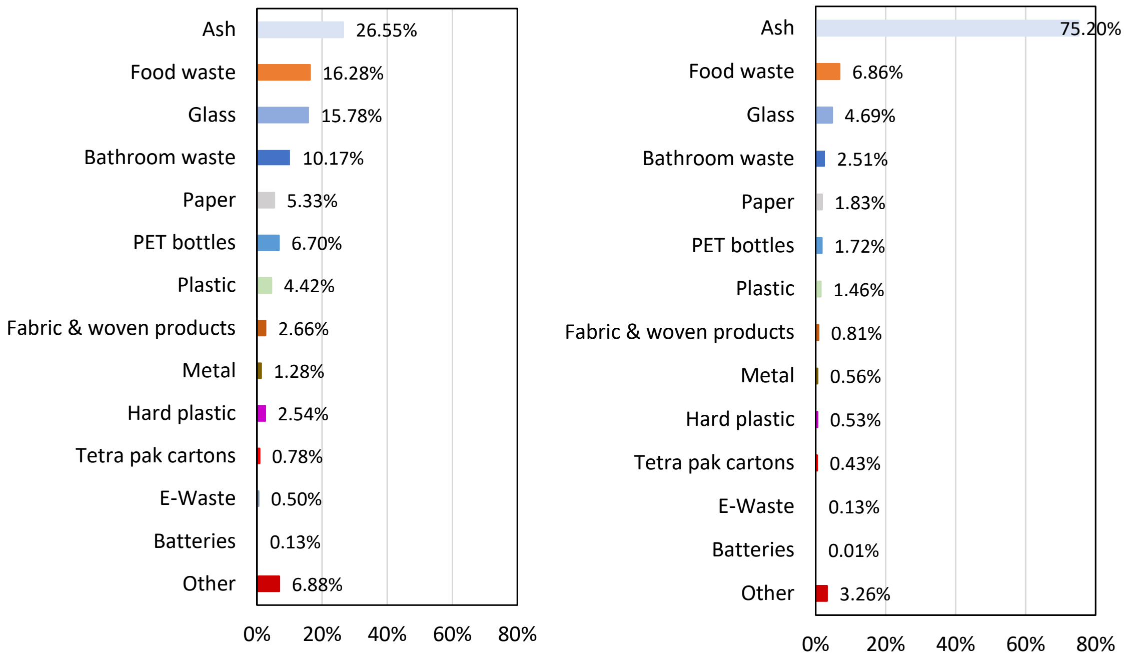
As mentioned above, UB City lacks the technology, financing, and legal systems for the increasing and diversifying wastes, and the institution in charge has a strong sense of crisis and is expecting support from other countries.

(2) UB City Waste Composition Data

The composition analysis of general waste in Mongolia has been reported in "ULAANBAATAR HOUSEHOLD WASTE COMPOSITION STUDY REPORT 2019" published by The Asia Foundation in 2019.

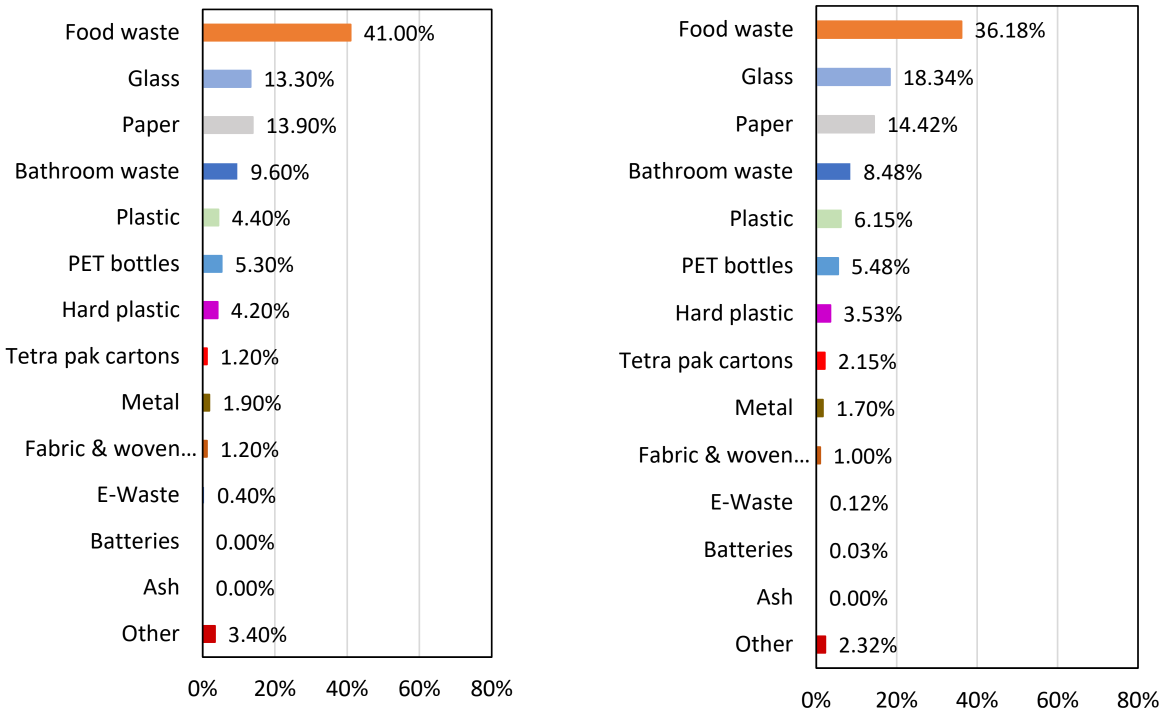
During the summer (September) and winter (November-December) of 2018, general waste was collected from 132 households in six districts of UB City. The composition of the waste was analysed and compared using Six (6) factors (geographical location, settlement area, dwelling type, heating type, income level, family size). The collection period was one week each in summer and winter, for a total of two weeks. After collecting in Seven (7) categories (paper, PET bottles, glass, food waste, bathroom waste, ash, etc.), they were sorted into 14 items.

Of the Six (6) factors, the results for the dwelling types (ger, apartment) whose results differed significantly are shown in **Figure 2.11** and **Figure 2.12**. In ger, ash accounted for 26.5% in summer and 75.2% in winter. In apartments, there was almost no ash and food waste tended to be abundant at any time. The result was that there was almost no waste such as batteries and E-Waste that needed to be treated in any of the houses.



Source: ULAANBAATAR HOUSEHOLD WASTE COMPOSITION STUDY REPORT 2019

Figure 2.11 Waste Composition in Ger (Left: Summer/Right: Winter)



Source: ULAANBAATAR HOUSEHOLD WASTE COMPOSITION STUDY REPORT 2019

Figure 2.12 Waste Composition in Apartment (Left: Summer/Right: Winter)

(3) Status and Issues Related to Final Disposal Site

Both the Narangin Engel and Tsagardawa disposal sites currently in operation are scheduled to close in 2023. As the next final disposal site, the Moringin Dawa final disposal site is planned to be constructed with the support of EBRD, and the construction work is scheduled to start in 2021 after an international bid. If this project goes smoothly, a final disposal site for UB City's solid waste will be secured for the time being.

(4) Status and Issues Related to Solid Waste Recycling

MRTD is working to revitalize the private recycling business in cooperation with the NPO "Recycling Federation", which has 300 domestic companies. In addition, according to an interview with EPWMD, a complex recycling facility (Eco-park) is planned to be constructed at the site of the final disposal site, which is scheduled to be closed in 2023.

The Eco-park project, in collaborate with the Mongolian Waste Recycling Federation, will carry out glass recycling, plastic recycling, organic waste recycling, bone processing, and E-Waste separation at both the Tsagaan davaa and Moringiin Davaa Dump Sites. On May 17, 2019, a contract was signed with 14 companies to implement the project to set up 14 facilities for dismantling and paper recycling. In 2019, 3 out of 14 facilities are planned to start operation, and as of the end of 2019, the construction work has reached 90%.

According to MRTD, many recycling companies are small companies, lacking technology for hazardous waste treatment, and having a small financial base.

(5) Status and Issues Related to Car Recycling

MRTD, which oversees automobile recycling, has decided to implement various measures as comprehensive measures to control pollutants generated from automobiles under the "Air and Other Environmental Pollution Control Program". As a specific item, it is stated that the prevent undeveloped automobiles that affect human health and adversely affect the environment from being driven in stages, promotion of a Promote the transition to gas fuel and electric vehicles, and gradually changing e vehicles used for public transportation to gas fuel vehicles, and the management of waste from the transportation sector (automobiles, airplanes, trains, ships, etc.) will be investigated, and that a plant will be constructed to properly treat of waste derived from used automobiles.

As a result of the above program, preferential policies for Eco-cars with less environmental impact have been promoted since 2007, and the number of scrapped cars due to replacement of cars is increasing, and proper treatment is a problem. Due to the absence of automobile manufacturers, etc., the legislation corresponding to the End-of-life Vehicle Recycling Law (hereinafter referred to as “EVRL”) in Mongolia has not been developed, and the system and standards for recycling scrapped automobiles have not been established.

At present, in automobile recycling in UB City, individual businesses collect, and scrap scrapped automobiles and sell iron scraps to steel makers and small and medium-sized rebar makers. However, it takes time and effort to convert scrapped automobiles into scrap iron, and the bulk specific gravity becomes small, so they are often sold unprocessed to steel mills, and as an iron scrap material, the price is set lower than that of iron scrap derived from construction.

In order to establish an automobile recycling market as an issue for automobile recycling in UB City based on the above situation, introducing and disseminating processing technology to improve the quality of iron scrap derived from scrapped automobiles and the issue is the development of the EVRL.

(6) Status and Issues of E-Waste

According to the interview with EPWMD, there is no mechanism to separate E-Waste (PC, mobile phone, etc.), but UB City recognizes that the need for recycling facilities is very high. In addition, due to changes in social conditions, the number of E-Wastes for personal computers and mobile phones is increasing, and it is recognized that creating a proper processing mechanism is an important issue. At present, it is considered that valuable resources are collected and recycled mainly by the informal sector and private businesses.

(7) Status and Issues Regarding Hazardous Waste Treatment

In Ulaanbaatar, there is no comprehensive facility for landfill and detoxification to dispose of hazardous waste in a way that is environment-friendly, and a large amount of hazardous waste is accumulated, stored in an inappropriate location, and there is a risk of serious damage to the health of the population and the natural environment.

To solve the problem of hazardous waste, the Cabinet has launched a 2020-2024 business program with the goal of establishing facilities that meet the international standards for hazardous waste. The expected outcome of setting up a temporary storage and disposal facility for hazardous waste is to dispose of 369 tons of hazardous waste and 68,000 litters of chemical hazardous substances that currently need to be stored or disposed of on appropriate land in Japan, and a system can be established to prevent risks to the health of residents and the natural environment.

Hazardous waste facilities can be constructed within the framework of concessions and public-private partnerships, in 2009, the Institute of Chemistry and Chemical Technology conducted a feasibility study and related surveys jointly with an overseas consultant on the order of the Ministry of Natural Environment and Tourism, and the total cost was estimated to be 308 billion MNT (about 11.2 billion yen). A land with an area of 10ha was secured in Baganuur district, Ulaanbaatar city as a site for construction of a facility for hazardous waste, but the application for construction site was cancelled due to strong opposition from the executives of local government agencies and residents. In October 2020, the Ministry of Environment and Tourism (MET) is requesting the Mayor of Ulaanbaatar to promptly resolve and decide on the matters to secure land for construction.

Hazardous waste treatment facilities will be important facilities for UB City in the future but securing construction land and raising construction costs are issues.

(8) Status and Issues Related to Waste Incineration Power Generation and Heat Supply Project

February 20, 2019 The Commission established by State Development Commissioner Order No. A-22 was approved by the 2013 Mongolian Cabinet Decision No. 317, reflected in item 44 of the "State Asset Concession List", "Power generation project by waste recycling" was selected from 3 groups by bidding method. As a result, a Working Group (WG) responsible for direct contract negotiations with partnerships between Taij Group Limited Liability Company and China Tianing Limited Liability Company in China was established in accordance with 2019 State Development Commissioner Order A-163 (refer to **Table 2.31**).

The specifications of the waste incineration facility adopted are that the total construction cost is 264 billion MNT (about 11.4 billion yen) and the waste disposal capacity is 400,000 to 4540,000 tons per year. However, the selection of business proposers has been difficult because the waste purchase price and power generation purchase price have not been finalized.

At the negotiation stage, the waste purchase price is 15 to 25 USD per ton and the power generation purchase price is 0.135 USD per kWh, which is a good business environment if realized. However, the waste purchase price is likely to be influenced by the political judgment of the citizens' representative council (city council), which poses a serious risk on the business side. In addition, although the power generation purchase price is set based on the Renewable Energy Law, there is no definition in the Renewable Energy Law regarding waste power generation, and discussions are being held on whether to include it in renewable energy.

Table 2.31 Comparison of Concession Project Proposals for Incineration Facilities

No.	Item	Unit	(Co., Ltd.) China National Investment Group, (Limited company) Erel Energy	(Limited company) China Tianing (China), (Limited company) Taij Group	(Limited company) D Eco Energy (Korea)
1	Total construction cost	USD	150 million	110 million	110 million
		MNT	360 billion	264 billion	264 billion
		JPY	14.5 billion	10.6 billion	10.6 billion
2	Operation start time		Q4 2019	14 months after signing the contract (Excluding winter season)	24 months after signing the contract
3	Power generation rated output	mW	8	15	15.4
4	Heat Supply rated output	mW	24	unknown	5.9
5	Waste disposal capacity	t/Y	400,000~450,000 t	400,000~450,000 t	400,000~450,000 t
6	Subsidy per ton of waste	USD	25	22	20
		MNT	60,000	52,800	48,000
		JPY	2,603	2,291	2,083
7	400,000~450,000 t Budget spending on waste incineration	MNT	27 billion	32 billion	21 billion
		JPY	1.09 billion	1.29 billion	0.85 billion

Source: Minister of Environment and Tourism (MET)

In another move, Naanovo Green Energy Mongolia Limited Company is planning to implement a 14mW output waste power plant project in Songinolhairkhan District, UB City, in partnership with Naanovo Energy UK Group in London, UK. In addition, implementation is planned for Five (5) Aimags by Mongolian regions. The first facility has been F/S approved for construction in Songinolhairkhan District, UB City, and is currently in the process of approving the selling price of electricity by the Electricity Regulatory Commission and is expected to be approved in near future.

In UB City, it is becoming difficult to secure land for a final disposal site due to population growth, and there is a strong interest in incineration of waste to prolong the life of the disposal site. On the other hand, due to the financial situation of Mongolia, raising the construction cost of incineration facilities has become an issue.

(9) Other Issues

Disposal of animal carcasses and other waste generated by livestock and food processing businesses has become a problem in UB City. According to MOFALI, the treatment of livestock waste (residues of livestock meat, internal organs, skins, etc.) has become a problem at the livestock base Emelt. In addition, there is a problem that veterinary drugs (medicines, vaccines, etc.) and livestock carcasses (from livestock that die due to livestock infectious diseases) are buried underground without being properly treated. It has become a serious problem in rural areas (Aimag Center) that do not have incineration facilities.

2.4.4 Understanding the Current Status of Environmental Issues related to Climate Change Mitigation and Analyzing Issues

According to the Mongolia's Third National Communication submitted by GOM to the UNFCCC in 2018, the trends and impacts of climate change and the outline of vulnerabilities are as follows:

- Near-surface temperature and its annual mean in Mongolia has increased by 2.24 Degree-Celsius between 1940 to 2015 period. The warmest 10 years in the last 76 years have occurred from 2000. One of clear features and changes is a sudden increase in number of hot consecutive days, and a decrease of freezing and cold days. There is no significant change in annual precipitation during the last 76 years, only small decrease of around 7% has been noticed. However, winter snow is in increase. Since 1940, it has increased by 22%, and 40% since 1961. In terms of spatial pattern, warm season and summer precipitation have increased slightly in Altai Mountain, the western Gobi in Altai region and south-eastern part of the country since 1961. Statistically there is a significant decrease in the central part of the country, and also slight increase in the western Gobi in Altai region.
- Certain changes have occurred in plant world in 65% of the pastures. The pasture area, which urgently requires recovering and enhancing has already exceeded 40%.
- If there is a severe drought during the summer and harsh conditions during the next winter, there will be a massive number of livestock loss, as usual. Therefore, the Dzud (heavy snow and large coverage) is evaluated by the combination of summer and winter conditions. The livestock loss is expected to increase by about 50% in the middle part of this century.
- The agricultural crops cultivated in conditions without an irrigation system, directly depend on climate situation. The harvest of wheat without being irrigated in 2002, 2005, and 2015 was very low and nearly 2 times less than the country's average. The reason for such a small yield was the drought, extremely hot days and late planting in the aforementioned years. Wheat yields are projected to decline by 9% in 2020, 18% in 2050 and 37% in 2080.
- The total annual river flow since 1978 has varied, gradually increasing and has reached its maximum value of 78.4 km3 in 1993. In comparisons with data of 1940s, the total lake area has been reduced by 7.8% or 1201.9 km^2, and 832 lakes have dried out in 2015. The glacier areas retreated by 12.1% in the period of 1940 to 1990, by 4% in 1990-2000, and by 13.75% in 2000-

2011 period. Totally glaciers retreated by 29.9% in the last 70 years. The glacier retreat and shrinkage intensified after 1990 and most intensive ablation occurred in the last 10 years.

- Recently, the forest cover of Mongolia is changing significantly due to the combined effect of climate change and human influence. Direct causes of such changes are logging, frequent forest fire, epidemics of insects, mining activities, etc. Forest area of Mongolia was 13.1 million ha in 1999, while forest area was estimated to be 12.3 million ha in 2015. It reduced approximately by 50.4 thousand ha or 0.41 % every year. Add for the last 5 years (2010-2015 year), forest area has reduced by approximately 760.0 thousand ha or 6.2%.
- The permafrost in Mongolia is either thawing or disappearing with the current climate warming. In Mongolia, the permafrost occupies approximately 29.3% of the country's area, and it has isolated to a continuous distribution. According to the monitoring data, permafrost temperature at 10 and 15m depths has been increased by 0.57-0.85 degree Celsius over the past 25-29 years. Once the soil temperature exceeds 0 degree Celsius, the ground temperature will accelerate very quickly. The distribution of permafrost was 28.01% or 0.44 million km^2 of the total territory of Mongolia during the period of 1896-2005, while it was expected that permafrost area will cover 22.88 or 0.36 million km^2 of the total territory of Mongolia in 2016-2015. The permafrost area of Mongolia will continue to decline, and it is expected that it will occupy 10.88% or 0.17 million km^2 of the total territory of Mongolia by 2046-2065, and the degradation of permafrost will continue and it is expected that permafrost area will occupy only 1.48% or 0.02 million km^2 of the total territory of Mongolia by 2080-2099.

As mentioned above, it is expected that in the future the environmental impact by climate change will become more serious in Mongolia. Therefore, it is necessary for Mongolia to carry out GHG emission reductions activities and respond to climate change issues, and Mongolia's contribution is promised at an international level through NDC. In the long-term development policy, since further promotion of climate change mitigation measures to reduce GHG emissions is an issue, it has been declared that Mongolia will aspire the green development and promote climate change mitigation measures.

Many of various projects leading to climate change mitigation measures are already being implemented in Mongolia. The following table shows the technological trends of local companies related to climate change mitigation measures.

Table 2.32 Technological Trend of Local Companies on Climate Change Mitigation Measures

Technology	Technological Trend in Mongolia
Introduction of energy conservation technology (Hot water valve control system for heating)	A valve control system and controlled heating panels are introduced in 'the report of data collection survey on the partnership between the private sector in Hokkaido and Mongolia, Central Asia, and the Caucasus area' (JICA). It is featured by temperature control that minimizes the amount of heat consumption, allowing an increased heating efficiency. It is possible to install these heating panels in Mongolia. On the other hand, in order for this system to become widespread, it is necessary to change the heating fee system, from the charge per total building floor to the charge based on the amount of heat actually supplied.
Introduction of energy conservation technology (house building with high standard insulation)	The 'Improvement for planning and implementation skills of Ulaanbaatar master plan, sub-project 2: The second phase of project on capacity development in urban development sector in Mongolia (MUGCUP2)' (JICA) carried out interview research for a Mongolian company. Since in Mongolia some companies sell insulation materials such as rock wool, it seems that insulation materials can be produced in Mongolia.

Technology	Technological Trend in Mongolia
Effective use of renewable energy by introduction of storage batteries connected to the electrical grid	Currently the project on storage batteries connected to electrical grid is not being carried out in Mongolia, as it is very difficult for a Mongolian company to carry out the Operation and Maintenance (O&M) for this project. However, in the future, since ADB project and a private company will start operation of the storage battery business, it is expected that a local Mongolian company will be stablished that will be able to carry out O&M.
Introduction of geothermal heat pumps	In Mongolia, the introduction of geothermal heat pumps is in its initial stage, and the basic operation is possible. On the other hand, it is difficult to say that we have sufficient technology for equipment maintenance at this moment. According to the SDGs Business Supporting Surveys by JICA, it is necessary in the future to transfer construction and maintenance technology to partnering companies in Mongolia. However, currently it is hard to say that O&M activities can be carried out independently in Mongolia. The geothermal heat pump is operating at the ZUUNDELGER 4th School in Zuunmod soum of Tub aimag. According to the interview research of the expert of ADB carried out in February 2017 in the MUGCUP2 Project, the geothermal heat pump systems are already operating in the following five sites: (1) 2 houses in Nukht area, (2) Shopping or service center in Nukht area, (3) Secondary school and kindergarten in Tuv aimag, (4) Kindergarten in Bayanzurkh district, and (5) Asem villa in UB.
Introduction of thermal storage heaters	The electric block heaters made in Germany are already sold by the distributor firm in the UB City. In addition, this is a system that stores heat from an electric heated wire into bricks, and the O&M can be implemented in Mongolia without any particularly difficult technology.
Hot water supply project for district heating, by producing solar water heating with solar thermal panels (A business that produces a large amount of hot water with solar heat and uses it for hot water for district heating during the winter.)	According to Ms. J. Erdenechimeg, a senior expert in the development policy planning department of the UB Governor's Office, there was a project to introduce a heating supply system using solar heat in Gyeongsangbuk aimag from 2018 to 2020. On the other hand, according to Ms. Tumendelger, director of the Research and Analysis Bureau of the National Development Agency, there was no such a project in Mongolia. According to the capacity development project for air pollution control carried out by SUURI-KEIKAKU, the future plan of the district heating contains a similar project, and it was confirmed that a similar project has already been carried out in the EU. From the above, it was judged that there is a technical possibility, but the possibility of commercialization it is not very high in Mongolia at this moment.

2.5 Environmental Issues that are expected to occur or worsen in the Future and their Impact on Other Sectors

2.5.1 Air Pollution Control

(1) Measures for Improved Fuels and Alternative Fuels to Coal

a. Challenges of Installation of Improved Coal-Fired Hot Water Supply Boilers

Emissions from HOBs in UB City have resulted in a high PM10 concentration of around 13 μg/m^3 at the ground level in the eastern part of UB City. This has become one of the major sources of air pollution in the ger area.

HOBs are high-efficient installed hot water boilers imported from abroad such as from China, Russia, Czech Republic, Hungary, and other countries. However, a large number of Mongolian manufacturers remain in the market, as the price per unit is a fraction of foreign-made products. However, there are problems with the structure of HOBs, and its low thermal efficiency, and in most cases inadequate environmental equipment, which results in high air pollutant emissions. As for the Japanese companies, although they have the capacity to manufacture coal-fired steam boilers of No. 4 thermal power or higher, there is almost no Japanese manufacturer that manufactures large-scale coal-fired hot water boilers, and they have no price or technological advantage.

The introduction of a new and improved large-scale coal-fired boiler is expected to be as effective as the Amgalan Heat Supply Facility. The higher stacks will allow the exhaust gas to diffuse widely, and the PM10 concentration at the ground level can be expected to decline by around 75%. However, the cost for reduction of emissions by one ton is rather high, and the heat loss due to distant supply is taken in consideration, and it results that the fuel consumption of the coal-fired large-scale hot water boiler is higher than that used in the HOBs taken out of use.

As part of Mongolia's environmental policy, except for the high-altitude ger area in UB City, the target facilities that had been receiving heat supply from HOBs will sequentially receive heat supply from the central heat supply network. Therefore, it is possible for 3/4 HOBs to be taken out of use. The taking out of use of HOBs, will require the expansion of the central heat supply network by increasing the capacity of the 3rd and 4th thermal power plants by another 10-20%, and operating the heat supply of the Amgalan Heat Supply Facility to its maximum output. In addition, the introduction of large-scale coal-fired boilers, and the consolidation of HOBs in the higher elevation ger areas and locations far from the central heat supply network will be effective as an environmental measure. At the same time, the air quality in the ger areas can be improved by promoting the migration of people from ger areas to housing complexes.

b. Challenges in Introducing Alternative Fuels to Coal

(i) Fuel Cost Comparison

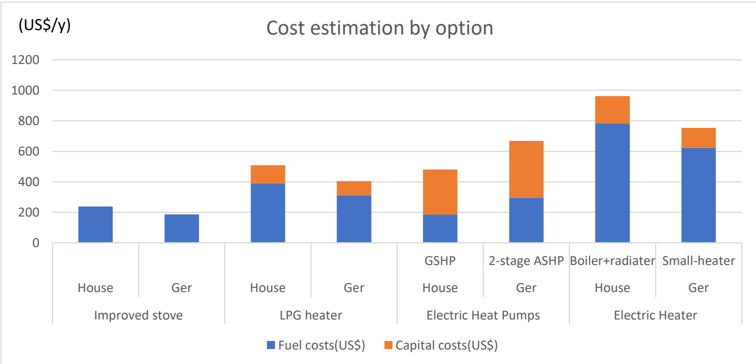
To achieve the 2020-2024 government action program "5.1.1 Reduce air pollution in UB City to 80% and gradually solve air pollution in other large cities and towns'', the issues are the content of fuel conversion from coal, and the cost of fuel borne by each household. On the other hand, some households may be able to prioritize the convenience of the fuel used depending on their income, so it is expected that fuel conversion will progress as the economy develops in the future. **Table 2.33** shows the comparison between the annual fuel cost of a new stove using improved fuel, and the fuel cost plus equipment cost when using LPG, heat pumps, and electric heaters.

Figure 2.13 is a graphical representation of **Table 2.33**. The source is the draft report, so at the present the figures are only for reference. According to this cost comparison, when comparing each fuel including the equipment cost with the use of current improved fuel, LPG is about twice as expensive, heat pumps are two to three times as expensive, and electric heaters are around three and a half to four times as expensive.

Table 2.33 Cost Comparison of Alternative Fuels to Coal

	House	Ger	Remrks
Consuption of buriquettel (t/year)	4.5	3.5	
Fuel price (MNT/t)	150,000	150,000	
(US$/t)	52.95	52.95	MTN = US$ 0.000353
Fuel cost per year (US$)	238	186	
Electricity supply costs ($/MWh)	76.4	76.4	

	Improved stove		LPG heater		Electric Heat Pumps		Electric Heater	
	House	Ger	House	Ger	House	Ger	House	Ger
					GSHP	2-stage ASHP	Boiler+radiater	Small-heater
Fuel costs(US$)	238	186	390	311	185	295	782	623
Capital costs(US$)	0	0	119	94	295	373.4	179.9	130.5



Source: Ulaanbaatar Air Quality Improvement Program-Phase 2, Clean Heat supply (DRAFT), 26 July 2020, using unit price and quantity of improved coal as modified by the study team.

Figure 2.13 Cost Comparison of Alternative Fuels

Alternative fuels to coal have a great effect in terms of climate change measures. The Clean Heat Supply Plan (Draft) prepared by the consultancy firm (ECA) that conducted the Policy Based Loan (hereinafter referred to as "PBL") 2 for ADB (refer to **Subsection 4.1.1**), which was referred to at present, summarizes the environmental assessment and cost of alternative fuels to coal, which is very helpful and will be described in more detail in the final report. This report covers the period 2021-2026, which does not include CNG.

(ii) Coal Gasification

The amount of investment in coal gasification depends on the scale of production, but the report on the Feasibility Study on Coal-to-Synthetic Natural Gas Plant commissioned by the Ministry of Mining and Heavy Industry, with a loan from the World Bank to Wuhuan Engineering Co Ltd., Wuhan, China (completed in 2019), shows a total investment of USD 2.5 billion for production shown in **Table 2.34** with a supply of 4 million tons of Baganuur coal. This includes the cost of facilities to pipeline the SNG produced at the Baganuur coalmine to Ulaanbaatar city. The amount of SNG is the amount that can be used as an alternative fuel to coal during winter in the ger region.

Table 2.34 Coal Gas Production Amount

Production	Ton/annual	Remarks
Main Products		
(1) SNG	725 million m^3	In summer, SNG unit is not in full load.
(2) Gasoline	326,400 t	Non heavy metal pure gasoline from methanol
(3) Ammonia	99,500 t	9,200 t/a will be consumed by the boilers equipped in this project.
By-Products		
(1) CNG, LPG	57,600	Deliverable to remote area and countryside
(2) Sulfur	15,440	
(3)) Ammonia sulphate	31,000	

Source: Coal to Synthetic Natural Gas Project MONGOLIA

The Coal to SNG Mongolia Project Unit, which was set up in the Ministry of Mining and Heavy Industry, was dissolved in March 2020, and it is unlikely to be feasible at present due to the huge amount of investment. The alternative is to use imported LNG. Kazakhstan, Russia, and China have been mentioned as import sources. Examples of LNG and CNG use are the gas-powered FS at the No. 2 power plant and a plan to convert public buses to CNG. When CNG becomes widespread in the future, there is a possibility that SNG produced by coal gasification will be reconsidered, but it will probably take some time. Therefore, LNG is the most promising alternative fuel to coal in this area, and it will be of an urgency to improve the infrastructural environment for imported LNG.

(iii) Issues of the Central Heating using Renewable Energy

Renewable energy has relatively large effects on air pollution control and CO_2 emissions reduction. However, the initial and operating costs of power generation are more than double of those of coal. In terms of location, the possibility of introducing renewable energy other than solar power is low.

As for incineration facilities, the supply of hot water is not considered, and there is no possibility at present.

c. Improvement Measures for Existing Improved Fuel

According to the government in the winter of 2019-2020, air pollution was reduced by 50% due to improved fuels. It has been estimated that the use of improved fuels in the winter of 2019-2020 was around 400,000 tons. The amount of used conventional raw coal is estimated at 1.2 million tons based on calculations, although the actual amount used is not known. Since the conversion to improved fuels, the government has been using a card system to record the amount of coal sold, and this is starting to reveal the actual amount used, so the actual amount used in the winter of 2020-2021 will become much clearer. If the amount used is 1.2 million tons, the amount of improved fuel consumed during the winter of 2019-2021 should be about 1/3. It is true that the calorific value of the upgraded fuel is higher than that of raw coal, but the questionnaires completed by the users indicate that this does not change the amount that they use. Although the details of the allocation of this shortfall are still under analyses, it can be said that one of the reasons for the decrease in the air pollution during the winter of 2019-2020 is that the use of improved fuels has decreased due to insufficient supply. Therefore, the air pollution situation in the winter of 2020-2021, when more improved fuels will be used, is likely to be very problematic.

On the other hand, low-income households in the ger areas using HOBs will continue to be forced to use improved fuels. As a result, if the air pollution situation in the winter of 2020-2021 becomes worse, the government will consider improving the use of improved fuels, and it is hoped that a technology will be developed for this purpose. In the Capacity Development Project for Air Pollution Control in Ulaanbaatar City (Phase 3), which is currently being implemented as a JICA technical cooperation project, the content of technological development is being studied while verifying the improvement effect. Since the improvement process can be applied to the existing and new improved fuel production plants, it is expected to have a significant effect on reducing air pollution and production cost, with a relatively small investment.

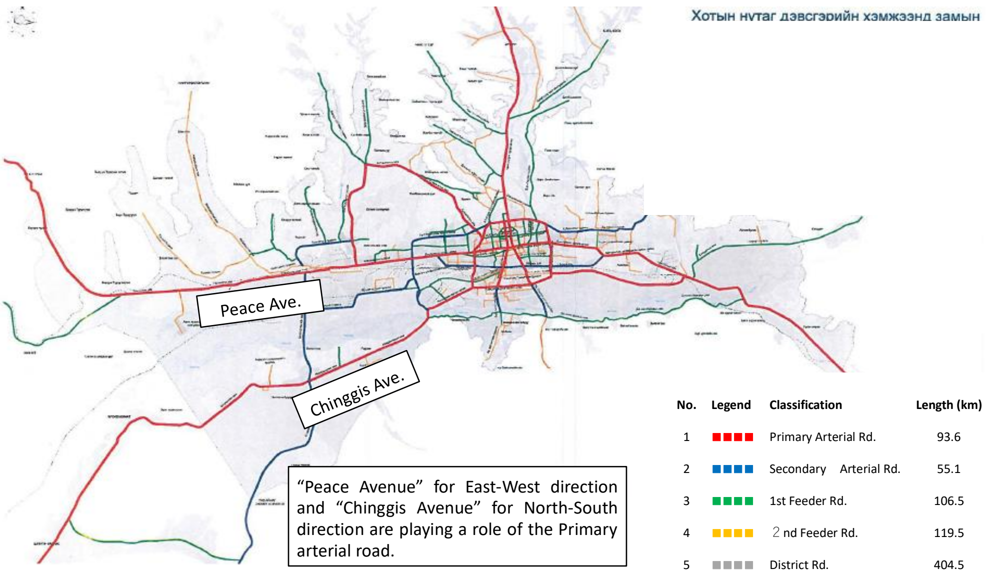
The current selling price of the improved fuel is 150,000 MNT/t (around 5,550 yen/t), but the actual cost is estimated at around 200,000 MTN/t, including raw material transportation, manufacturing, and sales costs, and the difference of 50,000 MTN (around 1,850 yen/t) is covered by subsidies. While it is unlikely that subsidies will continue in the future, it is expected that the price of improved fuel will increase or that an environmental tax will be introduced for all residents, as residents will understand the effects of improved fuel on environmental pollution.

The effect of having residents understand that environmental measures are costly will make it easier for them to adopt alternative fuels to coal, which is expected to be the way forward. The demonstration that a change in fuel is the most effective way to combat the air pollution will have a major impact.

(2) Measures for Vehicle Emission

a. Road and Traffic Condition in Ulaanbaatar City

The length of the road network in Ulaanbaatar City (hereinafter referred to as “UBC”) and neighboring satellite cities is 1,051.0 km. As shown in **Figure 2.14**, the total length of road network in the center of UBC is 779.2 km consisting of 148.7 km of arterial roads, 226.0 km of feeder roads and 404.5 km of district roads. There are 70 bridges with 3,956 m in total length crossing rivers and railways.

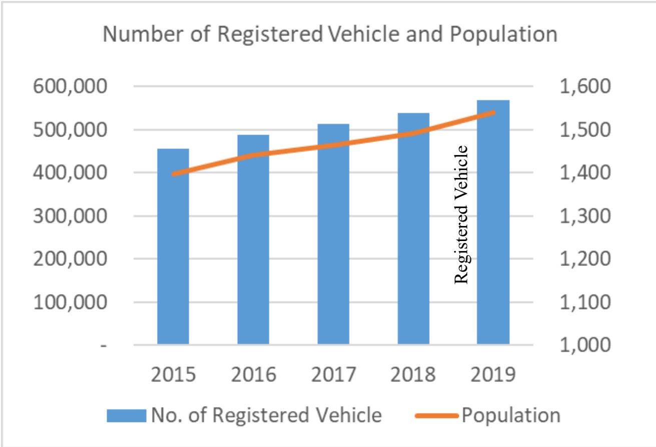


No.	Legend	Classification	Length (km)
1	■■■■	Primary Arterial Rd.	93.6
2	■■■■	Secondary Arterial Rd.	55.1
3	■■■■	1st Feeder Rd.	106.5
4	■■■■	2 nd Feeder Rd.	119.5
5	■■■■	District Rd.	404.5
		Total	779.2

Source: Ulaanbaatar Mid-term Road Development Plan

Figure 2.14 Existing Road Network in Ulaanbaatar City

As shown in **Figure 2.15**, the number of registered vehicles in UBC is increasing year by year with high population growth, and this have been caused heavy traffic congestion due to shortage of the traffic capacity at major arterial roads in the central part of UBC. The other main factors of the traffic congestion are shortage of railway crossing to connect the road network in North-South direction, enlargement of the Ger Area in the northern part of UBC, and development of residential area in the southwest of UBC.

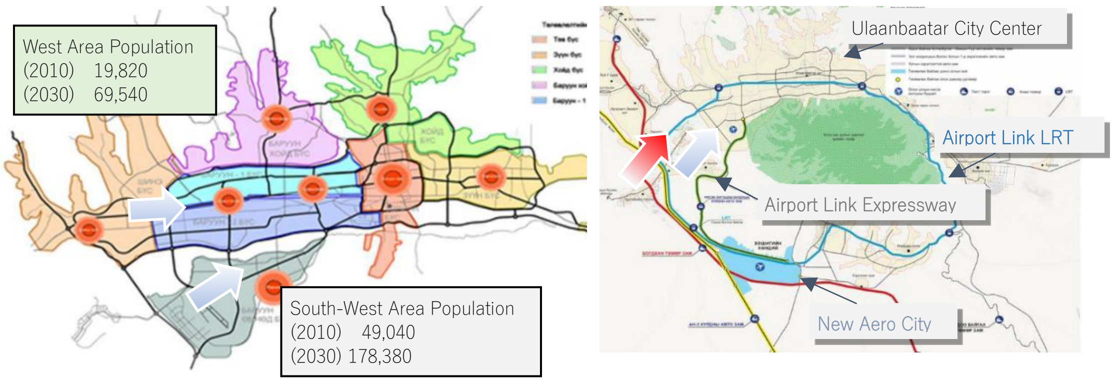


Source: Year Book 2019 (National Statistics Office, Mongolia)

Figure 2.15 Transition of Number of Registered Vehicles and Population

b. Development Trends of UBC

In the Ulaanbaatar City Master Plan (2030), the population framework consists of eight subareas. The population of the southwest area is 49,000 and the population of the west area is 20,000 as of 2010. The population of both areas is expected to increase by more than 2.5 times by 2030, namely, the population of the southwest area and the west area will be 278,000 and 70,000 by 2030 respectively. Moreover, transfer of a part of the capital functions to the southwest area have been planned and the City Hall and other facilities are under construction. The New Ulaanbaatar International Airport was constructed under Yen-loan project expected to open soon, and the surround area of the new airport is being developed as a logistics base, an ecological city and a new sub center of the city with the population of 34,000. Therefore, traffic resource from the west area of UBC is highly expected to increase due to such population growth and the development trends of UBC (see **Figure 2.16**).



Source: Ulaanbaatar City Master Plan (2030) (Left), New Ulaanbaatar Airport Aero City MP (Right)

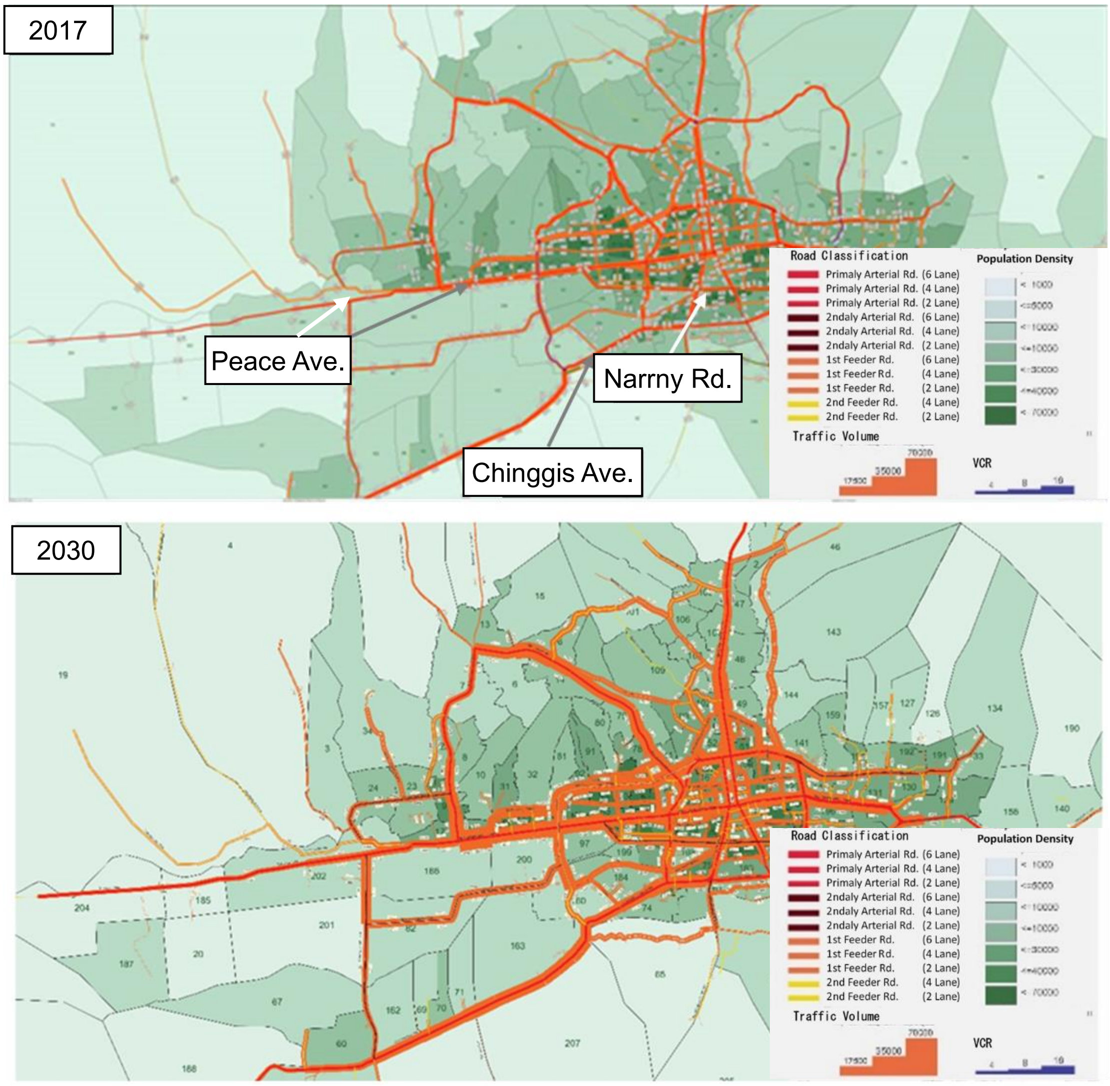
Figure 2.16 Population Expansion Frame and Development Trends in Ulaanbaatar City (Left: Population Frame, Right: Location of New Airport)

Traffic demand forecast with target year of 2030 based on traffic survey in 2017 was conducted by the Ulaanbaatar Mid-Term Road Development Plan (UBRP), which was formulated in 2018 and it has been in the process of approval by the Ulaanbaatar City Council. **Figure 2.17** shows the existing traffic volume in 2017 and the future traffic volume in 2030. As shown in **Table 2.35**, the traffic volume in primary arterial roads had already exceeded their capacity since 2017 and it is estimated to increase by 1.46 to 1.67 times by 2030. Consequently, the increasing of vehicle emission due to traffic congestion will be highly expected and this will lead to the expansion of air pollution along the main roads, which will accelerate the deterioration of living condition and the increase of health hazards.

Table 2.35 Prediction of Traffic Volume in 2030

Road	2017		2030 (Prediction)	
	Daily traffic volume	VCR	Daily traffic volume	VCR
Peace Avenue	27,500	2.15	46,009 (1.67)	3.51
Narrny Road	12,500	1.25	20,500 (1.64)	2.05
Chinggis Avenue	18,500	1.85	27,000 (1.46)	2.70

Note) Daily traffic volume: Average of 24 hours traffic volume each road (one direction),
VCR: Vehicle Capacity Ratio (Traffic volume/ Capacity Ratio)
Source: Ulaanbaatar Mid-term Road Development Plan

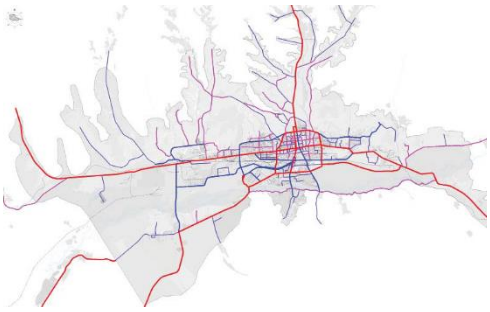


Source: UBRP

Figure 2.17 Simulation Result of Traffic Volume in Ulaanbaatar City (2017/2030)

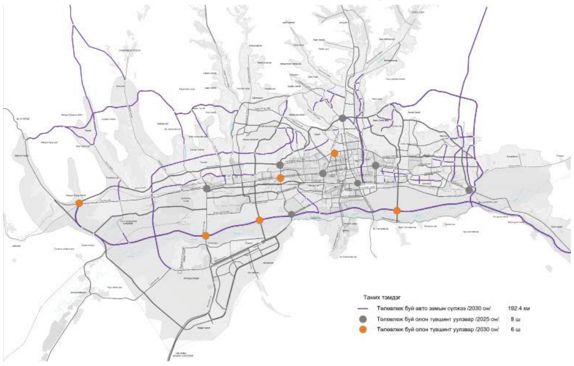
c. Ulaanbaatar Mid-Term Road Development Plan (UBRP)

To address the issue on future serious traffic congestion, improvement of road network to strengthen the traffic capacity of arterial road, to mitigate traffic congestion at major intersection and to shorten the travel time, as shown in **Figure 2.18**, have been proposed in the UBRP and its implementation have been already started. According to the UBRP, six (6) corridors in the East-West direction, ten (10) corridors in the North-South direction and four (4) ring road system will be developed, and the current road network with a length of 779.3 km will be extended to 1026.2 km by 2025 and to 1726.3 km by 2030.

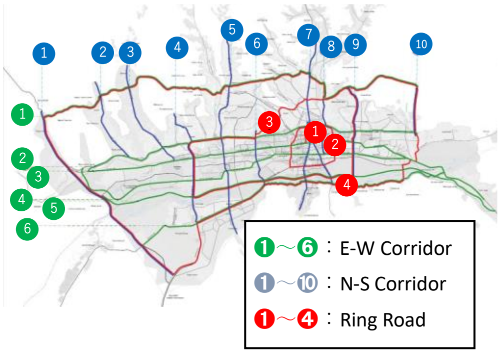


2019（Existing）

New Road Construction Plan (2020-2025)



New Road Construction Plan (2025-2030)



Road Network Plan in 2030

Source: Ulaanbaatar Mid-Term Road Development Plan

Figure 2.18 Future Road Network in UNRP

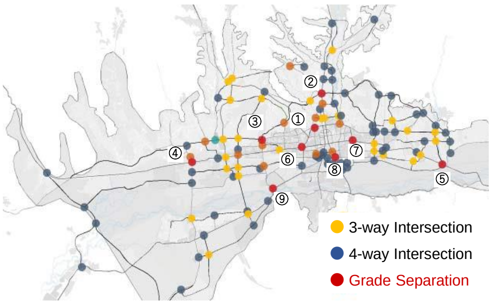
Once the road network is formulated as proposed in the UBRP, traffic volume of arterial roads will be drastically diversified and reduced. As shown in **Table 2.36**, the traffic volume in the East-West direction concentrating on Peace Avenue as well as the South-North direction such as Chinggis Avenue, will be reduced, and a large effect on the mitigation of traffic congestion has been expected.

Table 2.36 Effect of Road Network Improvement

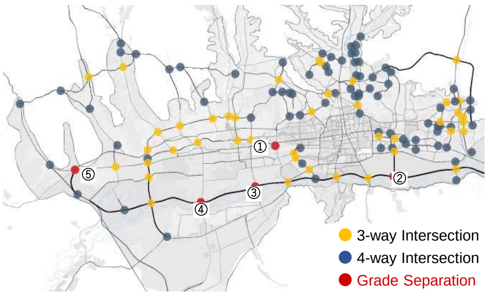
Road	2019 (Current)		2030 (Without Improvement)		2030 (After Improvement)	
	Daily Traffic Volume	VCR	Daily Traffic Volume	VCR	Daily Traffic Volume	VCR
Peace Avenue	27,500	2.15	46,009	3.51	22,750 (0.49)	1.78
Narrny Road	12,500	1.25	20,500	2.05	17,300 (0.84)	1.73
Chinggis Avenue	18,500	1.85	27,000	2.70	16,000 (0.59)	1.60

Note) Daily traffic volume: Average of 24 hours traffic volume in each road (one direction),
VCR: Vehicle Capacity Ratio (Traffic volume/Capacity Ratio)
Source: UBRP

The improvement of intersections and the installation of grade separation have been also proposed in the UBRP, in association with the construction of the new road network mentioned above. Specific locations of the grade separation are indicated by red circles (●) in **Figure 2.19**, and the type of crossing for other intersections is going to be examined in the future.



No,	Intersection	Remarks
①	GeserTemple Intersection	
②	Newly-built	
③	Newly-built	
④	Tovchoo Intersection	FS was implemented (2013)
⑤	Gachuurt Intersection	
⑥	West Crossroads	DD by China
⑦	East Crossroads	DD by Korea
⑧	Fly-over in front of Traffic Police	Under construction by China
⑨	Yarmag Intersection	Chinese Gannt (2019)



No,	Intersection	Remarks
①	Sapporo Intersection	
②	Ikh Tenge Intersection	Tuul River Express Way
③	Tuul Yarmag Intersection	Tuul River Express Way
④	Tuul Songsgolon Intersection	Tuul River Express Way
⑤	Tuul Tovchoo Intersection	

Source: UBRP

Figure 2.19 Planned Location of Intersection Improvement and Construction of Grade Separation (Upper: as of 2025, Lower: as of 2030)

In addition, the construction of road facilities, such as railway overpass/underpass, river crossing bridges and new pedestrian bridges required for the extension of the road network, have been scheduled in the UBRP. **Table 2.37** shows the number of planned facilities, together with the target year, and **Figure 2.20** shows the construction sites for these facilities.

Table 2.37 Number of Bridges and Road Facilities to be Constructed by 2030

No.	Type of Facilities	2017 (Existing)	2025 (Newly-built)	2030 (Newly-built)
1	Bridges for crossing rivers	66	10	13
2	Fly-over for crossing railway	4	3	4
3	Underpass (Road)	5	9	9
4	Culvert (Road)	0	24	17
5	Pedestrian bridge on road	9	25	24
6	Pedestrian bridge on railway	2	6	0

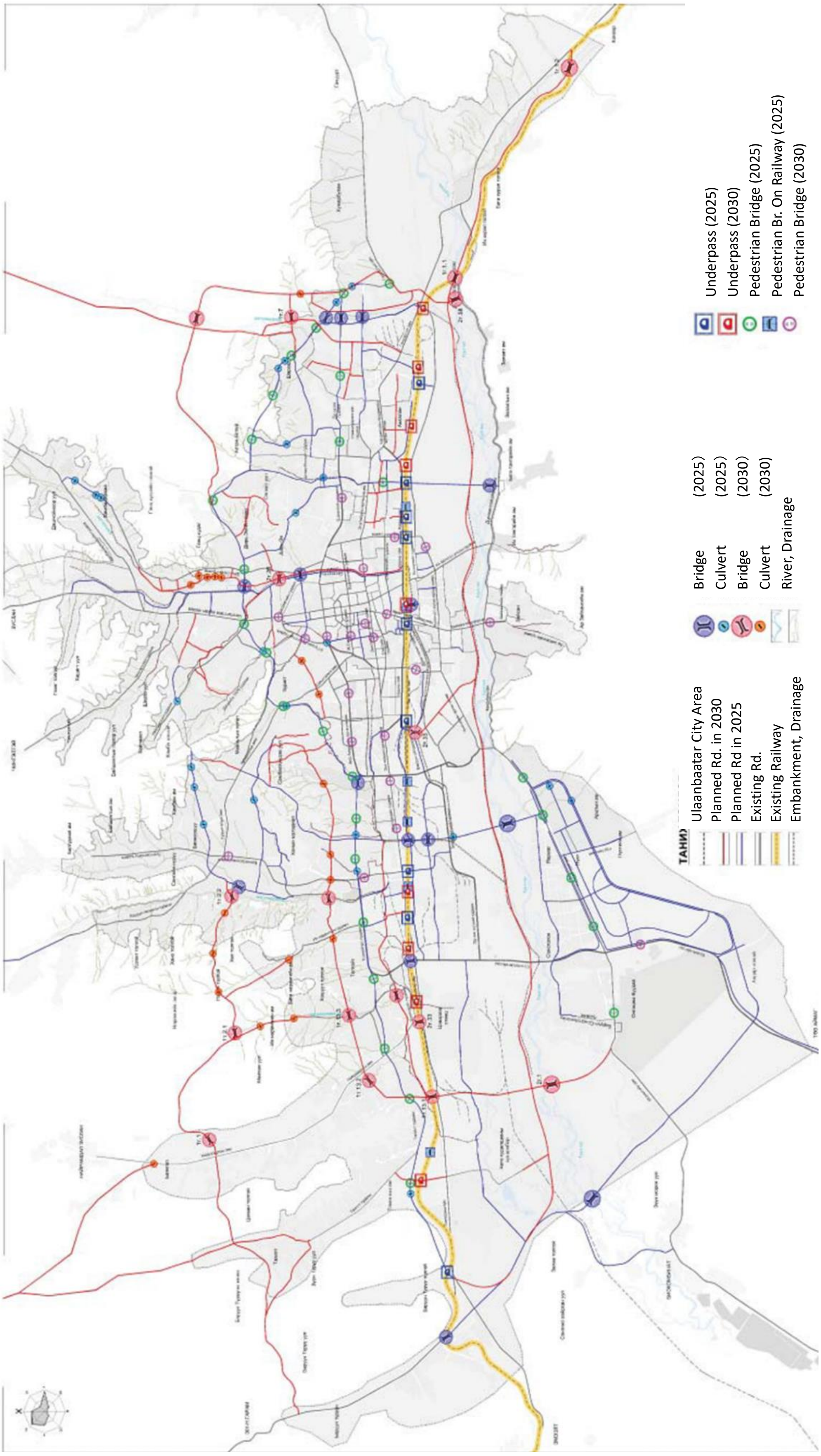
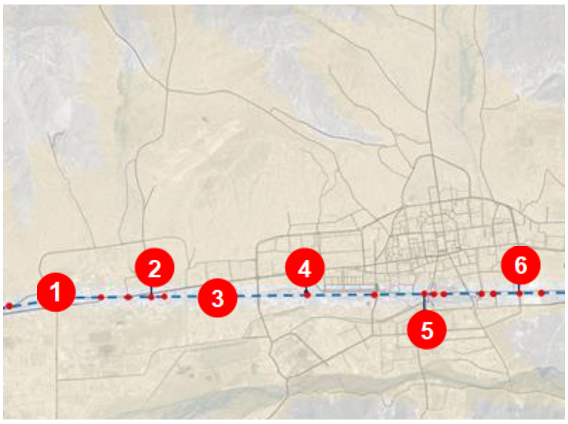


Figure 2.20 Construction plans of Road Facilities in the UlBRP

d. Construction plan of underpass by DIIP

The UBRP include the construction of underpasses crossing the railway to be implemented under the Development Initiative Infrastructure Project (hereinafter referred to as "DIIP") of the Ministry of Finance. DIIP has planned the construction of six (6) underpasses as shown in **Figure 2.21** and **Figure 2.22** through a loan from the Export-Import Bank of China. There will be many issues to construct the underpass connecting to existing road, such as longitudinal slope to ensure the traffic safety, keeping sufficient vertical clearance for large trucks, and relocation the underground utilities.



Source: DIIP

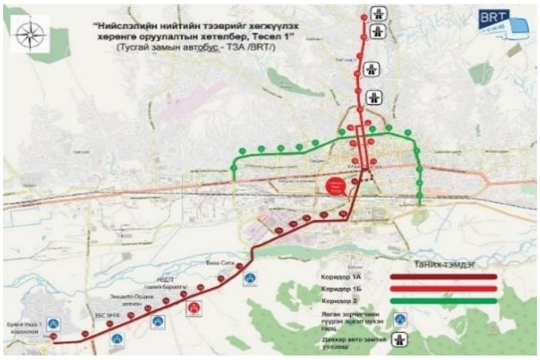
Figure 2.21 Railway Underpass Proposed by DIIP

Source: UBRP

Figure 2.22 Images of Planned Underpasses in Ulaanbaatar City

e. Development of the Bus Rapid Transit (BRT) by ADB

The Bus Rapid Transit (hereinafter referred to as "BRT") in the Urban Transport Development Investment Program, which was implemented by the ADB for the amount of 274.4 Million USD and started in 2012, was expected to strengthen the capacity of public transportation using existing roads and to mitigate traffic congestion in the urban area of UBC. Although the route of the BRT has been decided as shown in **Figure 2.23** and its detailed design was implemented, the Ministry of Finance stopped the project without final confirmation of the design after expiry of the loan



Source: Road Department of Ulaanbaatar City

Figure 2.23 Planned Route of BRT

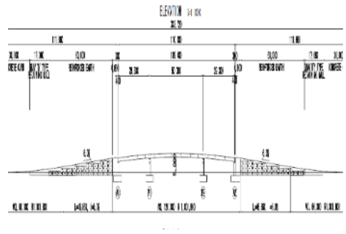
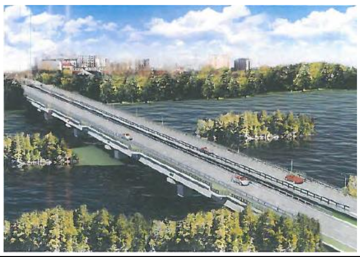
agreement. Reasons for the termination of the project and whether the project will resume in the future are unknown.

f. Intersection Improvement and Bridge Construction Planned in the UBRP

The Road Department of UBCG has studied the grade separations, flyovers crossing railways and new roads to eliminate missing link (**Table 2.38**) in order to formulate the East-West Corridor and the North-South Corridor as well as the Ring roads proposed in the UBRP introduced in **Figure 2.18**. It should be highlighted that implementation of the grade separation project in such urban area will require special technology for the construction not to disturb railway operation and existing road traffic, and for the quality infrastructure to minimize lifecycle cost.

Table 2.38 Projects for Grade Separation and Bridge (Flyover)

Project	Project Outline	Project Image
Tolgoit-Songsgolon Flyover (Ring Road③)	Bridge Length: 365 m/4 Lanes Construction Cost: 36 million USD Traffic Volume: 48,718 vehicles/day (2020) Note: ADB conducted a Feasibility Study in 2011. This project includes an improvement plan to change a grade railway crossing to an underpass.	
Narantuul Market Grade Separation (Ring Road②)	Bridge Length: 435 m (4 Lanes) Construction Cost: 25 million USD Traffic Volume: 40,641 vehicles/day (2020) Notes: Two plans (fly-over and underpass) are being examined. DIIP is also considering this project as a part of the projects supported by China.	
East-Crossroads Grade Separation (Ring Road②)	Bridge Length: 135 m (4 Lanes) Construction Cost: 25 million USD Traffic Volume: 48,500 /day (2018) Note: An underpass for pedestrian crossing the intersection is also planned in addition to the fly-over. The project was financed by the Development Bank of Mongolia but it was stopped in 2013.	
West-Crossroads Grade Separation (Ring Road②)	Bridge Length: 584 m (4 Lanes) Ramp: 636 m Approach: 2,440 m Construction Cost: 52.5 million USD Traffic Volume: 49,500/day (2018) Note: D/D was carried out in 2008 and the project started in 2012 with support from China but suspended.	

Project	Project Outline	Project Image
Ajilchin Flyover (East-west road④)	Bridge Length: 828 m (4 Lanes) Ramp 274 m Approach: 515 m Construction Cost: 70.3 million USD Traffic Volume: 29,100 /day (2021) Note: The JICA FS was carried out in 2013 and targeted as a Yen Loan Project (STEP).	 
Sapporos Grade Separation (Ring Road③)	Bridge Length: 110 m (4 or 6 Lanes) Construction Cost: 20-25 million USD Traffic Volume: 103,485 /day Note: Rapid construction can be applied. In 2016, the Ministry of Economic Development (at that time) conducted channelization.	 
Bayanburd Grade Separation (Ring Road②)	Bridge Length: (To be decided) Construction Cost: 36 million USD Traffic Volume: 92,307 /day (Survey data in 2011) Note: This project has not been designed thoroughly yet.	 
Green Avenue Construction Project (South-north road⑤)	Underpass crossing railway: 24 m Bridge Length: 440 m (3 bridges) Road Length: 5.1 km Construction Cost: 4 billion JPY Traffic Volume (vehicles/day) (crossing railway): 27,200 (crossing river): 16,100 (UB2030 demand forecast) Note: The shortest route to the new Ulaanbaatar City Hall. Fly-over and underpass are being examined for railway crossing.	 
Zaisan Bridges Widening (South-north road⑦)	Bridge Length: 226 m Construction Cost: 26.2 million USD Traffic Volume: 18,000 vehicles/day (2017) Notes: Improvement of the existing RC bridge by changing 2 lanes to 4 lanes.	 

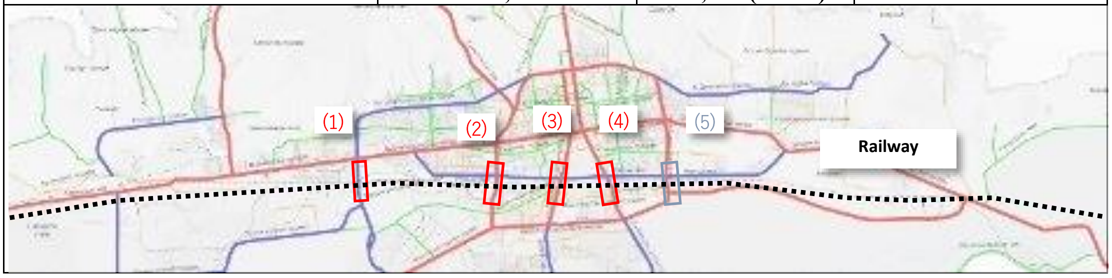
g. Indicators to Select Priority Projects Based on the UBRP

(i) Traffic Volume of Railway Crossing in the North-South Direction

The total traffic volume of four (4) flyovers and one (1) at grade railway crossing across the railway in the central part of UBC is expected to increase by about 12% by 2030 as shown in **Table 2.39**. Chronic traffic congestion has observed at all locations crossing railways as of 2020, since the traffic capacity of such locations has been saturated. Therefore, strengthening of the road network in the North-South direction crossing railway is an important factor in prioritizing the projects. Traffic volume of the western side of UBC is expected to increase more than that of the city center (Peace Bridge) due to rapid development in the western area in UBC. Thus, projects which will contribute to mitigate traffic congestion at railway crossing in the western part of UBC shall be higher priorities for the implementation.

Table 2.39 Traffic Volume of Existing Railway Crossing in the North-South Direction

Location		Current Traffic Volume (vehicles/day)	Traffic Volume in 2030 (vehicles/day)	Remarks
West ↔ East	(1) Gulvarjin Bridge	32,200	46,300 (+44%)	Flyover (4 Lanes)
	(2) Narrny Bridge	38,600	51,200 (+33%)	Flyover (4 Lanes)
	(3) Peace Bridge	31,000	43,800 (+41%)	Flyover (4 Lanes)
	(4)Flyover (police station)	32,300	32,500 (+ 1%)	Flyover (4 Lanes)
	(5) At grade railway crossing in front of the Narantuur Market	42,800	41,300 (-3.5%)	At grade railway crossing (4 Lanes)
Total		**176,900**	**198,800 (+12%)**	



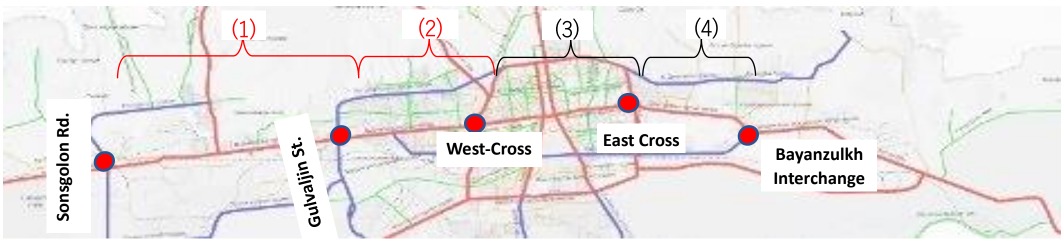
Source: UBRP (traffic volume is 2-way direction)

(ii) Mitigation of Traffic Congestion in the East West Direction

Peace Avenue passing through the central part of UBC is the most important East-West Corridor that is facing extremely heavy traffic congestion. In the UBRP, mitigation of traffic congestion of Peace Avenue is addressed by developing new six (6) arterial roads in the East-West direction as shown in **Figure 2.18**. Therefore, positive impact of the mitigation of traffic congestion on the Peace Avenue is one of the highest priorities. Particularly, the projects to mitigate the traffic congestion at the west area of UBC should be high priorities since the traffic volume is significantly increasing in the west side from the West Cross (**Table 2.40**).

Table 2.40 Traffic Volume of Peace Avenue by Section

Section	Current Traffic Volume*1 (Vehicles/Day)	Traffic Volume in 2030*2 (Vehicles/Day)	Remarks
(1) Sonsgolon-Gulvarjin	**70,200**	**112,500 (+60%)**	**Maximum value in the section**
(2) Gulvarjin-West Cross	**53,500**	**90,400 (+69%)**	**Maximum value in the section**
(3) West Cross-East Cross	60,900	76,000 (+25%)	Maximum value in the section
(4) East Cross -Bayanzulkh	60,300	85,700 (+42%)	Maximum value in the section
Average	**61,225**	**91,150 (+49%)**	



*1: Planned traffic volume in 2017
*2: Although the UBRP presents a one-way traffic volume, this report will discuss it with two-way traffic volume.

(iii) High Priority Projects based on Interview with UBCG and MRTD

High Priority Projects which need foreign assistance are listed in the order of priority in **Table 2.41** based on interview survey with UBCG and MRTD. These projects are inclusive of the improvement for intersections and bridges scheduled in the UBRP, and have necessity of development. In this Survey, the projects which should take the highest priority in terms of the project effect will be selected from these six (6) projects presented in **Table 2.41** and **Figure 2.24**.

Table 2.41 High Priority Project Proposed by the Road Department of Ulaanbaatar City and MRTD

Project	Reason for High Priority
1. Green Avenue Construction Project	This avenue will connect to the location of the new Ulaanbaatar City Hall, which is under construction in the southwest area of the city. Since the avenue crosses Peace Avenue and a railway, there is a possibility that new flyover will be large-scale. Therefore, plans of both a flyover and an underpass must be compared. In addition, careful consideration is required since the avenue passes through an environmental preservation area for water resource.
2. Tolgoit-Songsgolon Grade Separation Project	This is a flyover at a crossing section of the east-west arterial road (Peace Avenue) and the south-north road (No.⑤) and constitutes a main traffic nodal point. It will be an important arterial road since the western side of the UB City is being developed as per UBMP2020.
3. Sapporo Grade Separation Project	This intersection is located along Peace Avenue and one of the intersections with large traffic volume. Since it has a wide median strip and the existing space can be used during construction, technical difficulty will not be high.
4. Narantuul Market Grade Separation Project	This is an at-grade railway crossing with the heaviest traffic congestion. The construction to change to grade separation must be implemented in a limited area. Therefore, design and construction plan with high quality are required regarding land management, traffic control and others.
5. Ajilchin Flyover Construction Project	Since it curves and crosses the railway yard, it will be a large-scale bridge extension. A method of a steel bridge which can be constructed in a limited area must be applied and advanced design and construction technology are required.
6. Zaisan Bridge Widening Project	Technical difficulty of this project is low. Demand for this route is expected to grow because it connects to Zaisan Observatory, which is a tourist attraction and surrounding area is being developed as residential area.

Figure 2.24 Location of High Priority Road Improvement Projects

h. Effect of Grade Separation and Road Improvement on Travel Speed

The impact on air pollution of the Six (6) projects has been examined to materialize the project effect. Amounts of vehicle emission and its concentration were quantified before and after the project by changing travel speed of passing vehicle.

(i) Improvement of Travel Speed by Grade Separation

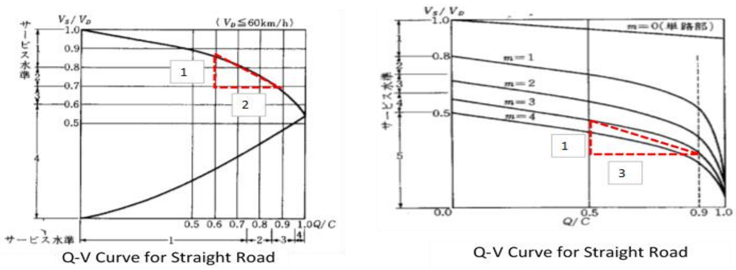
Travel speeds of intersections on main roads (grade separations) and sub roads after grade separation are expected to increase by about 5 km/h (**Table 2.42**) due to the reduction of waiting time at traffic signals.

Table 2.42 Change in Travel Speed by Grade Separation

Condition	Unit	Existing Intersection		After Grade Separation	
		Main Road (6-lane with Traffic Signal)	Sub-road (4-lane with Traffic Signal)	Main Road (6-lane without Traffic Signal)	Sub-road (4-lane with Traffic Signal)
Traffic Capacity	Vehicle/hour	2540	1693	2540	1693
	Vehicle/second	0.71	0.47	0.71	0.47
Link-length before and after intersection	M	500	500	500	500
Free Driving Speed	km/h	25	25	25	25
Period for Green Signal	Sec.	100	60	-	100
Period for Red Signal	Sec.	60	100	-	60
Number of vehicles in the queue	Vehicle	45	30	-	30
No. of Passing Vehicle in 1-cycle	Vehicle/cycle	71	28	-	47
Free Driving Period	Sec.	72	72	-	72
Total time of Free Driving	Sec.	5080	2032	-	3386
Waiting time for stoplight	Sec.	1350	1500	-	900
Total time to pass the intersection	Sec.	6430	3532	-	4286
Average Passing Time	Sec/Vehicle	91	125	-	91
Average Passing Speed	km/h	19.8	14.4	25.0	19.8
Increment of Passing Speed	km/h			**+5.2**	**+5.4**

(ii) Effect of Road Improvement on Vehicle Travel Speed

A new road network will distribute the current traffic volume for adjacent roads. In each section of the target route, the increase of travel speed due to reduction of traffic volume is estimated by using Q-V curve (Highway Capacity Manual, Transportation Research Board, USA) as shown in **Figure 2.25**. The road widening, 2 lanes to 4 lanes, will double the traffic capacity and increase travel speed with 8.5km/h. **Table 2.43** shows the effect on travel speed by the improvement of intersections and network in the high priority project.



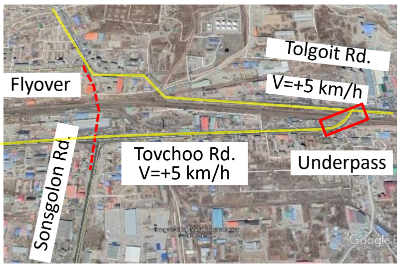
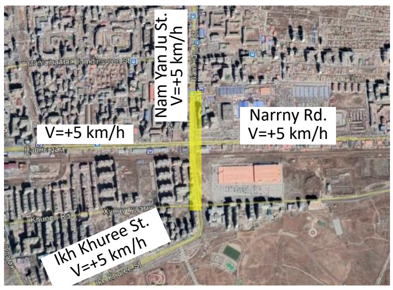
-30% of Traffic Volume increases 15% of V s/Vd	7.50 km/h
-20% of Traffic Volume increases 10% of V s/Vd	5.00 km/h
-10% of Traffic Volume increases 5% of V s/Vd	2.50 km/h

-30% of Traffic Volume increases 10% of V s/Vd	5.00	km/h
-20% of Traffic Volume increases 6.6% of V s/Vd	3.35	km/h
-10% of Traffic Volume increases 3.3% of V s/Vd	1.65	km/h
2 times of Lane number increases 17% of Vs/Vd	8.50	km/h

Design Speed: 50 km/h
Source: Highway Capacity Manual, Transportation Research Board, USA

Figure 2.25 Increase of Interval Travel Speed According to Traffic Volume Reduction

Table 2.43 Effect of Road Improvement on Travel Speed

Improvement Location	Ameliorating Effect on Travel Speed	Estimated Change of Travel Speed
1. Green Avenue Construction Project	1) Traffic dispersal (30% of current traffic volume) at Sonsgolon St. improves the travel speed (Existing Average Speed 22.3km/h) by ***7.5 km/h*** (demand forecast in 2030). 2) Grade separation at the Peace Avenue improves the travel speed (Existing Average Speed 17.5km/h) by ***5 km/h*** due to signal downtime reduced in the east-west direction.	
2. Tolgoit-Sonsgolon Grade Separation Project	1) Grade crossing of flyover and railroad crossing improves the travel speed (Existing Average Speed 31.3km/h) by ***5 km/h*** at Tolgoit Avenue. 2) Grade crossing improves the travel speed (Existing Average Speed 31.3km/h) by ***5 km/h*** at Tovchoo Avenue which crosses Songsgolon Street (subsidiary road)	
3. Sapporo Grade Separation Project	1) Reduced signal downtime improves the travel speed (Existing Average Speed 15.6km/h) by ***5 km/h*** at upward Peace Avenue in the east-west direction. 2) Reduced signal downtime improves the travel speed (Existing Average Speed 31.3km/h) by ***5 km/h*** in the north-south direction (sub-traffic direction).	
4. Narantuul Market Grade Separation Project	1) Grade separation improves the travel speed (Existing Average Speed 15.6km/h) by ***5 km/h*** due to signal downtime reduced at Nam Yan Ju Street and Ikh Khuree Avenue. 2) Reduced signal downtime improves the travel speed (Existing Average Speed 22.3km/h) by ***5 km/h*** at Narny Zam.	
5.Ajilchin Flyover Construction Project	1) Improvement of arterial road that parallels with Peace Ave. reduces traffic volume of Peace Ave. by 21% (JICA preparatory survey), which improves the travel speed (Existing Average Speed 15.6km/h) by ***<u>3.4 km/h</u>***. 2) New establishment of grade crossing with a railway reduces traffic volume at Gulvaljin St. by 22% (JICA Preparatory Survey), which improves the travel speed	

Improvement Location	Ameliorating Effect on Travel Speed	Estimated Change of Travel Speed
	(Existing Average Speed 15.6km/h) by ***3.4 km/h***.	
6. Zaisan Bridge Widening Project	1) Widening of Zaisan Bridge (from 2 lanes to 4 lanes) doubles its traffic capacity, which improves the travel speed (Existing Average Speed 19.4km/h) of the bridge section, which improves the travel speed of the bridge section by ***8.5 km/h***.	

Note: The travel speed applied to the above simulation is defined as averaged travel speed based on actual measurement for each link of 0.5 to 1.0 km in length. Consequently, the travel speed at the vicinity of intersection where the speed is reduced less than 10 km /h to stop and to accelerate was not be simulated. In order to quantify the state of vehicle stoppage and acceleration and its hazardous emission, it would be effective to analyze the peak traffic volume per hour using the micro-simulation software. It is possible that the above simulation result which does not reproduce the low-speed less than 10km/h, underestimated the actual reduction of vehicle emission as the effect of grade separation. It is recommended to conduct detailed analysis during succeeding feasibility study to evaluate more accurate emission.

i. Effect of Road Improvement on Air Pollution

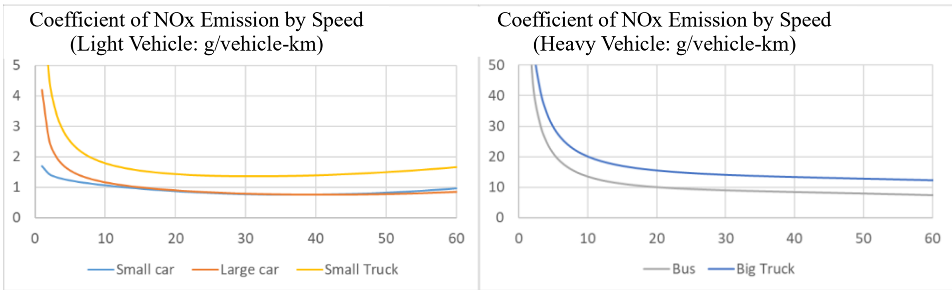
To verify the effect of road improvement on travel speed, emissions of NOx and PM10 were calculated and then a simulation of diffusion was conducted by using the total emission. Details of the simulation model are explained in **Table 2.44**. The coefficients used for the calculation of emission amounts of NOx and PM10 are shown in **Figure 2.26** and **Figure 2.27**.

It can be observed that the emission of NOx and PM10 is significantly affected by large vehicle such as Bus and Truck. In addition, the emission drastically increases when the travel speed slower than 10 km/h due to traffic jam or stopping/starting at the vicinity of intersection. Therefore, it would be important to increase the travel speed for the mitigation of the hazardous emission from the vehicle by improving the road network and intersection.

Table 2.44 Details of Simulation Model

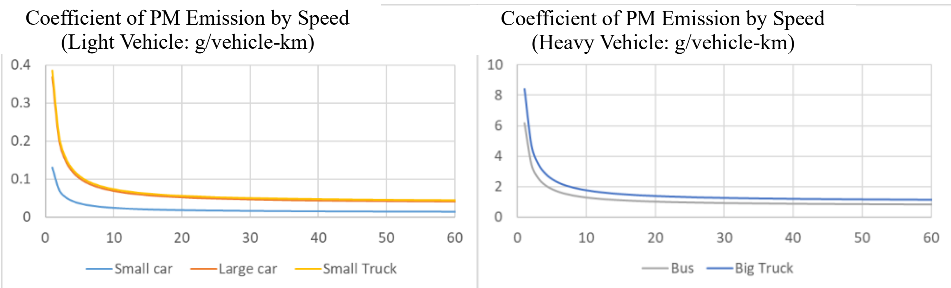
Item	Settings
Model	CALPUFF Ver5.8.4 (USEPA recommended model)
Topography	SRTM30/GTOPO30 Global Data (～900 m, 30 arc-sec)[*1]
Land use data	USGS Land Use/Land Cover Scheme Eurasia (optimized for Asia)[*2]
Ground weather data	NCDC TD3505 Integrated Surface Hourly Data[*3]
Aerology data	NOAA/ESRL Radiosonde Database[*4]
Target area	about10 km square from centering on each target road
Resolution	1 km x 1 km
Target harmful substance	NOx, PM10 (inclusive of SO_4, NO_3 and HNO_3 by chemical reaction)
Source	Vehicle travelling data and exhaust gas in 2015 (Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2 (JICA, December 2013-June 2017)
Target Period	From January 11 to January 17, 2016
Point of concentration	Center point of a grid square (1 m x 1 m)

Reference: Coefficient of NOx Emission by Speed
Note: [*1]http://dds.cr.usgs.gov/srtm/version2_1/SRTM30/
[*2]http://edc2.usgs.gov/glcc/tablambert_euras_as.php
[*3] http://rda.ucar.edu/datasets/ds463.3/
[*4] http://www.esrl.noaa.gov/raobs/



Source: Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2 (JICA; 2013-017)

Figure 2.26 Coefficient of NOx Emission by Speed



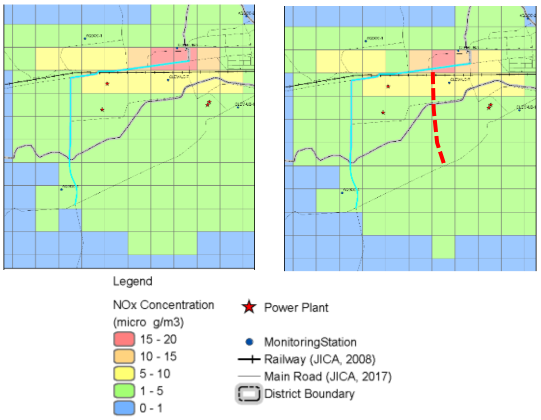
Source: Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2 (JICA; 2013-017)

Figure 2.27 Coefficient of PM10 Emission by Speed

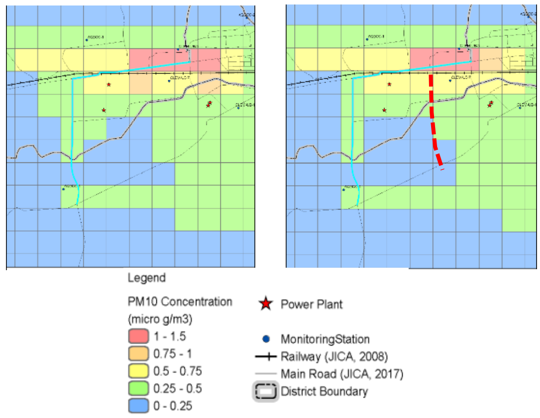
Regarding NOx and PM10, expected reduction rates of maximum concentration and emission amounts after the implementation of each project were estimated as shown below. The value was estimated by using the emission of each target route only, but not considering the emission from other routes.

(i) Simulation Result: Green Avenue Construction Project

Item		Before Improvement	After Improvement	Reduction Rate	Environmental Standard
NOx	Maximum concentration (µg/m³)	16.334	15.068	-7.8%	50µg/m³
	Emission amount (kg/week)	5,911	5,545	-6.2%	—
PM10	Maximum concentration (µg/m³)	1.488	1.374	-7.7%	100µg/m³
	Emission amount (kg/week)	405	381	-5.9%	—



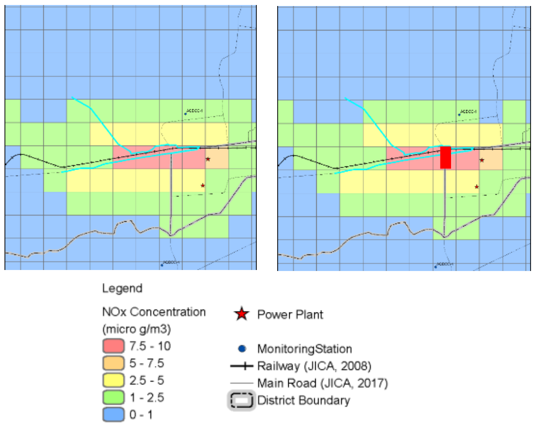
NOx (Before/After)



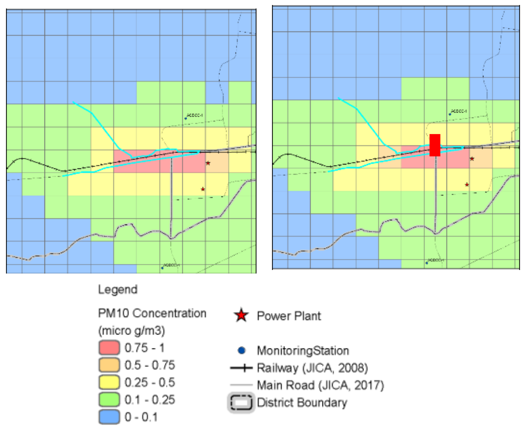
PM10 (Before/After)

(ii) Simulation Result: Tolgoit-Sonsgolon Grade Separation Project

Item		Before Improvement	After Improvement	Reduction Rate	Environmental Standard
NOx	Maximum concentration (µg/m³)	9.202	9.036	-1.8%	50µg/m³
	Emission amount (kg/week)	3,298	3,235	-1.9%	—
PM10	Maximum concentration (µg/m³)	0.873	0.855	-2.1%	100µg/m³
	Emission amount (kg/week)	237	232	-2.1%	—



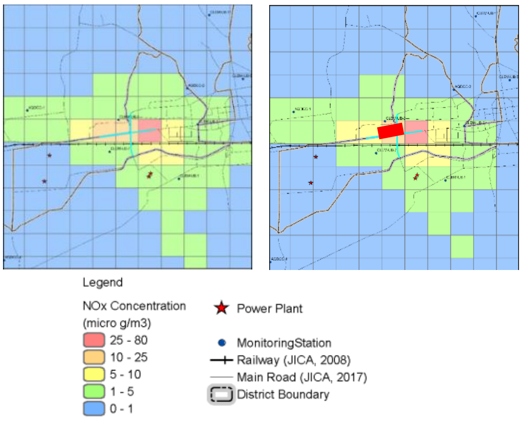
NOx (Before/After)



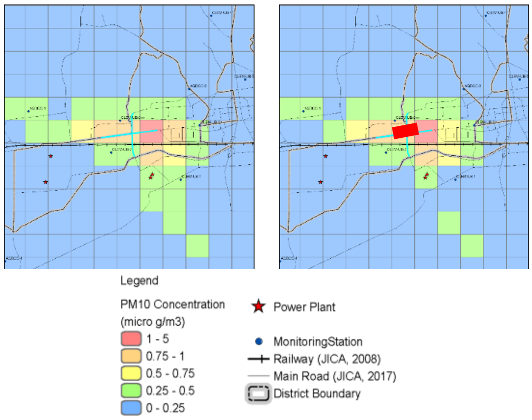
PM10 (Before/After)

(iii) Simulation Result: Sapporo Grade Separation Project

Item		Before Improvement	After Improvement	Reduction Rate	Environmental Standard
NOx	Maximum concentration (μg/m^3)	72.867	66.967	-8.1%	50μg/m^3
	Emission amount (kg/week)	3,501	3,213	-8.2%	—
PM10	Maximum concentration (μg/m^3)	4.734	4.331	-8.5%	100μg/m^3
	Emission amount (kg/week)	206	190	-8.2%	—



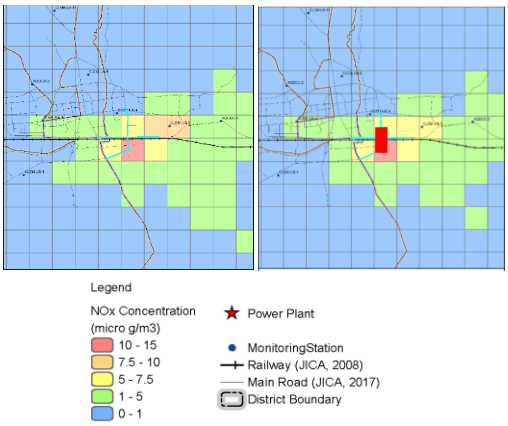
NOx (Before/After)



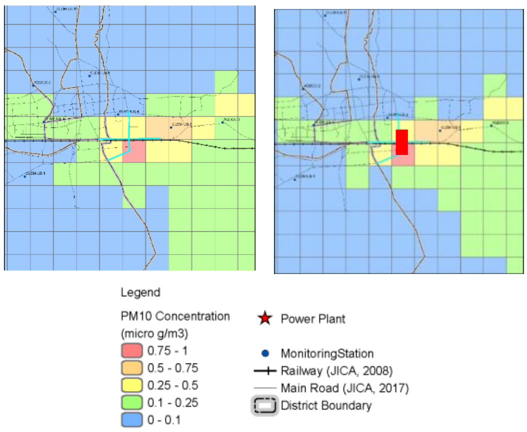
PM10 (Before/After)

(iv) Simulation Result: Narantuul Market Grade Separation Project

Item		Before Improvement	After Improvement	Reduction Rate	Environmental Standard
NOx	Maximum concentration (μg/m^3)	13.152	11.961	-9.1%	50μg/m^3
	Emission amount (kg/week)	3,176	2,868	-9.7%	—
PM10	Maximum concentration (μg/m^3)	0.860	0.774	-10.0%	100μg/m^3
	Emission amount (kg/week)	170	151	-10.8%	—



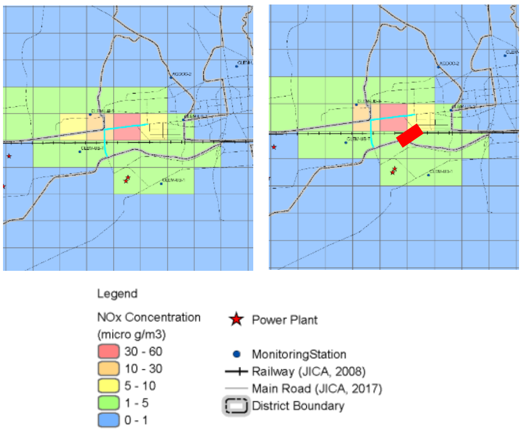
NOx (Before/After)



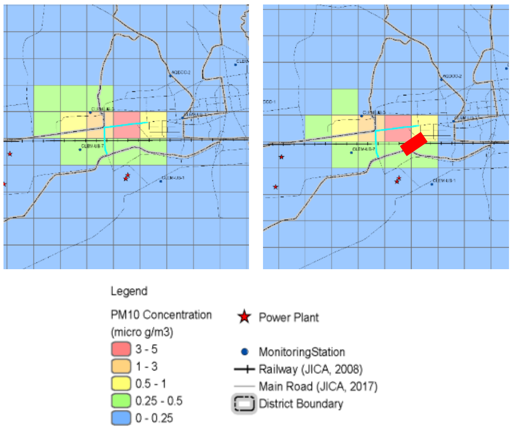
PM10 (Before/After)

(v) Simulation Result: Ajilchin Flyover Construction Project

Item		Before Improvement	After Improvement	Reduction Rate	Environmental Standard
NOx	Maximum concentration (μg/m³)	59.711	55.675	-6.8%	50μg/m³
	Emission amount (kg/week)	1,825	1,699	-6.9%	—
PM10	Maximum concentration (μg/m³)	3.756	3.485	-7.2%	100μg/m³
	Emission amount (kg/week)	105	97	-7.0%	—



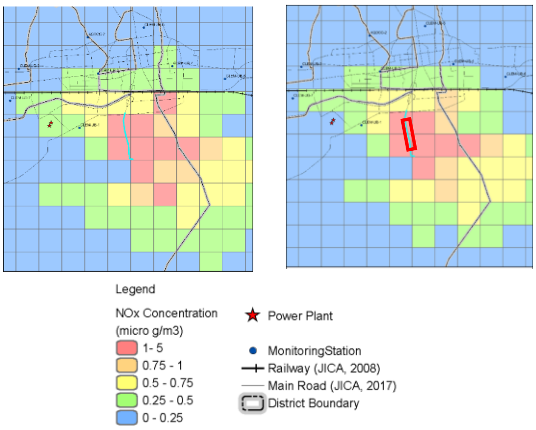
NOx (Before/After)



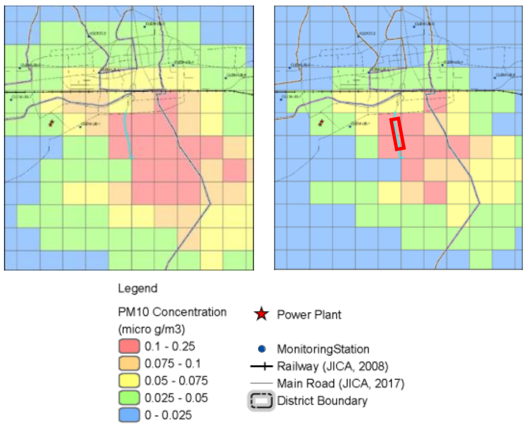
PM10 (Before/After)

(vi) Simulation Result: Zaisan Bridge Widening Project

Item		Before Improvement	After Improvement	Reduction Rate	Environmental Standard
NOx	Maximum concentration (μg/m³)	2.849	2.642	-7.3%	50μg/m³
	Emission amount (kg/week)	593	550	-7.3%	—
PM10	Maximum concentration (μg/m³)	0.240	0.222	-7.5%	100μg/m³
	Emission amount (kg/week)	32	29	-7.5%	—



NOx (Before/After)



PM10 (Before/After)

j. Priority of Projects

High priority projects according to the UBRP are summarized with project effects as shown in **Table 2.45**. Based on the reduction of vehicle emission, expected traffic volume, and diversifying effect on existing primary arterial roads, the priority of projects in terms of the project effect was re-evaluated and updated from the priority proposed by the Mongolian side.

Table 2.45 Summary of Project Evaluation

Items to be Compared	(1) Green Avenue Construction Project	(2) Tolgoit- Songsgolon Grade Separation Project	(3) Sapporo Grade Separation Project	(4) Narantuur Market Grade Separation Project	(5) Ajilchin Flyover Construction Project	(6) Zaisan Bridge Widening Project
Type of Improvement	Elimination of Missing Link	Elimination of Missing Link	Grade Separation of At grade Intersection	Grad Separation of At-grade Railway Crossing	Elimination of Missing Link	Widening of Existing Bridge
Crossing railway	Yes	Yes	No	Yes	Yes	No
Lanes	4/6	4	6	4	4	4 (Additional 2 lanes)
Existing traffic volume (2017) vehicles/day	-	23,300	49,900	42,800	-	18,000
Future traffic volume (2030) vehicles/day (without improvement)	-	62,300	86,800	54,600	-	34,600
Future traffic volume (2030) vehicles/day (with improvement)	13,400-24,300	7,400	53,300	36,200	57,000*2	32,000 (Estimated value)
Effect on Traffic of Peace Avenue	Medium	Medium	Large	Medium	Large	Small
Effect on Traffic of S-N direction	Medium	Small	Small	Small	Large	Small
Effect on Surrounding Road	Large	Medium	Large	Medium	Very Large	None
Effect on Vehicle Emission (Reduction rate)	NOx: -7.8% PM10: -7.7%	NOx: -1.8% PM10: -2.1%	NOx: -8.1% PM10: -8.5%	NOx: -9.1% PM10: -10.0%	NOx: -6.8% PM10: -7.2%	NOx: -7.3% PM10: -7.5%
Construction cost	8.7 billion yen *1	3.8 billion yen	2.5 billion yen	2.6 billion yen	8.0 billion yen	1.0 billion yen
Priority by Project Effect	2	4	3	5	1	6
Evaluation	**<Overall Evaluation>** Diversifying effect of existing traffic in north-south direction at Sonsgolon St. and Gulvaljin St. by construction of a new link is expected. The shortest route connecting new City Hall and city center. Landscape effect is expected similar to Peace Bridge in the city center. **<Individual Evaluation>** ・Effect of reducing traffic congestion at the intersection by grade separation of Peace Avenue in north-south direction ・Share approx. 7.2% of North-South traffic volume (198,800 vehicles / day) crossing railway	**<Overall Evaluation>** It is possible that future traffic volume will decrease and that the project effect will be reduced due to construction of new link for north-south direction such as Green Avenue, etc. **<Individual Evaluation>** ・Effect of reducing traffic congestion at the intersection by grade separation of Tovchoo Avenue (extension of Peace Avenue) ・Share approximately 3.7% of North-South traffic volume (198,800 vehicles / day) crossing railway.	**<Overall Evaluation>** While directly mitigating congestion of Peace Avenue, no diversifying effect is expected. One of the heaviest traffic intersections and relatively large impact on vehicle emission. **<Individual Evaluation>** ・Improvement of travel speed at Peace Ave. and Gulvaljin St. ・Public Transport Project in the future proposed at same route such as Metro and BRT shall be coordinated.	**<Overall Evaluation>** No diversifying effect for traffic of connecting road is expected. Effect on mitigation of traffic congestion may be small because the interval of adjacent road to be connected by grade separation is very small. **<Individual Evaluation>** ・Improvement of travel speed at Narrny Road (east-west) ・Mitigation of traffic stoppage by train (north-south) ・It will invoke the congestion at next intersection due to very close interval of crossing road.	**<Overall Evaluation>** Expected to diversify the traffic of Peace Ave. (east-west) and Gulvaljin St. (north-south) respectively by formulating new link. **<Individual Evaluation>*3** ・Diversify approx. 21% of the traffic of Peace Ave. to Narrny Rd. ・Diversify approx. 22% of the traffic of Gulvaljin St. ・Time saving from the railway station to the airport by 16 minutes.	**<Overall Evaluation>** It would not contribute to mitigation of traffic congestion of arterial road since less diversifying effect by the project. Vehicle Emission is originally small due to less traffic volume. **<Individual Evaluation>** ・As the traffic volume increases according to the progress of residential development in the neighbouring area, the need for widening is high, but the effect and beneficiaries are limited.

Note: *1 Construction amount of Green Avenue was originally estimated based on the railway underpass (24m) and shorter river crossing bridge at Tuul River. The amount is likely to increase in the case of flyover and longer river crossing bridge.
*2 Traffic volume for Ajilchin Fly-over Construction Project is based on JICA F/S.
*3 JICA FS

2.5.2 Water Pollution Control

As mentioned in the section on understanding the status of water pollution control measures and analyzing the issues, there are various issues in UB City, such as factory wastewater control measures, proper sewage sludge treatment and disposal, reconstruction of aged sewer pipes, and improvement of rainwater drainage facilities. If these issues are not resolved and become more serious, the impacts on each sector are as shown in **Table 2.46** below.

Table 2.46 Impacts of Water Pollution Control-Related Issues on Other Sectors

Sector	Environmental Issues that are Expected to Become More Serious	Impacts of Worsening Water Pollution
River and Water Supply Sector	In the downstream area of the Tuul River, where the treated water of CWWTP is discharged, water pollution has become serious and water quality standards for public water bodies has not been complied with. In addition, UB City uses groundwater from the Tuul River basin as its main water source, and the deterioration of river water quality will worsen groundwater pollution.	The impact on securing drinking water source in UB City will be significant. The MCC Project is seeking a source of drinking water downstream of CWWTP, and there is concern about the impact of the plant.
Living Environment and Soil Sector	The accumulated sludge in CWWTP and in riverbed of Tuul River downstream from CWWTP emits a foul odor.	It worsens the living environment of residents. In addition, heavy metals and other substances from the sludge permeate into the ground, causing groundwater and soil contamination.
Industry Sector	Leather industry is one of the major industries in Mongolia, but most of the leather factories are small and medium-sized enterprises, and it is difficult for them to secure funds to install pre-treatment facilities. The inability to set up pre-treatment facilities will continue, forcing the factories to stop operations.	More and more leather factories will go out of business due to factory shutdowns. As a result, Mongolia's main industry will decline.
Urban Function Sector	If aged pipes are not reconstructed, damage and corrosion of the pipes will become more serious. In addition, the lack of construction of rainwater drainage facilities such as rainwater pipes will worsen the damage caused by flooding.	The possibility of road cave-ins caused by aged pipes and interfering with traffic functions will increase. In addition, worsening flood damage will lead to paralysis of urban functions and loss of personal property, endangering the lives of residents.

Source: JICA Survey Team

2.5.3 Solid Waste Management

The problem of SWM is an important issue that transcends sectors such as the industrial sector, sewage sector, livestock sector, and transportation sector. As for the status of SWM in UB City, as mentioned in Understanding the status of environmental issues and analyzing issues, there is a chronic shortage of equipment due to aging and lack of supply. Furthermore, the treatment capacity and technology are insufficient for the ever-increasing amount of waste due to the overconcentration in urban areas. In addition, there is a problem that the treatment technology for hazardous waste has not been developed.

Table 2.47 shows the environmental issues and impacts that can be foreseen in each sector from the SWM status.

Table 2.47 Impacts of Solid Waste Management-Related Issues on Other Sectors

Sector	Environmental Issues that are Expected to Become More Serious	Impacts of Worsening SWM
Industrial Sector	Water quality and sludge pollution derived from the leather industry are emerging in UB City. On the other hand, at present, the mainstream industry in Mongolia is local coal and mines, so it is considered that pollution (pollution problem) derived from industrial waste has not reached a serious situation in the suburbs of UB City. In the future, it is considered that the treatment of various hazardous wastes generated when the chemical industry and the manufacturing industry have developed is an issue.	Currently, the waste treatment facilities in the city are final disposal sites that do not have impermeable facilities or leachate treatment facilities and a small incinerator owned by a livestock company is in charge. In the future, if the industry in the suburbs of UB City develops, further environmental pollution will occur, and it may develop as a pollution problem.
Sewage Sector	In the sewage sector, it is the treatment of heavy metal polluted sludge discharged from the leather industry. Since this sludge cannot be treated, there is a problem that the improvement of the central sewage treatment plant and the development of water sources in the lower reaches of the Tuul River are not progressing. At present, it is the most serious problem derived from waste generated by UB City.	For environmental problems caused by industrial wastewater in UB City, improvement efforts in the sewage sector such as tightening of wastewater regulations are necessary, but if this measure is delayed, it is currently not possible to secure a recipient for waste that requires final disposal. This is a problem that will become more serious in the future and can be a factor that constrains the growth of cities.
Livestock Sector	In the field of livestock, the treatment of carcasses of livestock that have died due to epidemics and the treatment of harmful chemicals used for livestock has become a problem, causing environmental pollution due to burial treatment.	Some processing plants in UB City have incineration facilities, but in the suburbs of UB City, especially in the livestock farming business, waste from livestock is treated by burial. These include epidemics such as foot-and-mouth disease and infectious waste such as vaccines for livestock, which can have a devastating impact on the livestock sector in the region if problems occur.
Transportation Sector	The processing and recycling of transportation vehicles such as automobiles has become a major issue. Regarding the recycling business, support from other countries and plans for business activities have been made, but full-scale implementation has not yet been achieved.	The recycling business is a field that is relatively easy to commercialize because it has few technical elements, but the problem is that the treatment equipment for hazardous waste such as chlorofluorocarbons collected in the process of dismantling is not in place, and only valuable resources will be collected, and hazardous waste may be dumped.

Source: JICA Survey Team

2.5.4 Climate Change Mitigation

Regarding climate change mitigation, the impact has been evaluated in the aspect of GHG emissions as shown in **Table 2.48**.

Table 2.48 Impacts of Climate Change Mitigation-Related Issues to Other Sectors

Sector	Environmental Issues that are Expected to Become More Serious	Impacts of Worsening Climate Change
Industrial Sector	GHG emissions are expected to increase in parallel with economic growth and industrial development.	Since as a country it is necessary to reduce GHG emissions under the Paris Agreement, etc., there is some potential of interference from industrial development, as the increase of GHG emissions

Sector	Environmental Issues that are Expected to Become More Serious	Impacts of Worsening Climate Change
	The high potential industries of UB city in the future are expected as following five sectors: (1) Mining support and mining related industry, (2) Tourism and tourism-related industry, (3) Cashmere industry, (4) Information and Communications Technology (ICT) industry and Business Process Outsourcing (BPO) industry, and (5) Agricultural food-processing industry. It is foreseen that GHG emission will increase in accordance with the development of these industrial activities.	based on industrial development may not be permitted. Fuel use and electricity use are also indispensable for business activities of the five future promising industrial activities of UB City. Fuel use and electricity use are also indispensable for business activities of the five future promising industrial activities of UB City. Therefore, if the increase in GHG emissions from these industrial activities becomes serious, the increase in the use of additional electricity and fuel may be restricted. As a result, it may be difficult to expand business activities.
Household Sector	It has been foreseen that GHG emissions from household sector will increase because it is supposed that people will demand the comfortable living and the electricity usage will be increased in accordance with improvement of living environment due to economic growth.	As a country, it is necessary to reduce GHG emissions under the Paris Agreement, etc. On the other hand, in order to improve the living standard and realize a more comfortable life, there are generally some trends such as decreasing solid fuel consumption and increasing electricity consumption. There are also some potential of increasing GHG emissions due to increasing electricity consumption. In addition, the energy shift from coal consumption to electricity consumption does not become contribution of GHG emission reductions, because the coal-fired thermal power plants are main power plants in Mongolia. As a result, there are some potential that the emission increases from household sector will become more serious. In this case, it may be necessary to limit the use of electricity to reduce GHG emissions from household sector, which may limit the improvement of the living standard of inhabitants.
Agriculture, Livestock, and Land Use Sector	GHG Emissions from AFOLU (Agriculture, forestry, and other land use) Sector in Mongolia account for many portion of total. It is expected that GHG emissions will continue to increase as the number of livestock increases, and land use will change continuously in the future.	As a country it is necessary to reduce GHG emissions under the Paris Agreement, etc. In order to reduce GHG emissions from agriculture, livestock and land use, it may be necessary to control strictly the number of livestock and land use. As a result, it may become difficult to expand socio-economic activities in this sector because it will not be possible to increase livestock freely and it will be difficult to modify land use for agriculture land development and urban land development.
Transportation Sector	Since the number of private cars is expected to increase due to economic growth, and the traffic volume of vehicles is expected to increase due to development of logistics, GHG emissions are also expected to increase.	As a country it is necessary to reduce GHG emissions under the Paris Agreement, etc. There is a possibility that gasoline and diesel consumption will continue to increase due to the increase in vehicle traffic volume. On the other hand, regarding the relationship between the electrification of automobiles and the effect of GHG emission reductions, if the electricity emission factor (index that estimated how much carbon dioxide is emitted to generate electricity) is approximately 1.0, there is a report

Sector	Environmental Issues that are Expected to Become More Serious	Impacts of Worsening Climate Change
		that the emission reduction effect of electrification of automobiles can hardly be expected (see Note). Since the coal-fired thermal power plants are main power plants in Mongolia, the electricity emission factor is very large as approximately 1.0 (ton-CO2/MWh) while the Japanese electricity emission factor is approximately 0.5 (ton-CO2/MWh). Therefore, it is difficult to expect for GHG emission reductions by shifting to the use of electric vehicles in Mongolia. As a result, in order to reduce GHG emissions from vehicles, reducing the total number of vehicles in the traffic may become the highest priority, which in turn may be a factor that will hinder the spread of vehicles in line with socio-economic development. Consequently, the socio-economic development may thus become sluggish.
Waste Sector	Due to increase in waste volume and increase in the volume of wastewater treated, it is expected that GHG emissions from the waste sector will continue to increase.	As a country it is necessary to reduce GHG emissions under the Paris Agreement, etc. There is an urgent need to reduce CH4 emissions from landfill site and wastewater treatment plants, and it may be necessary to introduce CH4 recovery facilities and waste incineration facilities.

Source: JICA Survey Team
Note: https://www.nies.go.jp/social/traffic/pdf/7-all.pdf (Last access: 15 March 2021)

CHAPTER 3. ANALYSIS OF UTILIZATION OF JAPANESE TECHNOLOGY

3.1 Survey of Technological Innovation Trends of Japanese Companies (Cold Region Technology)

Interviews were conducted with government agencies in Hokkaido to understand technological innovation trends of cold region technology possessed by Japanese companies, applicable technology in Ulaanbaatar (UB) City, and technical support such as intercity cooperation with UB City by the government agencies. The following is a summary of the major hearings and the minutes of each meeting are shown in the separated document.

3.1.1 Summary of Hearing Results

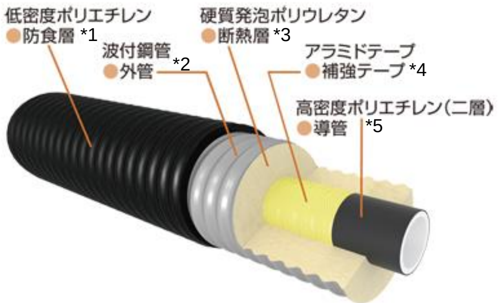
(1) Sapporo City Waterworks Bureau

The Sapporo City Waterworks Bureau cooperates with the Sapporo City Waterworks Service Association and the Hokkaido International Exchange and Cooperation Center (HIECC), and it has a track record of implementing the "Cooperation Project for Improving Water Supply and Distribution Function in Ulaanbaatar city, Mongolia" from January 2016 to December 2018, utilizing the JICA Grassroots Technical Cooperation Project "Special Frame for Regional Revitalization". Through this project, "Confirmation of operation management status of existing water transmission and distribution facilities", "Technical guidance for building an appropriate water supply and distribution system", and "guidance on the formulation of a model water supply and distribution function improvement plan" and "acceptance of trainees", are provided support for improving water supply technology in UB City and exchanged human resources.

In this interview, the water supply facilities and operational status of UB City were mentioned as below.

- The water supply business is under the jurisdiction of USUG, but the service from the main control to the building is under the jurisdiction of Ulaanbaatar Housing and Public Service Corporation (OSNAAG).
- Construction and repair work have been carried out with the assistance of various donors, and it is in a patchy state.
- The Geographic Information System (GIS) is used to grasp the position of pipes.
- The overburden thickness of the water pipe is about 3 m to prevent freezing, and the excavation width is widened by open cut.
- Construction of river crossing pipes is carried out in winter when the river freezes.
- The level of engineers on the Mongolian side is not low, and there are many excellent engineers who can respond on-site.

As a Japanese technology that can be applied in cold regions in the water supply field, in response to the problem that the water pipe burial depth is deep and the amount of earthwork during construction is large, a "heat insulation pipe" that makes it possible to bury the pipe at a shallower depth was mentioned (refer to **Figure 3.1** in the next page).



Source: MESCO, Inc., Home Page (https://www.mesco.co.jp/pipes/pipes_lineup/gngwa/)

Note: *1 Low Density Polyethylene (Anticorrosion Layer), *2 Corrugated Steel Pipe (Outer Tube), *3 Rigid Polyurethane Foam (Insulation Layer), *4 Aramid Tape (Reinforced Tape), *5 High Density Polyethylene [Bilayer] (Conduit)

Figure 3.1 Anti Freezing Water Pipe

(2) Hokkaido Mongolia Economic Exchange Promotion Study Group

The Hokkaido Mongolia Economic Exchange Promotion Study Group held the "Hokkaido-Mongolia Business Forum", etc. engaged in activities for economic exchange activities with Mongolia. The following interview results were obtained regarding Japanese technology and issues that contribute to the environmental problems of UB City.

- Improvement of traffic congestion (signal control, tightening of regulations, vehicle inspection system, parking lot installation, etc.) is effective for improving air pollution in UB City.
- Japanese technology is advancing regarding geothermal heat utilization technology, which is one of the cold region technologies, but in UB City, rock mass appears at a shallow depth of about 2 to 3 m, so the installation cost is high.
- When trading natural resources such as coal between Mongolia and Japan, the business risk is high because the transportation goes through multiple countries.
- There is a company in Hokkaido that has cold region technology, but it is thought that there are few companies that can lead businesses on the scale of billions to tens of billions of yen that are covered by yen loans.
- Aizawa High Pressure Concrete Co., Ltd. has cold region technology that enables concrete placement even in the winter environment of Mongolia.
- At each election, the director level of the administrative agency may be changed, and the continuity of business and policies may be weak.

In many cases, Chinese companies carry out the core part of the operation business of local infrastructure facilities, and the Mongolian side is a black box for the technology. Mongolians are highly motivated to acquire skills, but there are situations where they cannot get the opportunity, when proposing a yen loan project to the partner country, it is desirable to appeal to the Mongolian side as a proposal that includes the training of engineers.

(3) Asahikawa City Waterworks Bureau

Asahikawa City has implemented the "Urban Development Implementation Capacity Improvement Project", "Urban Development Technology Improvement Project in Cold Regions (Regional Proposal Type)" and the grassroots technical cooperation "Road Construction Quality Assurance Capacity Improvement Project in Cold Regions". It conducted interviews on cold technology through experience in operating a sewage treatment project in the cold region of Asahikawa City and a technical support project for Mongolia. The interview results are as shown below.

- As the operation management of the sewage sludge digestion tank, the temperature is manually controlled to keep the temperature inside the tank constant, which is a know-how during operation.
- Sewage sludge is incinerated after being dehydrated. Incineration ash should be landfilled by sprinkling with poly iron to suppress the elution of heavy metals or processed at a cement factory.
- The human waste in the ger district of UB City is directly put into the sewage manhole after being pumped, and since the environment is such that the dilution effect by rainwater is small, the load on the sewage treatment plant is very heavy. It is thought that a pre-treatment facility for human waste is needed.
- Wastewater treatment from the Harigae Industrial Park is quite difficult to construct because the quality of the inflow water from the factory is unstable.

(4) Sapporo City Environment Bureau

The Sapporo City Environment Bureau was able to obtain useful knowledge about the environmental infrastructure cases implemented by Sapporo City and the cold region technology possessed by Japanese companies. The interview results are as shown below.

- Sapporo City has formulated the "City Center Energy Master Plan 2018-2050" and action plans that set the policy for energy use toward 2050 and is promoting the introduction of district heating systems. Currently, the central heating service in Sapporo City supplies three types of hot water, hot water, and cold water to a wide area of 100ha in the city.
- As a Japanese cold region technology applicable in Mongolia, improvement of heat insulation of buildings can be considered. Currently, housing in Sapporo has a level of heat insulation that exceeds national standards. Sapporo City has adopted a subsidy system for dissemination.
- At administrative facilities, the fire department, which operates 24 hours a day, uses a central heat pump that uses geothermal heat.

(5) Japan External Trade Organization (JETRO) Hokkaido Trade Information Center

The Japan External Trade Organization (hereinafter referred to as “JETRO”) is a foundation established as an institution to comprehensively and efficiently carry out projects related to the promotion of Japanese trade. It conducted the following interviews on Japanese cold region technology that could be used in Mongolia.

- Resin fuel boiler technology for waste plastic treatment and heat source supply
- Insulation technology (insulation cover for pipes, external insulation for buildings)
- Boiler technology using engine oil and waste oil as raw materials
- Bio-toilet that treats microorganisms without using water
- Eco-house technology using geothermal heat

In exchanges with companies wishing to expand overseas as JETRO, it was said that expansion into Mongolia tends to be avoided due to logistics problems and the small market size.

3.1.2 Summary of Survey on Technological Innovation Trends (Cold Region Technology) of Japanese Companies

To understand the technological innovation trends of Japanese companies, especially cold region technology, government agencies in Hokkaido and organizations that have information on local companies such as JETRO were visited.

The administrative organs of Hokkaido have deep exchanges with Mongolia, and technical exchanges have been carried out through grassroots technical cooperation. For this reason, the actual situation and technical level of UB City are known. In addition, it was confirmed that the operation know-how of sewage treatment plants in cold regions has accumulated. As a notable cold region technology, in the urban energy MP project implemented by Sapporo City, the construction of a district heating system for the entire area of Sapporo City is considered to be useful knowledge for the modernization of the district heating system of UB City.

Regarding the technology of private companies in Hokkaido, the technology of heat insulation of buildings was seen, but the scale that can lead the yen loan business could not be confirmed. In addition, as an overseas market, Mongolia has a small market size and high transportation risk and political risk, the survey team could not confirm the major companies that are currently planning to aggressively enter the market.

Based on the above results, it is necessary to expand the scope of Japanese technology utilization in addition to cold region technology when considering the project of a yen-loan fund project related to environmental infrastructure. In addition, since the government agencies in Hokkaido have abundant experience in technical exchange with Mongolia, it is desirable to participate in maintenance technology incidental to the environmental infrastructure construction project and support projects for improving institutional development.

3.2 Air Pollution Control

3.2.1 Introduction of Improved Coal-fired Hot Water Supply Boiler

In Japan, most of the manufacturers produce large-scale coal-fired steam boilers, and just a few companies produce medium-scale coal-fired hot water boilers. Most of the hot water supply boilers applicable to Mongolia are manufactured by Chinese manufacturers. As for the Japanese companies, there are issues in regard to the price and technical competitiveness with China.

3.2.2 Central Heating using Renewable Energy, Incineration Equipment, etc.

Renewable energy that can be applied in Mongolia includes solar power and geothermal heat pumps.

3.2.3 Improvement of Heat Source by Introducing Coal Alternative Fuel Manufacturing Plant

(1) Coal Gasification and Liquefaction

In Japan, there are private companies with coal gasification technology such as MHI and IHI, but the question is whether they are willing to develop a market in Mongolia, and whether they are competitive with China. Japanese companies participated in the CCT seminar in UB City organized by the METI in 2016, but they were reluctant to discuss the coal gasification business due to the scale of marketability.

(2) Energy-Saving Heating Equipment by Electrification

The use of hybrid heat pump technology for power saving is in its demonstration stage, and the results will determine the evaluation of the heat pump introduction. At this stage, capital investment is still large, and the feasibility is low.

(3) Gas Utilization Technology including LPG and Safety Measure Technology

Based on the CNG introduction plan in the investment program of the 2021-2025 Basic Development Plan of Mongolia and the FS of 100 MW gas power generation using imported LNG at the No. 2 power plant, there is a great possibility that LNG will become an alternative fuel to coal if the cost of imported LNG has the price between the existing improved fuel and LPG. The first step would be to supply CNG to power plants and vehicles, and then to households, especially apartment buildings and other collective living quarters. It is also unclear at this point, whether Mongolia will use some of the CNG sent from Russia to China via Mongolia, but CNG liquefaction and storage technologies will also be necessary.

Since Japan uses a large amount of imported LNG, the use of Japanese technology is expected to include infrastructure technology from LNG and CNG storage to safety measures.

3.2.4 Construction of Improved Fuel Manufacturing Plant

Since a plant, with the capacity to produce enough fuel to meet the demand, is scheduled to be completed in November 2020, there will be no demand for a new production plant using Japanese technology. On the other hand, the results of the JICA's Technical Cooperation Capacity Development Project for Air Pollution Control in Ulaanbaatar City (Phase 3) that is currently underway, are expected to be utilized in the future development of the project.

As a project to further disseminate improved fuels for reducing air pollution in Mongolia, additional facilities are being considered for the production of improved fuels to reduce production costs and environmental impacts by utilizing Japanese technologies. In Phase 3, pilot projects for improved fuels will be conducted during the winter seasons 2021-2021 and 2021-2022.

By mixing biomass and desulfurizer with the existing fuels, several improved fuels that simultaneously reduce PM and SO_2 will be tested. Combustion tests will be conducted in the combustion laboratory of DAAP on several types of improved fuel prototypes, and the most effective improved fuel will be selected. The existing fuel and the improved fuel will be used in the pilot area during the severe winter season under the fuel conditions of ordinary households, and the air quality will be measured to evaluate the effect of both fuels on the air pollution control.

Source: Furukawa Industrial Machinery Systems Co., Ltd.

Figure 3.2 High Pressure Modeling Machine

Based on the results of the evaluation, the improved fuel with the highest cost effectiveness will be selected, and a detailed plan for full-scale operations related to the improved fuel will be formulated jointly with the Mongolian side. A typical high pressure modeling machine manifactured by a Japanese firm is presented in **Figure 3.2**. This machine makes addition rate of binders lowere when modeling and produces high quality modeling.

3.2.5 Improvement of Intersections and Road Networks for the Purpose of Eliminating Traffic Congestion

There are several restrictions to be considered during the design and construction of a railway flyover bridge in a congested urban area which may require advanced technology. Following items describe issues on grade separation and the construction of bridge in Ulaanbaatar City and the applicable technologies that may be adopted for each issue.

(1) Adjacent Construction near Railway Track within a Limited Space (Rotary Penetration Steel Pipe Pile Method)

The expected railway flyover bridge has a road alignment which strides over the railway premises where the railway main and feeder lines are closely laid. The railway is hundreds of meters in length, so that multiple piers need to be placed within the railway premises. However, limited space is available for the construction of piers.

Application of the rotary penetration steel pipe pile method will be effective in such a case. The method enables downsizing of the structure for construction in a narrow space. Due to the spiral steel plates attached to the edge of piles, each pile can be penetrated into the ground while the steel pile is rotated (see **Figure 3.3** and **Figure 3.4** below), so that the pile can be put in place even if the ground is very hard and/or contain large size boulders. Typical advantages are as described below.

Figure 3.3 Construction of Rotary Penetration Steel Pipe Pile

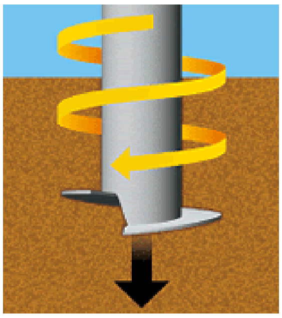


Figure 3.4 Image of Rotary Penetration

a. Large Bearing Capacity and Small Footing

Due to the effect of the steel plate's widening of the bottom end of the pile, approximately 1.5 times or more bearing capacity is obtained compared to the ordinary cast-in-place pile. Therefore, the number of piles can be reduced, and the footing size can be downsized (see **Figure 3.5**). This makes it possible to place piers on the railway site.

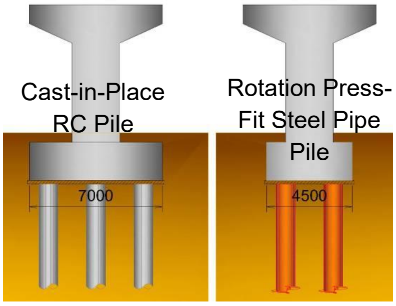


Figure 3.5 Comparison of Footing Size per Pile Type

b. Construction Adjacent to Railway Track

The construction work will be conducted within the railway premises and hindering train operations should be avoided. With this method, the rotating pile presses into and penetrates the ground, which can keep less vibration with a small risk of problems such as displacement of train tracks. Although a crane is used when suspending and installing steel pipes at the place, the Full-Perimeter Rotary Drill Machine penetrates the steel pipes into the ground, so there is less risk on disturbing the railway operation by the crane's rotating movement. Less risk of loosening the surrounding ground which may cause railway displacement also is expected since no excavation work is required. This method is appropriate for constructions adjacent to the railway track.

c. Compliance with Environmental Standards

Since the piles can be constructed without excavation of the ground, by this method, hauling of excavated soil after drilling is not required, which reduces adverse effects on the environment, drastically reduce the entry and exit of dump trucks, and thus improve traffic safety. Construction can be conducted within a limited space by using a small drilling machine. In addition, piling work near the resource of drinking water/industrial water requires measures to prevent contamination of groundwater. Since this method does not require concrete or bentonite, it is possible to minimize the effects of groundwater pollution.

(2) Construction Above Rail Tracks and the Existing Roads (Steel-Concrete Composite Deck Slab)

Ordinary concrete slab requires form work, construction of work platforms and supports for the concreting work. It requires extra vertical construction space in addition to the construction gauge above railway track or roadway. It is also difficult to control the construction safety without hindering the existing traffic (trains and cars) because the space under the girders shall be occupied during construction work. The steel-concrete composite deck slab is applicable to solve those issues (see **Figure 3.6**).

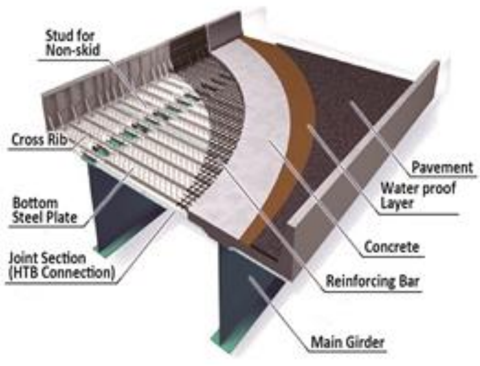


Image of Composite Deck Slab

Construction of Composite Deck Slab

Figure 3.6 Synthetic Plate

a. Improvement of Workability and Quality

Bottom steel plate of the composite slab will serve as form of the concreting work, so that no form is required for the construction work. Concreting can be done without support from the bottom since the steel plate is reinforced by longitudinal ribs, and it is strong enough to sustain the load of concrete works without any support. There is no risk to influence the existing traffic under the girders during construction.

b. Widening Span of Deck Slab

Bottom metal slabs of synthetic plates are functioning as structural members sharing cross sectional force after hardening concrete. Consequently, metal members sharing tensile strength and concrete sharing compression strength are combined effectively to synthetic structure, and it results in high rigidity and making span of plates longer. Since the span of synthetic plates is longer than that of reinforced concrete plates, it contributes to reduce the number of spans, the construction cost and the maintenance cost (see **Figure 3.7**).

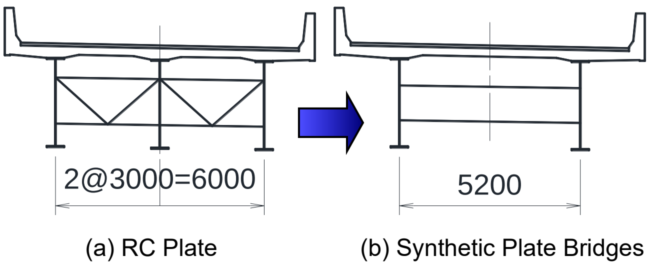


Figure 3.7 Difference of Girder Alignment per Slab Type

c. High Durability

The composite structure of steel plates and concrete has high rigidity and durability which may minimize the maintenance work, and its lifecycle cost. Besides, there is no chance of concrete fall down to the bottom which may affect the railway and/or roadway traffic safety. (see **Figure 3.8**).

(a) Underside of Damaged Concrete Slab (b) Underside of Composite Plate

Figure 3.8 Bottom of Slab

(3) Erection Method above Railway Track (Launching Method)

Erection of a bridge on the railway shall be performed in a manner that will not hinder train operation. General construction method is to install a bent (a column temporarily supports the girders), place a girder on the bent, and connect each girder. However, no space for installing the bent or placing a crane can be used over the railway, so the launching method which assembles the girders in advance next to the railway and slides them over the railway is to be effectively used.

The launching method itself has been generally used for locations where bents cannot be installed, such as railway or congested road. However, the girder stress inverts against ordinary time, and three-dimensional control is required for curved bridge during the girder launching, which will require advanced construction technology and experience.

3.2.6 Introduction of Diesel Particulate Filter (DPF) for Public Buses

The “Feasibility Survey for Reduction of Black Smoke from Diesel Buses with DPF in Ulaanbaatar” was conducted from November 2017 to September 2019. Twenty-four (24) public buses were equipped with DPF and the demonstration test was conducted. As a result, it was concluded that PM emission from public buses with DPFs would decrease by more than 93.7%. If additional DPFs are installed on all heavy-duty buses, the PM10 emissions from vehicles will decrease by more than 44%.

As for the cost of procuring new vehicles per vehicle, an electric bus from China is procured at a cost of approximately 270,000 USD. Although the air pollution reduction effect of procuring electric buses is significant, the procurement cost of electric buses is high compared with the DPF unit price of 1.25 million yen. New diesel buses are not imported but used Euro 3 buses are procured from China and other countries for 50,000 USD to 70,000 USD. Since Mongolia is unable to secure diesel oil that meets Euro 4 fuel regulations, used buses of Euro 3 or lower are procured. The difference in emission regulations between Euro 4 and Euro 3 is quite large. Therefore, it is necessary to install DPFs on newly purchased used buses, and the effect of air pollution control through replacement of buses is not expected to be significant.

3.2.7 Analysis of Japanese Technology Utilization in Air Pollution Control

Table 3.1 summarizes the results of the analysis on the use of Japanese technologies in Mongolia for air pollution control.

In the case of improved coal-fired steam boilers, there is no advantage of the technology of Japanese companies, and it is necessary to avoid the use of such boilers because the cost will be very high if they are produced on order. As for the improvement of heat source by introducing coal substitution fuel production plant, the infrastructure technology using Japanese technology can be utilized from LNG/CNG storage to safety measures. As for central heating using renewable energy, Japanese companies have advanced technology, but there is no suitable location for new renewable energy around UB City. In addition, since the calorific value of the incineration plant is not so high, the cost of power generation and hot water supply is high, and the business potential is low.

The construction of a plant for the production of improved fuel, and the intersection improvement project for the purpose of reducing traffic congestion should be promoted since there are Japanese technologies that can be introduced, and the business feasibility and environmental improvement effects of the project implementation are high. As for the introduction of Diesel Particulate Filters (hereinafter referred to as "DPF") to public buses, the frequency of use of DPF in Mongolia, which was introduced earlier in the DPF diffusion demonstration study, is low, and the business feasibility of procuring additional DPF is considered low.

Table 3.1 Analysis on Application of Japanese Technology for Air Pollution Control

Technology	Application of Japanese Technology
Improved coal-fired steam boiler	Japan has the technology to manufacture very large boilers, but Japan does not manufacture boilers of the scale envisioned for UB City. Therefore, it would be extremely costly to manufacture boilers for Mongolia, and there is a very high possibility that the boilers will be procured from other countries. In addition, there is a restriction policy on the use of coal in Mongolia, so the business potential of the project has been judged as low.
Central heating using renewable energy	Although Japanese companies have advanced technologies, they do not have the capacity to generate electricity and supply hot water from renewable energy sources in the vicinity of UB City, and the incineration facilities do not have sufficient heat to provide central heating. In addition, the cost of renewable energy is high, and the demand for renewable energy is not big in the Mongolian market, so Japanese companies do not see a high priority in implementing projects in Mongolia.
Improvement of heat source by installing coal substitute fuel production plants	There is a great possibility that LNG will be the alternative fuel to coal in Mongolia in the near future. Since Japan uses a large amount of imported LNG, the use of Japanese technology is expected to include infrastructure technology from LNG and CNG storage to safety measures.
Construction of plants for the production of improved fuels	As for the improved fuel production plant, Japanese companies have a great deal of knowledge in the production of high-pressure molding machines, binders, and biomass briquettes, and can provide facilities with high safety. On the other hand, it is necessary to avoid competition with third countries on the introduction of the plant in UB City, as the construction cost of the plant would be too high for the Japanese suppliers.
Improvement of Intersections and Road Networks for the Mitigation of Traffic Congestion	By application of prefabricated members (Steel Girder, Rotary Penetration Steel Pipe Pile) manufactured in workshop, the construction period can be minimized due to effective usage of the midwinter period, and the construction quality can be ensured in constant under strict meteorological condition. It is also possible to develop the Quality Infrastructure that has high durability and minimum maintenance costs. In addition, the technology that enables the bridge construction without disturbing a railway operation such as Launching Method and Rotary Penetration Steel Pipe Pile will be one of the most essential technology for the railway flyover in UBC. As an important

Technology	Application of Japanese Technology
	issue to be addressed, expensive initial costs due to transportation from Japan should be well explained through the concept of life cycle cost to facilitate the understanding of the Government of Mongolia to promote the project.
Introduction of DPF (Diesel Particulate Filters) for public buses	There are two types of DPF in Japan: catalytic and non-catalytic. Non-catalytic DPF, which do not deteriorate even when used with high sulfur fuels, are suitable to be introduced on public buses in Mongolia. Only Japan has the technology to manufacture non-catalytic DPF, and the introduction of DPF is expected to be highly effective in reducing PM. However, 24 DPFs introduced in JICA's Feasibility Survey with the Private Sector for the purpose of Utilizing Japanese Technologies in ODA Projects have not yet been used by bus companies, and it is not expected that the number of DPFs installed in public buses will increase further.

3.3 Water Pollution Control

3.3.1 Sewer Pipe Construction Technology

In Japan, when it is difficult to lay sewer pipes using the open-cut method due to heavy road traffic in urban areas and congestion of underground infrastructure, the jacking method is used to construct sewer pipes. In recent years, there has been an increasing number of pipe jacking works under severe construction conditions, such as construction at great depths, long distance construction, and construction in sharp curves. Furthermore, when pipe jacking work is carried out in residential and commercial areas, small shafts are adopted to shorten the construction period, reduce the area occupied above ground, and improve the workability below the groundwater level.

Although pipe jacking method has never been used in Ulaanbaatar (UB) City, there are potential needs for it because of the large amount of road traffic and traffic congestion, and because it is required to construct below the freezing depth (3.6 to 3.8 m).

The Japanese pipe jacking method has been steadily increasing its achievements overseas. Iseki Polytech Inc. was selected in 2013 as the first project of JICA's Private Sector Proposal-based Dissemination and Demonstration Project for the dissemination and demonstration of pipe jacking method in sewer pipeline construction and carried out pipe jacking work in Indonesia. In addition, Kidoh Construction Co., Ltd, Yasuda Engineering, and Iseki Polytech Inc. formed a three-company JV to carry out large-diameter (3500 mm pipe diameter, 2.6 km length) pipe jacking work for a flood control project in Indonesia.

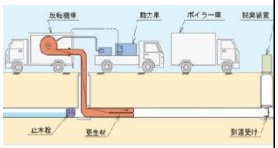
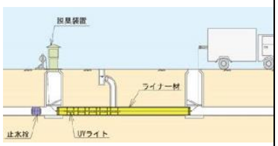
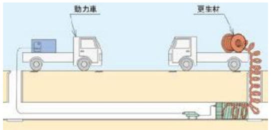
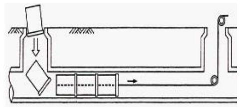
In June 2014, the Global Center for Sewerage Systems (GCUS) established a subcommittee dedicated to the deployment of Japanese technology overseas. The subcommittee conducted technical training in Japan, mainly targeting Vietnam, and worked with the Japanese public and private sectors to formulate technical standards for Vietnam. The Vietnamese version of the pipe jacking method standard was formulated in collaboration between the Ministry of Land, Infrastructure, Transport and Tourism of Japan and the Ministry of Construction of Vietnam. Since then, Japanese pipe jacking companies have been awarded contracts for sewerage projects in Ho Chi Minh City and other cities in Vietnam.

USUG has experience in the construction of sewer pipes but has no experience in pipe jacking method. Therefore, design, construction planning, construction guidance, and the provision of related materials and equipment are issues for the spread of Japanese technology in Mongolia.

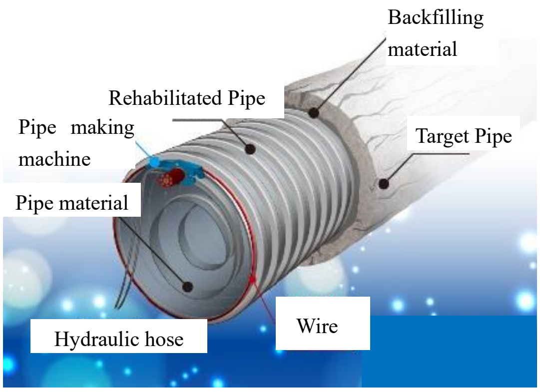
3.3.2 Pipe Rehabilitation Technology

The pipe rehabilitation method is a non-open-cut method for the reconstruction of pipes. In UB City, the pipe rehabilitation method has been adopted for the reconstruction of water supply pipelines. USUG plans to use the rehabilitation method in the future to reconstruct sewer pipes laid along busy roads. As shown in **Table 3.2**, there are four types of pipe rehabilitation methods: pipe inversion method, pipe forming method, pipe making method, and sheath pipe method.

Table 3.2 Pipe Rehabilitation Methods

	Pipe Inversion Method	Pipe Forming Method	Pipe Making Method	Sheath Pipe Method
Schematic				
Descriptions	Material impregnated with resin that hardens with heat or light is inserted through the manhole into sewer under inverted pressure (water pressure, air pressure, etc.) and hardened by hot water, steam, or light.	Material impregnated with resin that hardens with heat or light is pulled into sewer from the manhole, expanded and crimped by water pressure, steam, and hardened by temperature or light.	The pipe is made by interlocking materials made of hard polyvinyl chloride inside sewer and filling the gap with mortar. Construction can be done while sewage is flowing.	Pipe manufactured with an outside diameter smaller than the inside diameter of the existing pipe is laid inside the existing pipe by jacking or hauling and assembling, and filling material is injected into the gaps. Available only for medium and large diameter pipes.

Source: JICA Survey Team

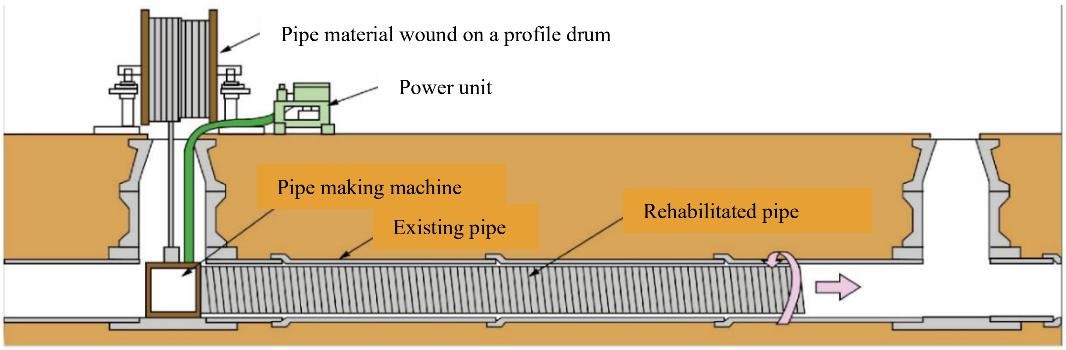


Source: https://www.eslontimes.com/system/items-

Figure 3.9 Schematic of SPR Method

In general, when carrying out rehabilitation works, it is necessary to take measures to temporarily stop the sewage so that it does not enter the rehabilitation work zone. However, the SPR method (Sekisui Chemical Co., Ltd., Adachi Construction & Industry, etc., **Figure 3.9**), which is a Japanese technology, can be used without stopping sewage up to a certain water level limit.

The SPR method is classified as a pipe-making method among pipe rehabilitation methods. In the pipe-making method, the pipe material is made into a pipe inside the existing pipe, and the gap between new pipe and existing pipe is filled with a backfill material such as mortar. As shown in **Figure 3.10**, the main materials and equipment include pipe making machines, pipe rehabilitation materials wound on a profile drum, and power units. In the case of construction in Mongolia, pipe making machines and pipe materials are manufactured in Japan and transported to Mongolia.



Source: https://www.eslontimes.com/system/items-view/71/

Figure 3.10 SPR Method (Pipe Making Method, Base-Push Type)

The SPR method has been widely used in the United States, Germany, Singapore, Taiwan, China, etc. In 2013, the SPR method was selected as JICA's SDGs Business Verification Survey with the Private Sector in Ho Chi Minh City, Vietnam. In this project, pipe rehabilitation with a diameter of 1300 mm was carried out, and a seminar was held to promote the SPR method. As a result of the project, it has been decided that approximately 2.7 km of sewage pipes will be rehabilitated using the SPR method in Ho Chi Minh City in May 2019 (grant aid). The main advantages of the SPR method are as follows.

- Extensive experience in construction in Japan, and high reliability of construction method
- The construction period can be shortened because it can be done while sewage is still flowing.
- The minimum required width of construction site is 2.5m, so the impact on traffic is smaller.
- This method has an extensive track record of construction overseas, mainly in Europe and the United States.

The main conditions for applying the SPR method are as follows. However, if the existing pipe has serious sagging in the vertical direction, the rehabilitation method cannot be applied, and the pipe must be reconstructed by the replacement method.

Shape:	Circular pipe
Pipe diameter range:	250 mm to 5000 mm
Water level limit: during construction:	About 30% of the pipe diameter and less than 60 cm
Flow velocity during construction:	Below 1.0 m/s
Remarks:	It can be used for curved construction and long-distance construction

Based on the above, it is thought that a project for the reconstruction of sewers using the SPR method is also promising in Mongolia as loan aid. As mentioned above, USUG has adopted the pipe rehabilitation method for the reconstruction of water supply pipes, so there is no problem with the implementation capacity of USUG, but there are issues to be addressed, such as the provision of construction guidance and associated materials and equipment. Depending on the condition of the aged pipes, other rehabilitation methods or open-cut methods may be adopted.

Toa Grout Industry Co., Ltd. was selected by JICA in 2019 to conduct "a feasibility study on a project to simultaneously rehabilitate non-cut sewer pipes by the light curing method, and effectively utilize sewage heat using the light curing method". However, this feasibility study was not carried out in 2020.

3.3.3 Wastewater Treatment Technology

In areas where sewerage systems are not yet developed, which are far from urban areas, or in areas where sewerage system development is delayed, the adoption of small-scale treatment technology can reduce construction costs and speed up sewerage system development. The Prefabricated Oxidation Ditch Method (hereinafter referred to as "POD"), which is suitable for small-scale sewage treatment plants, has been adopted by many in Japan. POD has the following features:

- It is a package system, which can be designed in a short time
- Prefabricated components are manufactured at the factory, which shortens the construction period and improves quality

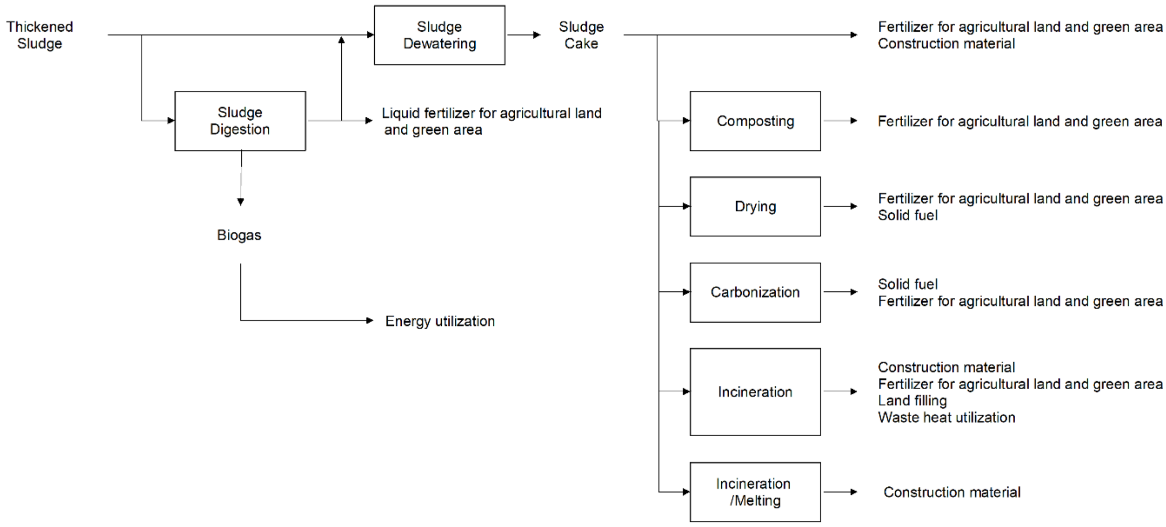
It is easy to maintain and economical. Therefore, in the case of UB City, it could be adopted in newly developed suburban areas and satellite cities.

In addition, in recent years, factory-made-type very small-scale water treatment facilities have been adopted in Japan. As with the POD described above, it can be manufactured in a factory, which can reduce costs and shorten the construction period. Furthermore, even if the facilities are no longer needed due to a decrease in population, they are flexible enough to be diverted to other areas and may be used for rapid sewerage improvement measures in ger area.

3.3.4 Sludge Treatment Technology

Sewage sludge that has just been thickened cannot be used effectively, but by dewatering it, it can be used for green farmland and as building materials. **Figure 3.11** shows how sewage sludge is used in Japan. One of the possible ways to effectively use sludge in UB City is to use green farmland, but if the sludge contains heavy metals, so that it will be difficult to use it effectively.

In addition, sludge digestion enables the use of energy (heating of digestion tanks or digestion gas power generation), and in Japan there are many examples of sludge digestion even in cold regions such as Hokkaido. In UB City, sludge digestion and biogas power generation are planned for the new Central Wastewater Treatment Plant, which is currently under construction with Chinese assistance.



Source: Sewage Sludge Utilization Manual, Ministry of Land, Infrastructure, Transport and Tourism of Japan

Figure 3.11 Sewage Sludge Utilizations

3.3.5 Monitoring Technology for Industrial Wastewater

While continuous monitoring of industrial wastewater at target factories can immediately detect wastewater violations, equipment, system, and maintenance costs are expensive. The Survey Team interviewed the Bureau of Sewerage of the Tokyo Metropolitan Government and the Department of Sewerage of Yokohama City regarding the monitoring of industrial wastewater. Tokyo Metropolitan Government is currently conducting continuous monitoring of cyanide and pH only. On the other hand, Yokohama City had implemented continuous monitoring in the past, but is not currently doing so after verifying its cost-effectiveness when to replace the measurement equipment.

Based on the results of the interviews, this section describes the monitoring technologies used by the Bureau of Sewerage of Tokyo Metropolitan Government for industrial wastewater.

Continuous Monitoring of Cyanide and pH

Cyanide is mainly found in the wastewater of plating factories. Cyanide easily gasifies and is highly toxic, making works in sewers dangerous and reducing the biological treatment capabilities of sewage treatment plants. Low pH (acidic) wastewater can corrode the concrete of sewerage facilities and produce toxic gases when mixed with another wastewater.

Regarding cyanide, the Bureau has been conducting continuous automatic monitoring at the inflow points of the Oku Pumping Station and the Mikawashima Water Reclamation Center, where plating factory wastewater flows in.

Regarding pH, since the wastewater from clinics where dialysis is performed is acidic, 20 clinics were selected, and pH meters were installed in their wastewater pit (public side) and automatically monitored for about a week. Later, the pH meter was collected, and the measurement data was analyzed to see if there was any violation.

Wide Area Monitoring and Individual Monitoring

The Bureau of Sewerage of the Tokyo Metropolitan Government conducts wide area monitoring and individual monitoring for industrial wastewater.

(1) Wide-Area Monitoring

- Since it is difficult to sample at wastewater pit (public side) of all factories, wide-area monitoring is conducted at about 500 sewage manholes in Tokyo metropolitan area. Sampling at these manholes makes it possible to monitor (narrow down) wastewater violations from factories located in the upstream area.
- In wide-area monitoring, monitoring points are set by sewage catchment area, and water quality is measured at 500 points per year (50 times × 10 points/time) by simple on-site measurement and sampling and manual analysis, or by installing automatic sampling equipment and collecting the samples later for analysis. The Tokyo Metropolitan Government outsources these operations to contractors. The results of the analysis are sent to the Tokyo Metropolitan Government from the contractor

(2) Individual Monitoring

Individual monitoring is conducted by the sewerage regional offices of the Tokyo Metropolitan Sewerage Bureau targeting all factories.

Sewerage regional office staffs visit all factories to test water quality in the wastewater pit (public side), and to check the water quality measurement results recorded by the factory's water quality control manager. The water quality parameters to be measured are as shown in **Table 3.3**.

Table 3.3 Water Parameters to be Measured and Measurement Frequency by the Bureau of Sewerage of the Tokyo Metropolitan Government

Water Quality Parameter	Measurement Frequency
pH, Temperature	More than once a day
BOD	More than once every 14 days
Dioxins	More than once a year
Other Parameters	More than once every 7 days

Source: The Survey Team

3.3.6 Industrial Wastewater Treatment Technology

(1) Industrial Wastewater Treatment Technology

In general, treatment methods for industrial wastewater have been established for each target substance. The main treatment methods are listed below.

- Acidic or alkaline wastewater: Neutralization method
- BOD, nitrogen, phosphorus: Biological treatment such as activated sludge method
- Heavy metals such as chromium: Coagulation-sedimentation method

Factories in UB City are required to install pre-treatment facilities to improve factory wastewater before discharge into sewer, and it is considered possible to introduce Japanese wastewater treatment technology. Japanese companies of wastewater treatment facility have a track record of delivering the facilities in countries such as China, Taiwan, the Philippines, Thailand, and Vietnam in Asia, and Saudi Arabia, Russia, the United States, Brazil, and other countries outside of Asia.

(2) Vegetable Tannin Tanning

In Mongolia, chrome tanning is the mainstream leather processing method, but the global trend is to focus on the environment, and vegetable tannin tanning is being adopted to improve the treatment of tannery wastewater. In some cases, chromium-saving tanning, which uses one-third the amount of chrome than regular chrome tanning, is used.

(3) Russetey Turning Technology

One technique that overcomes the weaknesses of conventional chrome tanning and vegetable tannin tanning is the Russetey Tanning Technique. Yamaguchi Sangyou Co., Ltd., the developer of the Russetey Tanning Technique, is currently implementing JICA's SDGs Business Supporting Survey (feasibility study) for technology transfer and horizontal deployment of the technique in Mongolia. The basic study in 2019 included technical guidance to two Mongolian pilot companies. This technique is a processing technology that produces high-specification materials that comply with domestic and international environmental standards, with emphasis on environmental impact and safety of the processing technicians (craftsmen). If this technique is adopted in leather factories, it will lead to the improvement of factory wastewater and enable the reuse of effluent in the hair removal process.

The person in charge of the Mongolian Federation of Leather Processing Industries, who was interviewed for this survey, wants to reduce the amount of chromium used and use environmentally friendly technology as much as possible, so there is a possibility that more companies will use the technique, which is currently undergoing technology transfer. As a part of the technology transfer, JICA has adopted the "Project Study on Leather Branding Business Using Russetey Tanning Technique [Framework for Innovation from Developing Countries]" in FY2019.

3.3.7 Rainwater Drainage Technology

Measures based on rainwater drainage hardware can be divided into two categories: (1) measures to eliminate rainwater quickly by rainwater sewers and rainwater pumping stations, and (2) measures to control rainwater runoff by reducing or slowing down rainwater runoff through storage and infiltration. In UB City, flooding has been occurring on roads without rainwater drainage facilities such as rainwater sewers and drainage gutters, so some measures are needed in the future. The introduction of the following rainwater drainage control technologies of Japan is expected to reduce the damage caused by flooding.

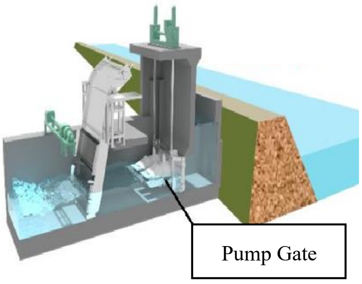
(1) Pump Gate

A pump gate is a facility that forcibly drains rainwater into a river by installing a pump facility integrated with a gate in the rainwater drainage channel. Pump gates do not require a large site and can be constructed in a short period of time and at low cost, thus contributing to the early reduction of damage from inland flooding. Ishigaki Co., Ltd. has been selected by the Ministry of Land, Infrastructure, Transport and Tourism of Japan (MLIT) as one of the demonstration projects for Japanese sewerage technology (WOW TO JAPAN Project) in 2020. The project is scheduled to be implemented in Vietnam in the future.

(2) Rainwater Retention Facility

A rainwater retention facility is a facility that temporarily stores rainwater underground to lower the peak drainage volume during heavy rains hit urban areas. The main types of rainwater retention facilities are cast-in-place, precast concrete products, and plastic products.

Of these, many Japanese plastic rainwater retention facilities have been installed in India, Indonesia, Vietnam, and Taiwan. This plastic product is characterized by the fact that it can be installed mainly by hand, which reduces construction costs and shortens the construction period. In Japan, there is a track record of plastic rainwater storage facilities from Hokkaido to Okinawa, and in cold regions, they are installed at a level deeper than the freezing depth. However, there is no track record of installation in areas that can be identified as dry regions in Japan. **Figure 3.12** shows the pump gate and rainwater retention facility.



Source: Ishigaki Co., Ltd.

Pump Gate

Source: Sekisui Techno Molding Co., Ltd.

Rainwater Retention Facility

Figure 3.12 Pump Gate and Rainwater Retention Facility

The installation of pump gates and plastic rainwater retention facilities mentioned above can be considered as a loan project for rainwater drainage measures. Geodesy Hydraulic Facility Agency (GUBBG) is considering its own rainwater drainage measures, and international donors are also providing support for rainwater drainage projects. If Japan is to introduce these Japanese technologies to Mongolia, it will be necessary to provide guidance on design, construction planning, construction guidance, and related materials and equipment, as well as guidance on how to maintain and manage the facilities, since Ulaanbaatar has no experience in this area.

3.3.8 Analysis of Japanese Technology Utilization in Water Pollution Control

Table 3.4 summarizes the results of the analysis on the use of Japanese technologies for water pollution control in Mongolia.

Regarding sewer pipe construction technology, there is a lot of traffic congestion on the roads in UB City, so the pipe jacking method should be used. Regarding sewer pipe rehabilitation technology, the SPR method, which allows construction without stopping the sewage up to a certain water level, may be utilized. The monitoring technology adopted by the Tokyo Metropolitan Government can be used as a monitoring technology for wastewater of factories. For the improvement of factory effluent in leather factories, the Japanese technology "Lacette Tanning Technique", which is currently under technology transfer, is effective. Pump gates and plastic rainwater retention facilities may be used as rainwater drainage technologies.

Table 3.4 Analysis on Application of Japanese Technology for Water Pollution Control

Technology	Application of Japanese Technology
Pipe Construction	There have been no cases where pipe jacking method has been adopted in sewerage of UB City. However, there is a potential need for pipe jacking method due to the high volume of

Technology	Application of Japanese Technology
	traffic and congestion on the roads, and the fact that construction below the freezing depth is required. USUG has experience in the construction of sewers, but has no experience in pipe jacking method, so it will be a challenge for the Japanese side to provide design, construction plans, construction guidance, and related materials and equipment.
Pipe Rehabilitation	USUG is planning to use the rehabilitation method to rehabilitate sewer pipes installed in roads with heavy traffic, and the Japanese SPR method can be used for this purpose. USUG has adopted the rehabilitation method for the reconstruction of water supply pipelines, so there is no problem with its implementation capacity. However, guidance on construction and the provision of materials and equipment to go along with it are issues that need to be addressed. In addition, depending on pipe diameter, vertical sagging of pipe, etc. on the condition of aged pipes in UB City, other rehabilitation methods or open-cut methods may be adopted.
Wastewater Treatment	Prefabricated OD and factory-built ultra-small-scale treatment facilities may be used as rapid sewerage improvement measures in ger area and suburban development areas. Since the ADB is currently implementing a sub-center development project and an infrastructure center is planned to be constructed in ger area with Chinese assistance (refer to **Chapter 4**), further investigation is needed to see if the above-mentioned Japanese technologies can be utilized.
Sewage Sludge Treatment	The effective use of sewage sludge in UB City is thought to be the use of green farmland, but the current situation makes effective use difficult due to the heavy metals contained in the sludge. In UB City, sludge digestion and gas power generation are planned for the new CWWTP, which is currently under construction with Chinese assistance, so the use of Japanese technology for sludge digestion is not also realistic.
Industrial Wastewater Monitoring	As for the monitoring technology of wastewater from factories, the case of Tokyo Metropolitan Government can be used as a reference, and the following monitoring system can be introduced in UB City to enable appropriate monitoring of wastewater from factories. Emergency response systems to maintain the functionality and safety of sewerage facilities (continuous automatic monitoring of pH, etc.) Integrated monitoring system by combining wide-area (narrowed down) and individual monitoring of factory wastewater. Establishment of a self-control water quality management system at factory (water quality control manager system)
Industrial Wastewater Treatment	It is possible that more companies will use the Russetey Tanning Technique, which is currently undergoing technology transfer, because the officials of the Mongolian Leather Processing Industry Federation want to reduce the use of chromium and use environmentally friendly techniques as much as possible. As a part of the technology transfer, JICA has adopted the "Project Study on Leather Branding Business Using Russetey Tanning Technique [Framework for Innovation from Developing Countries]" in FY2019.
Rainwater Drainage	Since UB City has been experiencing flooding damage, pump gates and plastic rainwater retention facilities could be used as rainwater drainage measures. Geodesy Hydraulic Facility Agency (GUBBG) is considering its own rainwater drainage measures, and other foreign donors are also providing support for rainwater drainage projects. In the case of considering the introduction of this technology, since UB City has no experience of introducing this technology, it is considered that the following issues should be addressed: design, construction planning, construction guidance, provision of materials and equipment, and guidance on how to maintain and manage the facilities.

Source: JICA Survey Team

3.4 Solid Waste Management

After experiencing pollution, Japan has strong social demands for waste treatment and recycling, and the public sector and private businesses have collaborated to develop technologies and systems related to waste treatment and recycling. As a result, the recycling industry related to waste treatment and recycling in Japan has come to have high technological capabilities. By expanding such a recycling industry overseas, it is expected that Japan's economy will be developed sustainably together with contributions to countries with waste problems.

Table 3.5 below shows the technological trends and overseas expansion trends related to SWM in Japan. There is a business that overseas achievements related to SWM include waste gasification systems, waste incinerators, waste incinerator power generation, relay stations, final disposal site leachate treatment, waste sorting, recycled fuel (FRP), hazardous industrial waste incinerators, and recycling.

In this section on waste incineration power generation, heat supply technology, solid waste intermediate treatment facility (recycling), automobile recycling, controlled final disposal site, and hazardous waste treatment facility, which are proposal projects for SWM to UB City, are described in the following.

Table 3.5 Examples of Overseas Expansion of Japan's Recycling Industry

No.	Country	Project Name	Project Summary	Company Name
1	China	Received an order for a waste gasification system for an existing cement factory	Year 2016: 4 locations, total 1,000t/day (Anhui Province, Guangxi Zhuang Autonomous Region, etc.)	Kawasaki Heavy Industries, Ltd.
2	China	Received an order for a waste incinerator (stalker type incinerator)	Year 2010: Hohhot City, Inner Mongolia Autonomous Region (500t/day)	Ebara Environmental Plant
3	China	Waste transfer facility	Year 2010: 2 locations, total 4,000t/day (Shanghai)	ShinMaywa Industry Co., Ltd.
4	India	Established a joint venture to incinerate waste, design, and construct power plants	Year 2014: Established joint venture	Plantec Co., Ltd.
5	Myanmar	Received for construction of waste incineration power plant	Year 2015: Stalker furnace 60t/day, power generation 700kW	JFE Engineering Corporation
6	Myanmar	Order received for construction of leachate treatment facility at final waste disposal site	Year 2015	Kubota Co., Ltd.
7	Thailand	Order received for construction of waste incineration power plant	Year 2016: Stalker type incinerator 370t/day, power generation 6MW	Hitachi Zosen Corporation
8	Thailand	Started cement raw fuel manufacturing business using advanced waste sorting technology	Year 2015: Established joint venture with Siam Cement Group and started project	Limatec Holdings Co., Ltd.
9	Malaysia	Waste incineration power plant (stalker furnace)	Year 2017: 600t/day Power generation 18MW	Hitachi Zosen Corporation-KNM Process
10	Malaysia	Industrial waste incineration plant	Year 2013: 60t/day	JFE Engineering Corporation, Tsukishima Kikai Co., Ltd.
11	Korea	Waste utilization	Year 2015: Ota City (power generation 3.8MW + heat)	Kawasaki Heavy Industries, Ltd.
12	Vietnam	Started manufacturing and sales of recycled fuel (FRP)	Year 2014: Project start → H28: Establishment of corporation	Ichikawa Environmental Engineering Co., Ltd.
13	Singapore	Order received for hazardous industrial waste incinerator	Year 2016: Vertical furnace 36t/day	Plantec Co., Ltd.
14	Singapore	SWTE waste power generation facility remodeling work order received	Year 2014	Mitsubishi Heavy Industries, Ltd.

No.	Country	Project Name	Project Summary	Company Name
15	Indonesia	Waste treatment and recycling project	Year 2009-: Holds 95% of the shares of PT.PPLi, the only comprehensive environmental and waste treatment company in Indonesia.	DOWA ecosystem

Source: Ministry of the Environment (2017) for overseas expansion of Japan's recycling industry

3.4.1 Waste Incineration Power Generation and Heat Supply Technology

In Japan, the incineration of municipal waste has been promoted since around 1960, and it is now the country with one of the world's leading waste incineration facilities. The number of facilities is 1,082 as of end of 2018, and the treatment methods include a stoker furnace, a fluidized bed furnace, and a gasification melting furnace for the purpose of recycling incineration ash.

In addition to the introduction of advanced environmental protection technology as Japanese technology, technologies related to stable operation such as high-efficiency power generation, automatic combustion equipment and automatic cranes have been completed. It has technology for driving a wide variety of waste, from low-calorie waste to high-calorie waste, and accumulated know-how tailored to a wide range of waste qualities.

In recent years, research on improving the efficiency of recovered energy has been promoted. For example, if the steam for power generation is heated to a high temperature and high pressure in order to improve the efficiency of waste power generation, there is a problem that high temperature corrosion of equipment occurs due to acid gas contained in exhaust gas. To overcome this problem, long-life and highly efficient power generation facilities are being constructed, such as research on long-life heat transfer tube materials that are resistant to high-temperature corrosion.

Japan has a history of more than 60 years in waste incineration and energy recovery technology, and it is safe and secure, and it is possible to incinerate a wide range of low-calorie to high-calorie waste. In addition, it has a technology with high energy recovery efficiency. On the other hand, in recent years, the technological development of Chinese and Korean companies has been remarkable, and the technological superiority of Japan is being lost year by year.

In addition, when interviewed Japanese companies with waste incineration power generation technology to enter the business in UB City, many companies were reluctant to enter the business due to the small market size and high business risk due to country risk. It was confirmed that it is difficult to operate a concession-type business that requires independent profitability. On the other hand, the EPC project and driving support provided by the yen-loan fund project can reduce the project risk, resulting in room for expansion. However, additional investigation is essential due to the lack of basic information on the local waste mixture status and incineration facility specifications.

Although heat can be supplied by incineration of waste, it is an incineration facility for reducing the volume of waste with non-uniform calories and detoxifying harmful substances, and from the viewpoint of efficiency and widespread use, it cannot replace the Heat Supply Boiler (HOB) using coal, which is commonly used in UB City.

3.4.2 Intermediate Treatment Technology for Solid Waste (Recycling)

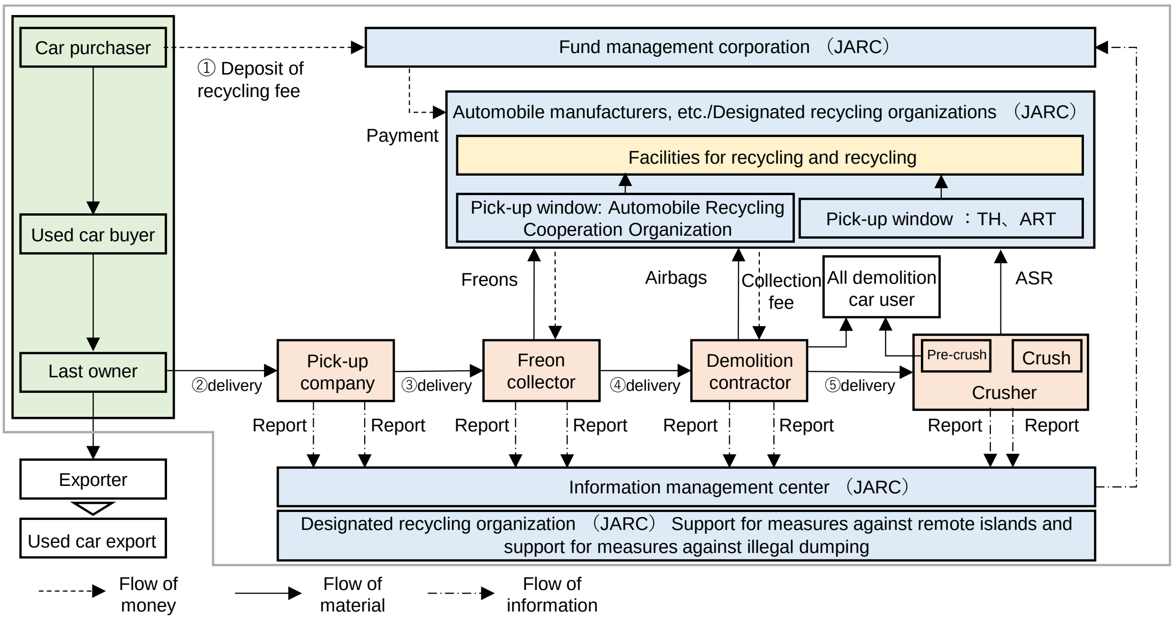
The following businesses can be considered for solid waste, but since the plant scale is small and manual sorting is the mainstream, it is considered that the business cannot compete with local companies and Chinese and Korean companies.

- Recycling of waste home appliances (disassembly, sorting of recycled products)
- Plastic recycling
- PET bottle recycling
- E-Waste

Moreover, in Mongolia, which depends on the export of coal and mineral resources, industrial-derived E-Waste cannot be expected, and it is thought that used electrical and electronic equipment will be targeted. In this case, there is a high risk that high-value parts (mobile phones, PCs, etc.) will be extracted by the informal sector, and also social system for collection and recycling of used products (facility certification, collection and distribution of recycling costs) and a crackdown by the authorities is required. In addition, in the case of home appliance recycling, it is considered necessary to have a collection system and a subsidy system (processing costs borne by the user and manufacturer). In interviews with Japanese companies, the answer was that it was extremely difficult for Japanese companies to enter the market for the above reasons.

3.4.3 End-of-life Vehicle Recycling

In Japan, advanced automobile recycling is carried out under the End-of-life Vehicle Recycling Law (EVRL). **Figure 3.13** shows the outline of Japan's EVRL. The Japan Automobile Recycling Promotion Center (JARPC) exists as a corporation that manages automobile recycling, a fund management corporation, and an information management center, and it manages recycling fee deposits, which are the source of funds for End-of-Life Vehicle Recycling, and also collection and delivery reports during the delivery of used cars to crushers. The automobile recycling business is becoming more and more divided, and there are collection companies, fluorocarbon recovery companies, dismantling companies, and crushing companies. fluorocarbons, airbags, and Automobile Shredder Residue (ASR) generated during this period are recycled and finally disposed through the collection window.



Source: Japan Automobile Recycling Promotion Center (JARPC)

Figure 3.13 Outline of Japan's EVRL

In UB City, there is a high need for a used car recycling business, and Korean companies are commercializing used car repair and sales with the support of KOICA. However, unlike the above-mentioned fluorocarbons, the disposal method for hazardous waste generated from the End-of-Life Vehicle Recycling Business has not been established, and unplanned expansion of the market may lead to the expansion of illegal dumping.

In the "Basic Survey on Collection, Transportation, and Processing to Improve the Efficiency of Disposal and Recycling of Metal Scraps such as Mongolian Waste Cars" conducted by a Japanese company in 2017, it points out the occurrence of environmental problems such as air pollution due to the leakage of chlorofluorocarbon gas due to illegal dumping of used automobiles and soil pollution due to the drainage of waste liquid. In addition, for the advancement of Japanese companies, the establishment of a mechanism for collecting used automobiles and the establishment of a recycling law system for proper treatment are mentioned.

3.4.4 Final Disposal Site Technology

Japan has a lot of knowledge about the management type, equivalent final disposal site that can landfill sludge contaminated with heavy metals, including impermeable technology and leachate treatment technology. When conducting a WtE project, the treatment destination for main ash and fly ash is essential, so the significance of implementing the project is high. Further, if it is organic sludge, methane gas power generation or the like is also possible. According to interviews with Japanese companies, as with the WtE business, there is a large risk of business operation, so it is considered that Japanese companies can enter the Engineering, Procurement and Construction (hereinafter referred to as “EPC”) project with yen-loan fund project.

However, the maintenance cost of the managed final disposal site, including leachate treatment, is higher than that of the final disposal site currently operated in UB City, so it is necessary to thoroughly investigate whether it is possible to operate with the current budget situation of UB City.

3.4.5 Hazardous Waste Treatment Technology

Hazardous waste is wide-ranging, and Japan's treatment technology can cover a wide range, but due to its high level of expertise, it is difficult to construct a business candidate that covers many hazardous waste treatments.

In addition, the collection of hazardous waste from the oil, gas and chemical industry, electronics industry, and pharmaceutical industry, which are highly profitable hazardous waste treatment businesses, cannot be assumed from the current industrial structure, but small-scale treatment projects for batteries, fluorescent lamps, medical waste and infectious waste are envisioned. In this case, it may be difficult to compete with local companies and Chinese and Korean companies.

According to a survey of Japanese companies, companies with incineration technology that can be expanded overseas often have incineration volume reduction technology for general waste, and since the companies that treat hazardous waste are relatively small and medium-sized, it was considered difficult to enter the business in UB City, which has a high business risk.

Therefore, when considering a hazardous waste treatment project in UB City, it is important to select a facility that can be constructed by a Japanese company locally, and it is necessary to conduct a sufficient basic survey when considering it.

3.4.6 Analysis of Japanese Technology Utilization in SWM

Table 3.6 summarizes the analysis results regarding the utilization of Japanese technology in SWM mentioned above in Mongolia. Japan's SWM technology has been improving and accumulating since the response to pollution caused by the high economic growth of the 1960s and 1970s and has many technologies from the source of waste to final disposal. However, interviews with Japanese companies show that these Japanese technologies are expensive in terms of cost, so it is difficult to compete with local companies and companies in other countries such as China, and in recent years, the technological level of other countries has risen, so the technological superiority is diminishing. In addition, the market size of Mongolia is small and it is difficult to expand horizontally in Mongolia, there is a risk of going through a third country in terms of transporting materials and equipment from Japan, and due to the high political risk, Japanese companies were reluctant to enter the business. For this reason, it is difficult for Japanese companies to enter the concession system, which is premised on independent profitability, and it is considered that the concession method is limited to EPC and driving support projects as yen-loan fund projects.

Table 3.6 Analysis on Application of Japanese Technology for SWM

Technology	Application of Japanese Technology
Waste incineration power generation and heat supply technology	Japan has over 60 years wealth of experience in waste incineration and energy recovery technologies. Regarding waste incineration, it is possible to carry out a wide range of incineration from low calories to high calories. Regarding energy recovery, higher efficiency and longer life of energy recovery are being promoted, and it has excellent technology in the world. However, the reality is that facility maintenance costs are higher than in other countries and the technical level of other countries is improving. Assuming the introduction of facilities as ODA yen-loan project to UB City, it is difficult to compete with other countries in terms of cost in facility construction. Therefore, we think that comprehensive development including transmission of driving know-how and ODA support for related legal system development is necessary. In addition, in business operation, it is judged that the operation risk is high, and it is difficult for Japanese companies to operate the business.
Intermediate treatment technology for solid waste (recycling)	Most of the recycling technologies are dismantled and sorted by hand, and when considering the entry of Japanese companies into UB City, it is difficult for Japanese companies to compete with local companies and other countries in terms of cost. What supports the recycling of home appliances in Japan is the collection system and the subsidy system (processing costs borne by the user / manufacturer). To build a healthy market in which Japanese companies can enter, it is necessary to put in place such a system.
Car recycling	In Japan, advanced automobile recycling is carried out under the Automobile Recycling Law. As a result, the collection and disposal of fluorocarbons, airbags, and automobile crushing residues (ASR), which have caused illegal dumping problems in scrapped automobiles, are progressing. When considering the introduction of a Japanese company into UB City, the scale of the project is small and the legal system for automobile recycling is not in place, so it is expected that a sufficient amount of scrapped automobiles cannot be collected for project operations and that valuable resources will be extracted in the informal sector. Since there is no treatment facility for separated hazardous wastes such as fluorocarbons, it is necessary to introduce the treatment facility in advance.
Final disposal site technology	Japan has a lot of knowledge regarding the final disposal site such as impermeable technology and leachate treatment technology, and it is possible to construct a highly safe facility. On the other hand, construction costs and maintenance costs are high, so it is necessary to avoid competition with existing disposal sites when introducing them to UB City. Currently, with the support of EBRD, the construction project of the next UB City final disposal site is underway, so the urgent demand is small.
Hazardous waste treatment technology	Since the fields of hazardous waste treatment are diverse, it is difficult to introduce Japanese technology for all hazardous wastes. Stable collection of hazardous waste from the oil and gas chemical industry, electronics industry, and pharmaceutical industry, which are highly profitable hazardous waste treatment project, cannot be assumed from the current industrial structure of UB City, and it is expected to be a small-scale project, so it is difficult for Japanese companies to operate the project. For this reason, an incineration facility EPC business that can treat a relatively wide variety of hazardous wastes can be considered.

3.5 Climate Change Mitigation

The Japanese technology related to Climate Change Mitigation sector was analyzed by using reports of the "Feasibility Survey for Environment-Friendly Ground Source Heat Pump System" and the "report of data collection survey on the partnership between the private sector in Hokkaido and Mongolia, Central Asia, and the Caucasus area: Final Report, Japan International Cooperation Agency". Although there are Japanese technologies that can be introduced, it is difficult to find Japanese technologies that have a large potential since the costs are higher than the costs of similar technologies and competing technologies in other countries, and a large local demand cannot be expected.

Regarding the photovoltaic power generation business, since Japanese companies are conducting many businesses in this regard in Mongolia through JCM (Joint Crediting Mechanism), they are not included in the evaluation in this survey.

Table 3.7 Analysis on Application of Japanese Technology for Climate Change Mitigation

Technology	Application of Japanese Technology
Intro duction of energy conservation technology (Hot water valve control system for heating)	In the "The report of data collection survey on the partnership between the private sector in Hokkaido and Mongolia, Central Asia, and the Caucasus area", the hot water panel heater with a thermo-head and a valve, through which the hot water can be stopped when the room temperature reaches the desired level is introduced. The radiators are widely used in Mongolia, and not only products made in China but also products made in the EU are used widely, and in this situation it is difficult to find a big advantage in introducing the Japanese technology. In order to make popular the control type heating system that enables energy saving, it is necessary to develop the system and rules for changing the heating fee system from the fee based on the building surface area or volume to the fee based on the amount of heat used.
Introduction of energy conservation technology (house building with high standard insulation)	In the "Survey of energy saving in low-priced housing construction projects for cold regions in Mongolia", there are some construction-related companies in China and South Korea that have already entered the market, but it seems that the entry of Japanese companies has been delayed. It is said that there is a small number of Japanese companies constructing and selling properties for the wealthy people. Potential overseas competitors are companies from China and South Korea, and it is possible to keep costs low, and the cost competitiveness is an issue for Japanese companies. In addition, there are high concerns about political and legal risks such as the enforcement of sudden regulations, and financial risks that constrict the possibility of trust financing due to high market interest rates. In addition, there are many risk factors that should be considered, such as procurement risk, labor-related risk, and agreement withdrawal scenario, which are issues for Japanese companies.
Effective use of renewable energy by introduction of storage batteries connected to electrical grid	According to the research interviews for Mongolia government officials, the storage battery project with 55 MW for private companies and 100 MW for ADB will be implemented, and it is not necessary to introduce new storage batteries by 2030. There is a possibility that a new battery system will be developed by 2030, and it will be desirable to reconsider it based on the technological trends. For example, Toshiba's rechargeable battery 'SCiB' is guaranteed to operate up to -30℃, and it is expected that some storage batteries will have a guaranteed performance even in extremely cold environments such as the one Mongolia. Since it is difficult to predict a high demand by 2030, and the market size of Mongolia will not grow much larger after 2030, it is a problem for Japanese companies to see the project implementation in Mongolia as a priority.
Introduction of geothermal heat pumps	Geothermal heat pumps are more widespread in the United States and European Nations than in Japan. However, even in Japan, the Ministry of the Environment of Japan is implementing a subsidy project for the use of geothermal heat, and its introduction is having a progress. A survey was also conducted by JICA in Mongolia, through business support project for SDGs and small to medium-sized enterprises. As a result, the following items have been clarified: 1) Japanese technology can be fully utilized, 2) the cost is high due to the competitive relationship with a heating by the existing coal-fired boilers, and 3) the establishment of O&M system in Mongolia is an issue.
Introduction of thermal storage heaters	While it is widespread in Europe, it is not so widespread in Japan, and no particular advantage can be found in Japanese technology. Since bricks are often used for heat storage, transportation costs are high, and consumption of local products in Mongolia is desirable.

CHAPTER 4. TRENDS IN OTHER DONORS AND GREEN CLIMATE FUND (GCF) UTILIZATION RELATED TO ENVIRONMENTAL MANAGEMENT PROJECTS

4.1 Support Policies, Achievements, and Related Aid Coordination Frameworks of Other Donors

4.1.1 ADB: Asian Development Bank

(1) Air Pollution Control

The Asian Development Bank (hereinafter referred to as "ADB") decided on December 5, 2019, that a USD160 million Policy Based Loan (PBL) for the Ulaanbaatar Air Quality Improvement Program would be disbursed to the Mongolian side in two tranches. The first tranche of USD100 million was disbursed to the Mongolian side on December 23, 2019, and the second tranche of USD60 million was disbursed to the Mongolian side on December 14, 2020. The PBL will be used to (i) support the National Program for Air and Environmental Pollution Reduction 2017-2025 and Air Quality Management of the Government of Mongolia to improve the efficiency of the government's regulatory framework; (ii) implement emergency measures to reduce air pollution and protect human health in Ulaanbaatar; and (iii) establish an environmentally sound and integrated urban, energy, and transportation system structure in the capital and throughout the country.

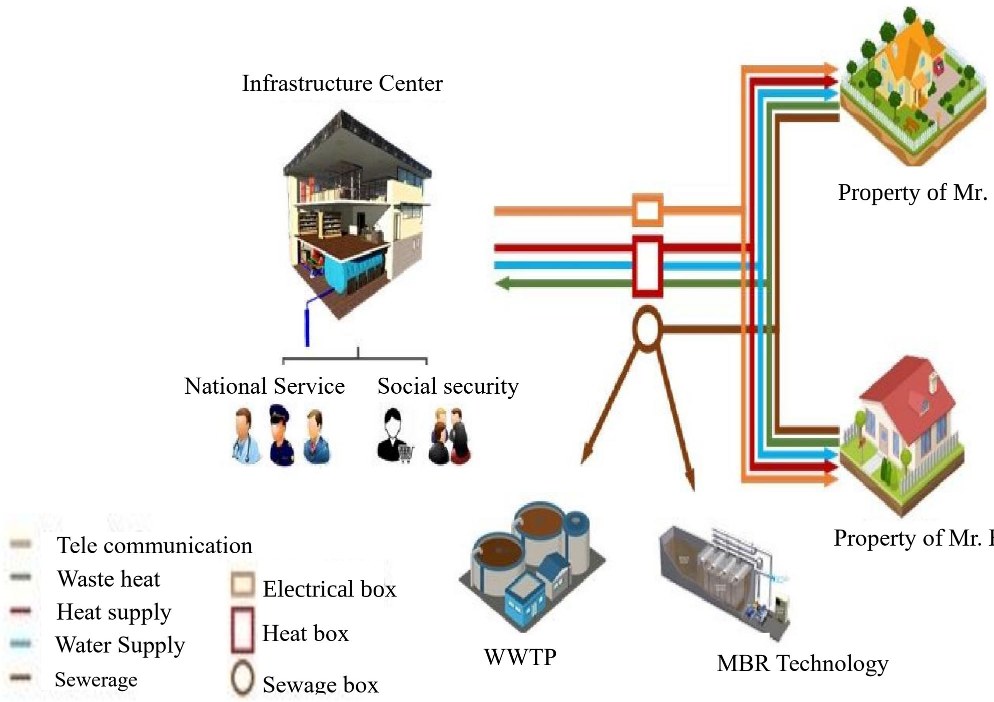
(2) Water Pollution Control

a. Ulaanbaatar Urban Services and Ger Areas Development Investment Program by ADB

This project aims to improve the living standards of the residents of ger area by developing basic infrastructure such as road expansion, heat supply pipes, and water supply and sewer pipes in ger area. The project implementation period is 2017-2023, and the target areas of the project are five sub-centers (Bayankhoshuu, Selbe, Dumberdarja, Denzhynmyanga, Torgoit, and Sharhad) consisting of 30,000-100,000 people. So far, 6.4 km of heat supply pipes, 8.5 km of sewer pipes, 8.2 km of power cables, etc. have been constructed, and seven water supply pumps have been upgraded. Sewage generated in ger area is transported to CWWTP for treatment.

b. Construction of an Infrastructure Center in Ger Area with Chinese Assistance

The plan is to build 100 units of infrastructure centers in 2018-2020 and each infrastructure center will serve 200-300 households (total of 20,000-30,000 households). The infrastructure center will be a three-story facility including a basement, where water supply, sewage treatment, heating, electricity supply, and other equipment will be installed in the basement. In addition, an administration department for the infrastructure center will be set up on the first floor to operate and maintain the center, including payments for various services. At the same time, heat supply pipes, electric cables, water supply pipes, and sewer pipes will be installed in the ger areas. Sewage will be treated and disinfected at the treatment facility in the infrastructure center, and then discharged. **Figure 4.1** shows the development plan for the infrastructure center.



Source: USUG

Figure 4.1 Development Plan of the Infrastructure Center

(3) Solid Waste Management

The ADB uses the JFPR Fund to provide the following support as an Ulaanbaatar Community Food Waste Recycling Project.

Budget: 3 million USD
Project Implementer: UB Mayor's Office, UB Mayor's duties, project team
Project Period: March 5, 2020-June 30, 2024
Project Purpose: To introduce food waste recycling technology with the participation of residents

Project progress: May 29, 2020 No. A/750 Mayor's order appointed UB City General Manager and Mayor's Chief of Operations T. Gantumur as Chair of the Project Steering Committee (hereinafter referred to as “SC”), also as an SC member, representative of related ministries and agencies, UB City department and a project coordinator was appointed as the SC secretary general. A project team has been formed, team members are being selected, SC meeting is being held, and an implementation plan is being prepared.

(4) Climate Change Mitigation

Although the storage batteries are generally not suitable for cold regions, the ADB judged that they can be introduced in Mongolia as the storage batteries are being used in the state of Alaska in the United States of America. The ADB has approved the project to help in the supply of renewable energy to Mongolia by installing its first large-scale advanced battery energy storage system (hereinafter referred to as “BESS”). The project will also help strengthen the capacity of the National

Dispatching Center to handle power dispatch and grid operations, and of the National Power Transmission Grid to operate and maintain the BESS.

This project was approved in April 2020, and the Mongolian Government has been preparing it since September 2020. Full operation will start in 2022, but since the general election was held in the summer of 2020, the schedule may be delayed a little. Since this is the first project for installing large-scale advanced BESS in Mongolia, the capacity development of the operator for O&M (Operation and Maintenance) will be carried out in parallel.

When introducing the renewable energy power generation into the power grid, it is important to have the necessary reserve capacity to respond to fluctuations in the electricity supply. The ADB project will also introduce facilities to the state-owned electric grid company, but in the future, the market for storage batteries connected to the electrical grid should be opened to the private sector, thus utilizing the vitality of private businesses.

The ADB is preparing the aforementioned contents as recommendations for the future, and the EBRD and other donors are considering support with the aim of establishing a storage battery market based on the market economy. In the future, the storage battery market that makes the most of the private sector vitality should be established, and it is thought that this suggests one of the directions for support by JICA.

4.1.2 WB: World Bank

(1) Air Pollution Control

The World Bank has been supporting stove laboratory and expanding the coverage to CFWH. In order to convert Turkish stoves to traditional gel stoves, the Bank has promoted the replacement of Turkish stoves through subsidies since 2010.

As a part of UBCAP (hereinafter referred to as “Ulaanbaatar Clean Air Project”) Phase 1, the World Bank implemented activities to improve energy efficiency, reduce insulation losses, and introduce new energy-saving technologies from 2012 to June 2019. Under the project, 12 kindergartens in UB City were insulated, and 1,500 heating systems were installed in 131 kindergartens, 17 schools, and 7 health centers.

To improve the insulation performance of houses in the ger area, an "Insulation campaign" was carried out, and 474 households participated. In addition, two standards (standards) were developed as follows:

- Standards on Energy Storage Technology (ETS) products for households to store electricity at night, and use it during the daytime, as electricity is cheaper during night-time in Mongolia.
- Development of standards for minimum required units (area, building, electricity, water and sewage) in ger areas.

UBCAP is implementing Phase 2 from 2019 to 2021. 12 million USD loan project with the Ministry of Energy and UB City as CP for Phase 2 is being carried out. The size of the project is USD 6 million for the Ministry of Energy, and USD 6 million for UB City, which comes to a total of USD 12 million. The main activities are as follows.

Phase 2 follows the activities of Phase 1 and aims to provide a comprehensive solution for heating and insulation by combining the "Insulation Campaign" and the "Night Electric Storage Heater" programs. From 500 to 800 gers will be equipped with ATS (Automatic Power Switching System). Districts will be selected for the establishment of four ATS service centers, and the construction of coal-free heat, water, and electricity pipelines for the facilities. It will also provide the Audit Office with equipment for measuring indoor environment, to check whether indoor environment standards are being met.

As for Transport Sector Project, IBRD is going to finance (50 Million USD) for the "Ulaanbaatar Sustainable Urban Transport Project (P174007)" to be implemented by UBCG. The Project consists of 1) Building effective institution for transport planning and management, 2) Integrated Corridors, 3) Sustainable Public Transport System, which will be appraised in 2021.

In the above components 2), rehabilitation of existing roads, construction of new road network and 3) introduction of intelligent transport system (ITS) as well as parking management system are scheduled within the budget of 35 million USD while the subject location and its scope have not been finalized yet.

(2) Water Pollution Control

There was information that the World Bank was considering providing WB funds to support infrastructure development, etc. for the Emeelt relocation project of factories in the urban area of UB City, but there has been no movement since the relocation project has not progressed since 2018. There is also information that the Bank is planning to prepare a master plan of flood control in UB City, but further investigation is needed for details of the plan.

4.1.3 EBRD: European Bank for Reconstruction and Development

(1) Water Pollution Control

The EBRD conducted a feasibility study (Ulaanbaatar Wastewater Expansion Programme - Feasibility Study) for the Emeelt Industrial Park wastewater treatment facility in 2015, but UB City has no financial resource plan to promote the Emeelt Industrial Park development. The relocation plan has not progressed due to lack of government support. If it becomes clear that strong support from the Ministry of Finance of Mongolia will secure financial resources for infrastructure projects related to the industrial park in the future, and if businesses such as leather factories express their willingness to relocate to Emeelt, the EBRD will consider reviewing the FS study.

The EBRD, under the Green Climate Fund (GCF) - Green Economy Financing Facility (GEFF) regional framework, has been implementing climate financing in Mongolia in coordination with the GCF. However, the EBRD has no experience in the field of water treatment so far. In addition, the EBRD has not presented any specific idea, but is ready to share possible information on direct cooperation with JICA.

(Reference: About GCF - GEFF Project)

- The EBRD and GCF provide funding for climate change financing in Mongolia's leasing sector.
- Providing up to 4 million USD in senior loans to XacLeasing LLC for lending to small businesses.
- Of this, up to 3 million USD will be provided by the EBRD and up to 1 million USD by the Green Climate Fund (GCF).
- The proceeds of the loan will be used for financing investments in climate change mitigation and adaptation technologies by local businesses, in line with the standards and reporting requirements for GEFF in Mongolia.
- In a similar framework, the EBRD and the GCF to provide a senior loan of up to 60 million USD to Khan Bank LLC for climate change financing in Mongolia.
- Of this, up to 45 million USD will be provided by the EBRD and up to 15 million USD by the GCF.

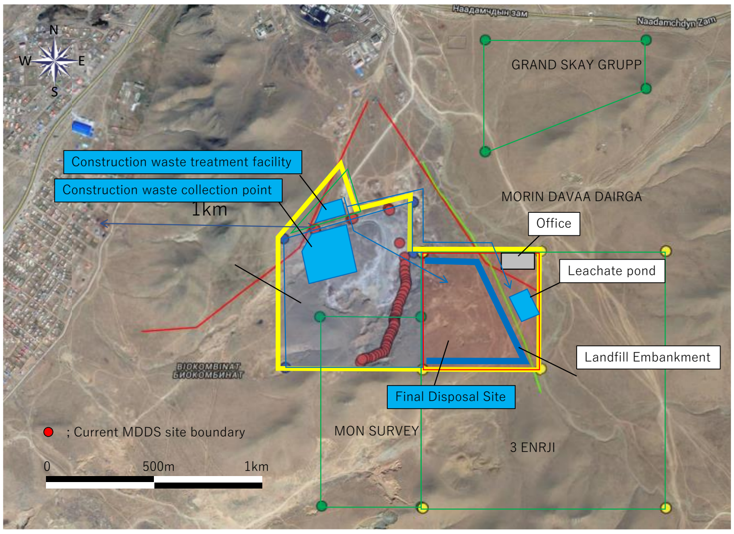
(2) Solid Waste Management: Ulaanbaatar Solid Waste Modernization Project

The EBRD is implementing the Ulaanbaatar Solid Waste Modernization Project as part of the construction of the next final disposal site in Ulaanbaatar and the construction of a construction waste treatment and recycling facility.

The loan and grant agreements for this project were signed, and the loan agreement was approved by the Mongolian Parliament in 2018. Project consultants will be selected, agreement, perform a natural environment impact assessment, implementation of a standard of living improvement program, concluding a project yen-loan agreement with the Ministry of Finance, the Project Implementation Unit (PIU) has been organized from 2019 to 2020. Construction work is scheduled to take place in 2021 after an international bid. **Figure 4.2** shows the maintenance plan.

＜Project summary＞

Fund:	Preferential loans and grant aid from the EBRD
Budget:	16.7 million USD
Project implementation:	The Government of Mongolia (GOM)
Project period:	2019-2021
Project objectives:	Construction and dismantling of waste recycling facilities, and construction of a solid waste landfill facility



Source: UB City

Figure 4.2 EBRD's Moringiin Davaa Disposal Site Development Plan

4.1.4 MCC: The Millennium Challenge Corporation and MCA: The Millennium Challenge Account

The Millennium Challenge Account (MCA) is a new special account of the United States administrated by the Millennium Challenge Corporation (MCC), whose purpose is to support economic growth and reduce poverty in the world's poorest countries. The MCC is independent of other U.S. aid management agencies, and its CEO is nominated by the President and confirmed by the Senate. For partner country assistance, the MCC invites aid-eligible countries to propose development priority programs, and once these proposals are approved, the MCC and the partner government enter into the MMC Compact (grant) agreement that includes program details and clear benchmarks.

The MCC is providing support in the field of water pollution control in Mongolia and will provide USD 350 million to the Mongolian government to implement a water supply project aimed at improving access to water and meeting the water needs of residents and commercial and industrial users in UB City. The construction work is scheduled to start in April 2021 and the project period is four (4) years. This water supply project consists of the following three programs:

- Groundwater development projects in the lower reaches of CWWTP: construction of groundwater wells and construction of distribution pipes, reservoirs, and water treatment plants;
- Sewage Treatment Water Reuse Project: Construction of a plant for reuse of treated water from the new central sewage treatment plant of Ulaanbaatar City under construction, and construction of water pipes to supply high quality recycled water to CHPP (Combined Heat and Power Plant) No. 3 and No. 4; and
- Assistance activities related to sustainable, policy reform, capacity building and technical support for the Ulaanbaatar City water sector.

Program A is a plan to develop a new source of water for drinking water by digging two wells downstream of CWWTP located near the Tuul River. For Program B, the treated water reuse plant (WRP) of the sewage treatment water reuse project will be constructed adjacent to CWWTP and will receive 50,000 m^3/day of the 250,000 m^3/day of treated water from the new CWWTP, which will be advanced treated to the required quality of CHPP. The reclaimed water is pumped from the WRP to CHPP No. 3 and No. 4 through two water pipes. The project includes a pumping station, additional storage tanks, and interconnection equipment with the CHPP.

The Mongolian government has imposed preconditions that must be met to implement the MCC project. This is to reduce the amount of pollution load of wastewater (industrial and commercial wastewater) flowing into New CWWTP to the level of 2013 (Factory Wastewater Pre-Treatment Plan) before commencement of operation of the new plant.

For this reason, MCA has proposed to the Mongolian side to prepare an "Industrial Pre-Treatment Plan (IPP)" as a countermeasure for factory wastewater, and three seminars were held in Ulaanbaatar City in November 2020 on the theme of IPP with MCUD, MOFALI, other related organizations, and factory owners. In the IPP, the following three measures are considered, and the water quality inflow to CWWTP is calculated if each of them is implemented.

(1) All 256 factories, not connected to Khargia Industrial Wastewater Treatment Facility, comply with MNS 6561
(2) Relocation of 28 leather factories connected to Khargia Industrial Wastewater Treatment Facility to Emeelt Industrial Park or Darkhan Leather Estate Complex
(3) When (1) and (2) are implemented simultaneously

4.1.5 GIZ: Deutshe Geselleschaft fuur Internationale Zusammenarbeit

GIZ has provided support to the UB City Air Pollution Abatement Agency (hereinafter referred to as “DAAP”) in the field of air pollution control. Four air quality monitoring stations were provided to DAAP by 2009, but DAAP was unable to operate the stations due to insufficient operation and technology transfer. Therefore, the monitoring stations were rehabilitated by the Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2 (2013-2017), and now DAAP is able to maintain the stations.

In addition, there was cooperation between the German government and the National Agency for Meteorology and Environmental Monitoring (NAMEM). The cooperation entailed training courses such as training on air quality monitoring, emission inventory and air quality dispersion simulation. The cooperation period is from the end of 2016 to October 2019, and the summary seminar was held in October 2019.

4.1.6 KOICA: Korea International Cooperation Agency

(1) Air Pollution Control

The Ministry of Finance has approved the Mongolian side's USD 14 million Korean soft loan, which will be granted to the Central Laboratory for Environment and Metrology (CLEM). Under the ongoing "Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 3", support to CLEM is provided to prepare the list of equipment necessary for the analysis of PM components, which would be covered by the soft loan in February 2019. However, CLEM has not accepted the preparatory study report on equipment provision conducted by KOICA, and the loan procedure is still pending.

(2) Solid Waste Management

As a trend of other donors regarding automobile recycling, in 2012, KOICA international cooperation project "Construction of ELV Recycling Park including ELV Dismantling Plant, Recycled Resource Storage, Repair Plant and Technical Training Center"(Recycling park business for scrapped cars). This project was a pilot project to provide a dismantling factory for used automobiles, but at that time, the number of scrapped automobiles was small, there was no urgency of the business, and the operation of the automobile recycling system was not decided, so the Korean technology provider went bankrupt and the business itself was abandoned.

After that, a new automobile recycling system improvement and scrap car recycling pilot project (budget 2,784,000 USD) was proposed in collaboration with a Korean company, and currently, the project is being evaluated by MET and MMHI. In this project, in addition to building a car registration system for scrap car management and building a scrap car recycling plant. However, results from the interview show that the treatment method of automobile-derived waste will be outsourced to a local treatment company, which seems to be an issue in the future.

Moreover, according to the interview with MRTD, this project does not include iron scrap processing technology and cannot be said to be complete recycling, and Japanese technical support therefore is required.

4.1.7 SDC: Swiss Development Cooperation

SDC is providing support as the UB City Household Waste Collection and Transportation Management Project (WCTM: Waste Collection and Transportation Management in Ulaanbaatar).

Budget: CHF 3.8 million

Project Implementer: UB Mayor Services, Kovi Limited Liability Company, Ikon Limited Liability Company

Project Duration: April 1, 2019 - April 30, 2023

Project Objective: To provide clean and healthy living environment for the residents of ger district, UB City, by increasing the efficiency and lowering the cost of waste collection and transportation management, as well as ensuring that all stakeholders are taken care of and services are provided.

Project Progress: Three (3) WGs were formed by the order of the Project SC, the General Manager of UB City and Director of Mayor's Office by the Mayor's Order No. A/91 of January 23, 2020. The project has been implemented in No. 7 and No. 12 Chingeltei District and No. 2 and No. 3 Songinokhairkhan District, and surveys and training courses have been carried out.

4.1.8 UNICEF: United Nations International Children's Emergency Fund

UNICEF is working in the area with air pollution activities utilizing the budget of the Swiss Agency for Development Cooperation (SDC) from 2018-2023: (1) Measures related to indoor pollution in kindergartens; (2) Monitoring; and (3) Online systems. One kindergarten in the area with a large number of low-income residents has been equipped with double-paned windows. National data is being analyzed in order to assess the energy efficiency. Indoor environments are being measured with analyzers to define the exposure levels as an evidence for policymaking.

UNDP and UNICEF have launched an air pollution platform, HazeGazer, to provide indicators of air pollution in the city of UB, and to monitor the impact of air pollution based on information provided by residents. The objectives of the air pollution platform are: (1) To collect and integrate air pollution data in Ulaanbaatar through digital smart devices based on the active participation of citizens; (2) To provide valuable data to researchers, journalists and policy makers; (3) To encourage citizens to take action to reduce the impact of air pollution by sharing their experiences and stories on the platform as part of their civic duty; and (4) To provide decision makers with information on the multifaceted impacts of air pollution on citizens, especially women and children, and integrate data as a secondary source of information.

4.1.9 Export-Import Bank of China

(1) Air Pollution Control

As introduced in 2.5.1 (2) d), Railway Underpass Construction Project in UB City has been scheduled as a part of measure for mitigation of traffic congestion by the Export-Import Bank of China. Approximately 40 million USD is estimated for overall construction cost and its detailed design will be completed by October 2021. According to DIIP, actual construction site will be selected from six(6) candidate sites to be accommodated within project budget based on the result of the detailed design.

(2) Water Pollution Control

Currently, the construction of new CWWTP in UB City is being financed by the Export-Import Bank of China. Construction work has already begun on 18 of total 38 main facilities, and some of the foundations have been laid. The construction is scheduled to be completed in August 2023, followed by 6.5 months of commissioning and adjustment, another six months of commissioning on the Mongolian side, and the start of normal operation in June 2024. Information on new CWWTP obtained from the PIU of this construction project is shown below. It can be confirmed from the sludge treatment diagram that sludge digestion and digestion gas power generation are planned.

Table 4.1 Planned Influent Water Quality of the New CWWTP

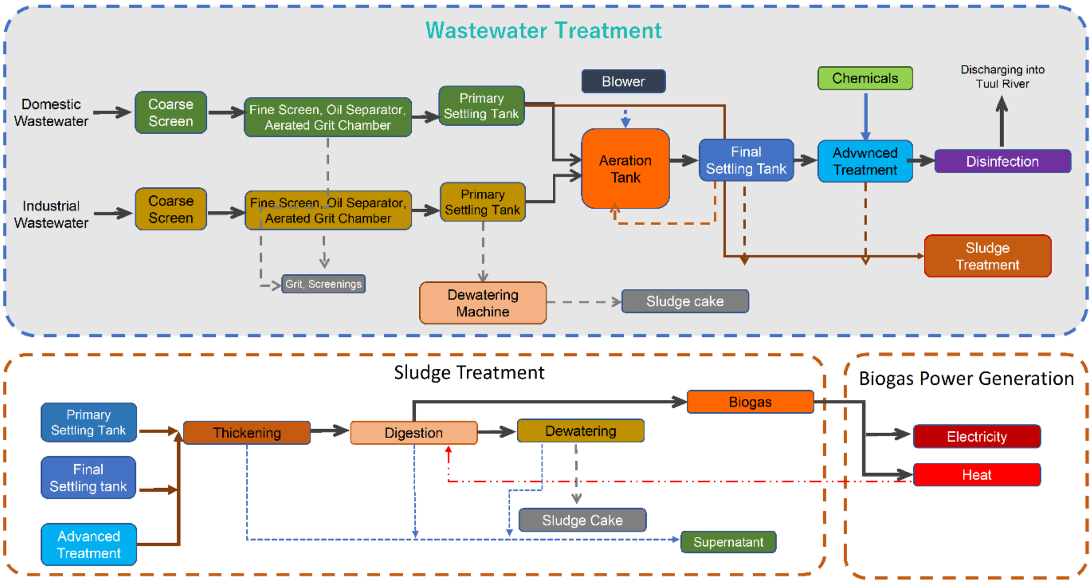
Item	Planned Influent Water Quality (mg/l)		Actual Water Quality (June 2020) (for reference)	Effluent Quality Standards of Factory for Discharging into Sewer（MNS 6561: 2015）	Effluent Quality Standards of Wastewater Treatment Plant for Discharging into Public Waterbody（MNS 4943: 2015）
	Domestic	Industrial			
COD	1,200	1,500	2,057	800	50
BOD	380	400	779	400	20
SS	800	1,000	1,033	400	30
T-N	40	40	-	30	15
NH_3-N	35	30	-	15	6 (※2011)
T-P	3	5	-	5	1.5

Source: PIU of New CWWTP construction project

Table 4.2 Planned Influent Flow

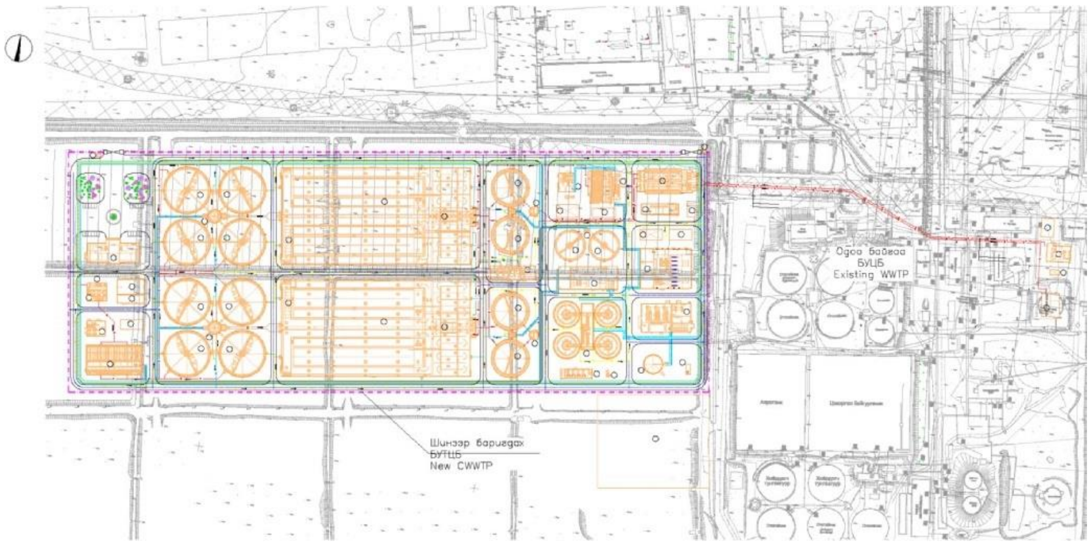
	Domestic Wastewater	Industrial Wastewater	Total
Planned Influent Flow (m^3/day)	150,000	100,000	250,000

Source: PIU of new CWWTP construction project



Source: PIU of New CWWTP construction project

Figure 4.3 Treatment Diagram of New CWWTP



Source: PIU of New CWWTP construction project

Figure 4.4 General Plan of New CWWTP

4.1.10 GGGI: Global Green Growth Institute

GGGI's program in Mongolia directly supports the Government's green development targets for 20% renewable generated electricity, 20% building heat loss reduction, and 2% of GDP for green investments by 2020. Counterparts from the Government are the Ministry of Environment and Tourism (MET), Ministry of Energy (MOE), Ministry of Construction and Urban Development (MCUD), Energy Regulation Commission (ERC), and the Municipality of Ulaanbaatar City (MUB).

One project is the Promotion of Energy Efficiency and ESCO (Energy Service Company) development in Mongolia. The project objectives are as follows: (i) Strengthening human resource capacity of the energy sector; and (ii) Increasing public awareness for energy conservation and information outreach. The incorporation of efficient and cost-effective energy solutions in construction drawings and comprehensive steps to reduce building heat loss are fundamental for improving the energy sector efficiency.

The project will focus on the following activities:

- Study of international examples for the design of Energy Efficiency Incentive Mechanisms;
- Development of the Roadmap for Building Energy Efficiency;
- Development of calculation methodologies for energy performance of electric space heaters within the framework of the Energy Standards and Labelling regulation implementation;
- Design and Improve the standard Energy Performance Contract Requirements;
- Design and deliver a capacity building program to the government and designated entities at the national and subnational level, to implement the National Energy Efficiency Action Program (NEEAP);
- Design and deliver a capacity building and public awareness program to the national and subnational stakeholders on Energy Tariff Policy Reform; and
- Strengthen the cooperation dialogue between national stakeholders ESCO companies and associations in China and Slovakia.

The expected outcome is for the energy efficiency of Mongolia's buildings and energy sectors to increase through incentive mechanisms, improved energy demand management and implementation of ESCO projects. The project outputs completed in 2019 are as follows:

- Green Growth Policies (Policy Assignment): The calculation methodology for electric heaters energy efficiency assisted the policy development in a direct manner;
- Green Investments: Energy Standards and Labelling, and Energy Efficiency Incentive Mechanism have progressed through Developing the Energy Performance Agreement template and the Technical Methodology on electric space heaters to accelerate the adoption of two major regulatory documents; and
- Capacity building for knowledge projects was carried out.

4.1.11 MGFC: Mongolia Green Finance Corporation

Alongside the Government of Mongolia (hereinafter referred to as "GOM") and the Mongolia Sustainable Finance Association, the program will establish the Mongolia Green Finance Corporation (hereinafter referred to as "MGFC") to lend money through local partner financial institutions (PFIs) for thermal insulation of housings, energy efficiency for business and mortgages for green affordable housing. The aim is to reduce 3.8 million tons of carbon dioxide equivalent ($MtCO2$ eq) in emissions. After initial operations, MGFC will look to attract new capital and target other sectors, with potential direct investment. Technical assistance is provided to operationalize MGFC, and build the capacity of GOM and the financial sector stakeholders.

The targets of MGFC are the mainstreaming of green, affordable and gender inclusive financing for households and businesses to switch to low-carbon technologies and to establish an improved environment policy, as well as to build the capacity and awareness of stakeholders in support of green finance mainstreaming. The MGFC's main beneficiaries are households, especially women-headed households, living in peri-urban (ger) areas of Ulaanbaatar and business transitioning to low-carbon and energy efficient practices, as well as Mongolia's major commercial banks that will act as participating financial institutions. The initial targets of the MGFC green credit products are: (i) the reduction of GHG emissions through the promotion of alternative heating and energy efficient insulation; (ii) the promotion of energy efficiency measures in large industries; and (iii) green and affordable housing mortgages.

The Gender Action Plan describes the following three main outputs:

- Output 1 - Establishment and launching of the MGFC
- Output 2 - Provision of wholesale financing: Financing for insulation measures of the existing houses (Category A), Energy efficiency improvement measures for business entities (Category B), Mortgages for green affordable houses (Category C).
- Output 3 - Technical support: (i) MGFC business operations is established in compliance with the international standards and internal capacity; (ii) An enabling environment for green finance is established among PFIs, project developers, households and policy makers; and (iii) The MGFC experience is documented, valued and disseminated.

4.2 GCF: Green Climate Fund

The Green Climate Fund (hereinafter referred to as "GCF") will be entrusted with a Greenhouse Gas (GHG) reduction (mitigation) in developing countries, and the United Nations Framework Convention on Climate Change (UNFCCC) to support the response (adaptation) of the effects of climate change. The GCF is a support for developing countries to propose, implement and manage projects in line with priorities for climate change in developing countries. Paradigm Shift Potential is shown as a screening standard for the adoption of GCF projects, and projects that have an impact beyond the project field are targeted for support.

In order to utilize GCF funds, it is necessary to submit a Funding Proposal through an Accredited Entity (AE), and in that case, it is necessary to submit a consent form (No objection letter) from the government of the project implementing country (NDA: National Designated Authority) or focal point (FP). The NDA, which is the GCF window in Mongolia, is MET.

The types of GCF project schemes include private sector investment type (business investment type, fund investment type), ordinary public bidding pattern (spec-in type), and others (two-step loan). Currently, there are nine (9) projects in **Table 4.3** as GCF projects related to Mongolia.

Table 4.3 GCF Business in Mongolia

No	Project name	Summary
1	Renewable Energy Program #1-Solar (EP046)	Project operator: Xac Bank Type: Project investment type Type: Mitigation GHG amount of reduction: 306,000 tons-CO_2/year Total project investment: USD 17.6 million Project period: 10 years Summary: 10 MW scale solar power generation facility financing project
2	MSME Business Loan Program for GHG Emission Reduction	Project operator: Xac Bank Type: Two-step loan type Type: Mitigation GHG amount of reduction: 150,000 tons-CO_2/year Total project investment: USD 60 million Project period: 8 years Outline: Provide low-interest loans to small and medium-sized enterprises that introduce or manufacture renewable energy and energy-saving equipment.

No	Project name	Summary
3	Energy Efficient Consumption Loan Program	Project operator: Xac Bank Type: Two-step loan type Type: Mitigation GHG amount of reduction: 46.96 million tons-CO_2/year Project period: 10 years Summary: Loan project for high-efficiency heating appliances and housing equipment
4	Climate Investor One	Project operator: Nederlandse Financierings-Maatschappij voor Ontwikkelingslanden N.V. （FMO） Type: Fund investment type Type: Mitigation GHG amount of reduction: 2.69 million tons-CO_2/year Total project investment: USD 821.5 million Project period: 20 years Summary: Financial support project for renewable energy development
5	Green Cities Facility	Project operator: EBRD Type: Spec-in type Type: Cross-disciplinary GHG amount of reduction: 5.17 million tons-CO_2/year Total project investment: USD 289.6 million Project period: 23 years Summary: Low-carbon, climate-resistant urban development project
6	Ulaanbaatar Green Affordable Housing and Resilient Urban Renewal Project (AHURP)	Project operator: ADB Type: Spec-in type Type: Cross-disciplinary GHG amount of reduction: 197,000 tons-CO_2/year Total project investment: USD 570.1 million Project period: 40 years Outline: Project to control greenhouse gas generation and air pollution by building a climate-resistant UB City and establishing an environmental measure implementation area (eco district)
7	GCF-EBRD SEFF Co-financing Program	Project operator: EBRD Type: Two-step loan type Type: Mitigation, adaptation, cross-cutting GHG amount of reduction: 1.83 million tons-CO_2 Total project investment: USD 1.4 billion Project period: 15 years Summary: Expansion of climate financial institutions by GCF and EBRD, financial cooperation projects for each industrial sector
8	Mongolia Green Finance Corporation	Project operator: Xac Bank Type: Two-step loan type Type: Mitigation GHG amount of reduction: 3.8 million tons-CO_2 Total project investment: USD 4.97 billion Project period: 6 years Summary: Mongolian Green Finance Corporation (MGFC) project, which, together with the Mongolian Government (GOM) and the Mongolian Sustainable Financial Association (MSFA), can borrow through local partner financial institutions for housing insulation and corporate energy efficiency.
9	Improving Adaptive Capacity and Risk Management of Rural communities in Mongolia	Project operator: UNDP Type: Project investment type Type: Conformity Total project investment: USD 7.93 billion Summary: Sustainable livestock policy support project to improve pasture management based on climate forecasts

CHAPTER 5. SUMMARY OF SURVEY RESULTS

5.1 Long List of Candidate Projects for Yen-Loan Fund

Table 5.1 is the long list of candidate projects proposed to be funded by Yen-Loan fund from the Government of Japan. Candidate projects examined are in addition to the candidate projects from other JICA studies (listed in the Particular Specification of Contract). Based on the interviews conducted in this survey, the projects are judged to have high needs of Mongolia.

For these candidate projects, their feasibility was evaluated through interviews with the partner country. Priorities have been set, and a short list was created as a candidate project summary table of the top six (6) candidate projects for the Yen-Loan fund.

Table 5.1 Long List of Candidate Projects for Yen-Loan Fund

Symbols	Classifications	Candidate Projects
Air01	Air Pollution Control	Introduction of improved coal-fired hot water supply boiler
Air02		Central heating using renewable energy, incineration equipment, etc.
Air03		LNG/CNG introduction infrastructure development
Air04		Construction of improved fuel manufacturing plant
Air05		Improvement of intersections and road networks for the mitigation of traffic congestion
Air06		Introduction of DPF for public buses
Wat01	Water Pollution Control	Main line pipe maintenance in the central treatment area
Wat02		Reconstruction of aged sewer pipes in the central treatment area
Wat03		Installation of factory wastewater abatement facility
Wat04		Sewage sludge utilization digestion gas power generation project
Wat05		Urban rainwater drainage plan/facility improvement management
WM01	Solid Waste Management	Construction of WtE facility (waste power generation/heat supply facility)
WM02		Construction of intermediate treatment facility (recycling facility) for solid waste
WM03		Construction of recycling facility for automobile parts
WM04		Hazardous waste final disposal site (managed final disposal site)
WM05		Introduction of hazardous waste treatment facility
WM06		Construction of a comprehensive waste treatment facility （WtE general waste + hazardous waste incineration facility）
CIC01	Climate Change Mitigation	Introduction of energy saving technology (hot water valve control system for heating)
CIC02		Effective utilization of renewable energy by introducing storage batteries
CIC03		Introduction of heat pump and heat storage heater

5.2 Consideration of Narrowing Down Projects

The following shows the project outline, project evaluation, general comment, special notes, comments from the partner country, and the results of the examination of technical support incidental to the yen-loan fund in each field and presents the evaluation result summary table.

Table 5.2 shows the project evaluation items and evaluation criteria. The evaluation sub-items differ depending on the candidate project, but the Japanese technology utilization and implementation environment are common. Therefore, the common evaluation items will be evaluated according to the evaluation criteria shown in **Table 5.3**. The evaluation results are weighted as shown in **Figure 5.1** and converted into the evaluation values with a maximum of 100 points.

Table 5.2 Project Evaluation Items and Evaluation Criteria

Major Items (Large)	Medium Items (Medium)	Sub-Item (Small)		Evaluation Criteria
Development Impact	Residents' Life	Improvement of Public Services	Set for each candidate project	
		Enlargement of Activity Range		
		Enhancement of Amenity		
	Environmental Improvement	Living Environment Conservation		
		Natural Environment Conservation		
		Global Environment Conservation		
	Local Economy	Expansion of Production		
		Increase of Employment		
Investment Impact		Cost-Effectiveness		
		Profitability		
Utilization of Japanese Technology		Technology Competitiveness	Possibility of future business development	Evaluation criteria (common)
			Uniqueness and superiority of the target technology	
			Local O & M system	
			Degree of interest of Japanese companies	
Implementation Environment		Project Feasibility	Relationship with higher-level plans	
			Relationship with other businesses	
			Ability of the other party (technology, finance)	
			System maintenance status	
		Partner Country Request	Request of the managing agency	

Table 5.3 Evaluation Criteria (Common)

Evaluation Points	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation. Very well prepared for project implementation. Very good, probability is high, great request, great interest, great relevance.
+3	Maintain the status quo (benchmark). There is no problem in implementing the project. Similar with other countries, medium possibility, there is a request, moderate interest, moderate related.
+1～2	By implementing the project, the situation will worsen from the current situation. High risk of problems in implementing the project. Inferior to other countries, etc., low possibility, no request, not interested, low related.

Total	Item	Weight	Item	Weight	Propotion	Item	Weight	Propotion
100	Development Impact	30	Resident's Life	40	12.000	Improvement of Public Services	40	4.800
						Enlargement of Activity Range	30	3.600
						Enhancement of Amenity	30	3.600
			Environment Improvement	40	12.000	Maintenance of Living Environment	30	3.600
						Maintenance of Natural Environment	40	4.800
						Maintenance of Global Environment	30	3.600
			Local Economy	20	6.000	Expansion of Production	50	3.000
						Increase of Employment	50	3.000
	Investment Impact	10	Cost-Effectiveness	80	8.000			
			Profitability	20	2.000			
	Application for the Japanese Technologies	20	Competitiveness of the Technology	100	20.000	Possibility of the Future Business Development	20	4.000
						Uniqueness and Superiority of the Technology	40	8.000
						Operation and Maintenance by the Local Agency	30	6.000
						Degree of Interest by the Japanese Firms	10	2.000
	Implementation Conditions	40	Prerequisites for Formulation of the Projects	50	20.000	Relevance with Upper Plans	25	5.000
						Relevance with Other Plans	25	5.000
						Capacity of Implementing Agency	25	5.000
						Situation of Development of Institutional Frameworks	25	5.000
			Requests from the Mongolian Government	50	20.000			

Figure 5.1 Evaluation by Weight

5.2.1 Air Pollution Control

(1) Air01: Introduction of Improved Coal-Fired Hot Water Supply Boiler

a. Outline and Purpose of the Project

Small and medium-sized HOBs are concentrated in the ger area, which is outside the central heat supply zone of UB City, and there is heavy air pollution in the surrounding areas of UB. Therefore, three 4 MW upgraded coal-fired hot water boilers will be installed to supply heat to the facilities in a 2.0 km square area. With the heat supplied by the large hot water boilers, 30 HOBs will be taken out of use, and gel stoves in 2 km square should be taken out of use to improve thermal efficiency and increase stack height, thereby reducing air pollutant emissions and air quality concentration at the ground level.

The project outline and main equipment of the improved coal-fired hot water boiler is shown in **Table 5.4** and **Table 5.5**.

Table 5.4 Project Outline of Improved Coal-Fired Hot Water Boiler

Items	Contents	Remarks
Project Summary	The heating systems of 60 schools and public buildings in ger areas supplied by HOB, will be replaced with improved fuel-fired hot water boilers by HOB.	Set based on HOB placement in UB City and surrounding areas
Heat Supply Building Information	Total of 60 locations Average building floor area (2,000 m^2) and building volume (7,600 m^3) in each location	Set from (Source 1) and (2)
Outline of Hot Water Boiler Equipment Revenue Source	Hot water boilers 4.0MW × 3 units	
Estimated Cost	Approximately one billion yen	Estimated from Source (1) and (2), including piping costs to surrounding facilities.
Construction Period	2 years	
Maintenance Cost	Improved fuel cost: 12,000 tons × 150,000 MNT / 25 MNT / yen = 72 million yen Labor cost: 30,000 yen/month × 9 months × 8 workers = approx. 2.16 million yen/year Maintenance and management costs such as electricity: 1 million yen/year Total maintenance and management costs: 75.16 million yen/year	Estimated from the data at the time of the JCM survey and the cost of improved fuel is the local sales price.
Revenue Source	Heating supply cost per month: approx. 500 MNT/m^3 (district heating price: 472 MNT/m^3 in 2019 for business premises in UB City) 500 MNT/m^3 × 7600 m^3 × 9 months / 25 MNT / yen = approx. 1.4 million yen Per facility: 1.4 million yen/year, 60 facilities total: 84 million yen/year	Project cost can be covered from the heating fee, and the number of facilities is calculated from the suppliers of HOBs to be taken out of use.

Source 1): "JCM Equipment Subsidy Project: Renewal and Installation of High Efficiency Heat Supply Boilers in Mongolia" (Ministry of the Environment), Suuri-Keikaku Co., Ltd.
Source 2): "Mongolian Urban Development Capacity Improvement Project Phase 2" (JICA)

Table 5.5 Main Equipment of Improved Coal Fired Hot Water Boiler

Items	Capacity	Number of sets	Remarks
Improved fuel hot water boiler	4MW	3 units	
Boiler building		1 building	
Heat exchanger	15MW	3 sets	
Water supply tank	90 ton	1 set	
Heat supply piping		1 unit	
Dust collector		3 units	Dust collection rate of 80% or more
Heat meter		3 units	
Chimney		1unit	80 m or more

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.6** and the evaluation criteria are shown in **Table 5.7.**

Table 5.6 Individual Evaluation Items and Evaluation Criteria (Air01)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Expansion of supply service area related to hot water for heating	**Table 5.4**
			Reduction of burden on citizen	**Table 5.4**
		Enlargement of Activity Range	Increased activities in public facilities	**Table 5.4**
		Enhancement of Amenity	Reduction of breakdown in hot water supply services	**Table 5.4**
			Improvement of dwelling environment / indoor environment	**Table 5.4**
	Environmental Improvement	Living Environment Conservation	Improvement of air pollution problem	**Table 5.4**
			Thorough management of coal ash	**Table 5.4**
		Natural Environment Conservation	Reduction of excessive water use	**Table 5.4**
			Water pollution by operation of hot water boiler facilities	**Table 5.4**
		Global Environment Conservation	Energy efficiency improvement of facilities	**Table 5.4**
			Climate change adaptation measurement	**Table 5.4**
	Local Economy	Expansion of Production	Increase number of HOB production	**Table 5.4**
			Increase of improved fuel production	**Table 5.4**
		Increase of Employment	Creation of new employment	**Table 5.4**
Investment Impact		Cost-Effectiveness		**Table 5.4**
		Profitability		**Table 5.4**

Table 5.7 Evaluation Criteria (Air01)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

In terms of improving public services, some households will have to pay a new heat supply fee, which may increase the burden on residents. In terms of improving public services, it may increase the burden on residents, since they may have to pay for new heat supply fees. In addition, comfort will be improved since there will be no indoor combustion.

Environmental improvement

Since HOBs will be consolidated, the concentration of PM in the air will be reduced to some extent, although not sufficiently to significantly solve the air pollution issue. In addition, the improvement of thermal efficiency will reduce the amount of coal used, resulting in lower CO_2 emissions.

Local economy

The impact of the project on the local economy will be minor since a system for manufacturing improved fuels has already been established.

(ii) Investment Impact

Cost-effectiveness

The introduction of large-scale hot water boilers will improve thermal efficiency and reduce the amount of fuel used per heat supply area, but initial costs will be required. Atmospheric concentration will be reduced by 30-40%.

Profitability

The fee will be collected from the heat supply facilities of the HOBs that will be taken out of use. Since the fee is set per area, there will be little change in the cost to the residents of the ger area. However, since the government sets the price of improved fuel, the profitability of the project depends on the price of the fuel.

(iii) Application of Japanese Technology

Possibility of future business development

Development of hot water boilers is not active in Japan.

Uniqueness and superiority of the technology

The Czech Republic, Hungary, and China have advanced technologies for hot water boilers using coal and improved fuels, and there is no uniqueness or superiority of Japanese technologies.

Operation and maintenance by the local agency

Mongolia operates high-efficiency hot water boilers manufactured overseas, and a maintenance company has established the maintenance system. By utilizing this system, maintenance and management can be carried out at a sufficient level.

Degree of interest by Japanese firms

Japanese companies are not interested in this project since similar technology exists in other countries.

(iv) Implementation Condition

Relevance with upper plans

Related to the Mongolian Five-Year Basic Policy to reduce air pollution by 80%.

Relevance with other plans

Although the project is related to the Ger Area Environmental Improvement Project, it does not support the promotion of hot water boilers.

Capacity of implementing agency

The Mongolian hot water boiler maintenance companies are engaged in the hot water boiler maintenance work; they have the necessary technical skills and do not require any special training.

Situation of development of institutional frameworks

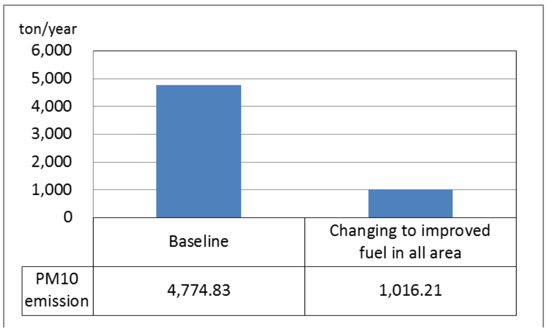
The registration and management system for boilers is in place, and the system has been established for the maintenance of hot water boilers. However, as a policy for Mongolia, the construction of new hot water boilers is not recommended.

Requests from the Mongolian Government

Under the National Program on Environmental Pollution Reduction, hot water boilers are being phased out; besides, there is no request from the partner country regarding hot water boilers.

c. Overall Evaluation

Since this is a project on hot water supply using coal, there is an effect on air pollution control, but since coal or improved fuel is used as it is, the effect on air pollution control is around 30%. However, the short-term effect on air pollution control can be expected. The phase-out of HOB has been indicated in the National Program on Reducing Environment Pollution. If the scale of the project is not big, the project is suitable for a two-step loan.



Source: Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2 in Mongolia, Final Report

Figure 5.2 Effect on Amgalan Heat Supply Facility

For coal-fired hot water boilers, it is conceivable to install new improved coal-fired large-scale hot water supply boilers by consolidating the small HOBs in Ulaanbaatar, which cannot be connected to the central heat supply area. In the Amgalan heat supply facility, which is slightly larger than the current project and was introduced in 2016, the taking out of use of 77 HOBs in the surrounding areas resulted in a reduction in PM10 emissions from 924.16 tons to 587.41 tons, which is a reduction rate of 36.44% (refer to **Figure 5.2**, Capacity Development Project for Air Pollution Control in Ulaanbaatar City, Phase 2 Final Report, June 2017). Therefore, it can be expected that the current project will improve the ground level concentration by 70% through use of large HOBs using improved fuel compared to the case when using raw coal, by taking out of use the small and medium HOBs. However, since the fuel used is modified coal, no further significant air pollution reduction effect can be expected.

In addition, the improvement of the living environment in the ger area is not very likely as a yen-loan project, because it would hinder the movement of people from gers to housing complexes.

As for the large-scale HOBs, there is no Japanese technology and it will be imported either from China or Russia, so there is almost no possibility for Japanese companies to enter this area, so that the possibility of this as a yen-loan project is not very high.

d. Remarks

Japanese companies have been developing coal steam boilers for large-scale thermal power plants and have not developed hot water boilers of a size suitable for Mongolia. Therefore, the introduction of hot water boilers will be a technology from China, the Czech Republic, Hungary, and other countries that have already advanced their businesses in Mongolia, and there is little possibility for Japanese companies to advance their business in Mongolia.

e. Comments by the Mongolian Government

Although there is a strong demand for improved fuels, the Ministry of Energy, the UB City Mayor's Office, and the UB City Auditor's Office recognize the fact that hot water boilers are a much-needed infrastructure, but because they use solid fuels, the National Program on Reducing Environment Pollution has a policy to phase out hot water boilers. Mr. Davaasuren, Director General of the Fuel Policy Department of the Ministry of Energy, believes that the Ministry of Energy does not have a high demand for new improved fuel-fired hot water boilers, since it is planning to expand the heat supply area from the thermal power plant to cover more of the ger area, and is also planning to increase the capacity of the Amgalan heat supply facility. The Ministry of Energy believes that the demand for a new improved fuel-fired hot water boiler is not high.

f. Consideration of Technical Assistance Related to Yen-Loan

Since there is no request from the Mongolian side, no paid account ancillary technologies will be considered.

Table 5.8 Evaluation Result Summary (Air01)

No.	**Air01**		
Project Name	Installation of improved coal-fired hot water supply boilers		
Implementing Agency	Ministry of Energy	Relating Agency	
Project Cost	Approximately 1 billion yen		

Outline and Objective of the Project

Three 4 MW upgraded coal-fired hot water boilers will be installed to supply heat to the facilities in Ger Area. With the heat supplied by the large hot water boilers, 30 HOBs will be taken out of use, and ger stoves in 2 km square should be taken out of use to improve thermal efficiency and increase stack height, thereby reducing air pollutant emissions and air quality concentration at the ground level.

Evaluation Item: Large	Evaluation Item: Medium	Evaluation Item: Small		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development impact	Resident's Life	Improvement of Public Services	Expansion of supply service area related to hot water for heating	High	Hot water supply services are expanded to Ger area that is not connected to the central heat supply network.	4.0	0.48	1.92	2.40
			Reduction of burden on citizen	Low	It may increase the burden on citizens, as they may have to pay new heat supply.	2.0	0.48	0.96	2.40
		Enlargement of Activity Range	Increased activities in public facilities	High	Maintain current level in urban areas.	4.0	0.72	2.88	3.60
					Compared to individual heating, the concentration of PM and SO_2 in the air will be reduced, and the use of coal-fired stoves will be discontinued, resulting in less coal ash.				
		Enhancement of Amenity	Reduction of breakdown in hot water supply services	High	Comfort will be improved, as there will be no indoor combustion.	4.0	0.36	1.44	1.80
			Improvement of dwelling environment / indoor environment	High	As HOBs will be consolidated, the concentration of indoor PM will be reduced to some extent.	4.0	0.36	1.44	1.80
	Sub-total							8.64	12.00
	Environment Improvement	Living Environment Conservation	Improvement of air pollution problem	High	As HOBs will be consolidated, the concentration of PM in the air will be reduced to some extent.	4.0	0.36	1.44	1.80
			Thorough management of coal ash	Normal	There is no change in the amount of coal ash scattered, but the accumulation sites of coal ash are concentrated.	3.0	0.36	1.08	1.80
		Natural Environment Conservation	Reduction of excessive water use	High	As hot water supply facilities are improved, amount of water use is reduced.	4.0	0.48	1.92	2.40
			Water pollution by operation of hot water	Normal	Water quality remains current.	3.0	0.48	1.44	2.40
		Global Environment Conservation	Energy efficiency improvement of	High	Heat efficiency is improved.	4.0	0.36	1.44	1.80
			Climate change adaptation measurement	High	As large-scale HOB will be consolidated, coal consumption and CO_2 emission decrease.	4.0	0.36	1.44	1.80
	Sub-total							8.76	12.00
	Local Economy	Expansion of Production	Increase number of HOB production	Low	Target HOBs are repealed, total number of HOBs is decrease, number of HOB production decrease.	2.0	0.30	0.60	1.50
			Increase of improved fuel production	Normal	As the system for producing improved fuel has already been established. The impact on the local economy is small.	3.0	0.30	0.90	1.50
		Increase of Employment	Creation of new employment	Normal	Increase of employment for boiler maintenance companies, decrease of employment for HOBs boiler man before they were decommissioned.	3.0	0.60	1.80	3.00
	Sub-total							3.30	6.00
Sub-total								20.70	30.00
Investment Impact	Cost-Effectiveness			Normal	Air quality is slightly improved, initial cost is required.	3.0	1.60	4.80	8.00
	Profitability			Normal	Profitability is not changed.	3.0	0.40	1.20	2.00
Sub-total								6.00	10.00
Application for the Japanese technologies	Competitiveness of the Technology	Possibility of the Future Business Development		Low	If the scale of the target facility is large, there is a possibility, but the current development is not very promising.	2.0	0.80	1.60	4.00
		Uniqueness and Superiority of the Technology		Very Low	The Czech Republic, Hungary, and China have advanced technologies for hot water boilers using coal and improved fuels	1.0	1.60	1.60	8.00
		Operation and Maintenance by the Local Agency		Normal	HOB operation and maintenance companies can support, but it is difficult if the number of operations is large.	3.0	1.20	3.60	6.00
		Degree of Interest by the Japanese Firms		Very Low	Japanese companies have been mainly developing coal steam boilers and do not have much interest in hot water boilers.	1.0	0.40	0.40	2.00
Sub-total								7.20	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		Very Low	Construction of new hot water boilers is not recommended as part of Mongolia's air quality policy.	1.0	1.00	1.00	5.00
		Relevance with Other Plans		Very Low	Although the project is related to the Ger Area Environmental Improvement Project, it does not support the promotion of hot water boilers.	1.0	1.00	1.00	5.00
		Capacity of Implementing Agency		Normal	The Mongolian hot water boiler maintenance companies are engaged in the hot water boiler maintenance work; they have the necessary technical skills and do not require any special training.	3.0	1.00	3.00	5.00
		Situation of Development of Institutional Frameworks		Very Low	Although the project is related to the Ger Area Environmental Improvement Project, it does not support the promotion of hot water boilers.	1.0	1.00	1.00	5.00
	Sub-total							6.00	20.00
	Requests from the Mongolian Government			Very Low	There are no requests from the partner country regarding the hot water boilers.	1.0	4.00	4.00	20.00
	Sub-total							4.00	20.00
Sub-total								10.00	40.00
					Ground Total			**43.90**	**100**

No.	**Air01**
Project Name	Installation of improved coal-fired hot water supply boilers

Overall Evaluation

As this is a project on hot water supply using coal, there is an effect on air pollution control, but since coal or improved fuel is used as it is, the effect on air pollution control is around 30%. However, the short-term effect on air pollution control can be expected. The phase-out of HOB has been indicated in the National Program on Reducing Environment Pollution. If the scale of the project is not big, the project is suitable for a two-step loan.

Remarks

Japanese companies have been developing coal steam boilers for large-scale thermal power plants and have not developed hot water boilers of a size suitable for Mongolia. Therefore, the introduction of hot water boilers will be a technology from China, the Czech Republic, Hungary, and other countries that have already advanced their businesses in Mongolia, and there is little possibility for Japanese companies to advance their business in Mongolia.

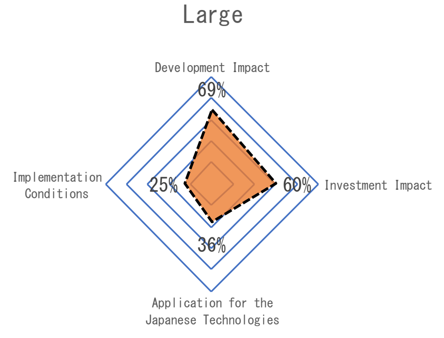
Comments by the Mongolian Government

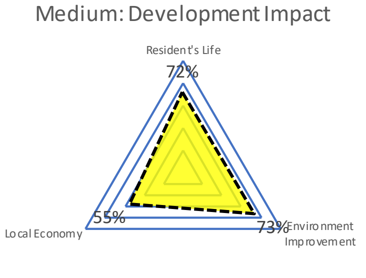
The National Program on Environmental Pollution Reduction, hot water boilers is being phased out, and there are no requests from the partner country regarding the hot water boilers.

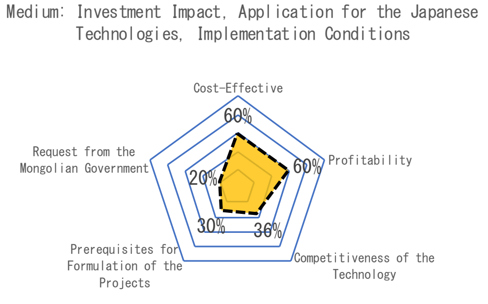
Consideration of Technical Assistance related to Yen Loan

As there is no request from the Mongolian side, no paid account ancillary technologies will be considered.

Charts







(2) Air02: Central Heating Using Renewable Energy, Incineration Equipment, etc.

a. Outline and Purpose of the Project

In order to increase the share of renewable energy in the total power generation in Mongolia, a 10 MW class photovoltaic power generation system will be installed in the outskirts of UB City. The main equipment for the solar power generation is as shown in **Table 5.9**.

Table 5.9 Main Equipment for Solar Power Generation

Items	Capacity	Number of Sets	Remarks
1. Solar Panel	Panel efficiency of about 260W, conversion efficiency of about 16%.	1 Set	Power generation capacity of about 10MW
2. Power Conditioner		2 Sets	Convert DC electricity generated from solar panels to AC.
3. Power Transmission Equipment	15MW	1 Set	

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.10** and the evaluation criteria are shown in **Table 5.11**.

Table 5.10 Individual Evaluation Items and Evaluation Criteria (Air02)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Expansion of supply service area related to hot water for heating	**Table 5.11**
			Reduction of burden on residents	**Table 5.11**
		Enlargement of Activity Range	Increased activities in public facilities	**Table 5.11**
		Enhancement of Amenity	Improvement of dwelling environment	**Table 5.11**
			Improvement of indoor environment	**Table 5.11**
	Environmental Improvement	Living Environment Conservation	Improvement of air pollution problem	**Table 5.11**
			Increase of coal ash	**Table 5.11**
		Natural Environment Conservation	Reduction of excessive water use	**Table 5.11**
			Deterioration of the surrounding environment	**Table 5.11**
		Global Environment Conservation	Decrease of Green House Gas	**Table 5.11**
			Climate change adaptation measurement	**Table 5.11**
	Local Economy	Expansion of Production	Direct effect by JICA projects	**Table 5.11**
			Production in Mongolia	**Table 5.11**
		Increase of Employment	Creation of new employment	**Table 5.11**
Investment Impact		Cost-Effectiveness		**Table 5.11**
		Profitability		**Table 5.11**

Table 5.11 Evaluation Criteria (Air02)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

The construction of district heating facilities will improve the comfort, as indoor combustion will be eliminated. However, the burden on citizens will increase due to the collection of heating fees.

Environmental improvement

Compared to individual heating, the concentration of PM and SO_2 in the air will be reduced, and the use of coal-fired stoves will be discontinued, resulting in less coal ash.

Local economy

There will be little direct impact in terms of increased production. It will lead to the creation of new jobs since new personnel will be needed for operation and maintenance of the facility, but it will come to an even situation, since the employment at the discontinued HOBs will be reduced.

(ii) Investment Impact

Cost-effectiveness

A solar power plant has already been constructed near the new Ulaanbaatar airport and is scheduled to supply electricity to the new airport. It is necessary to avoid this existing solar facility, and from the perspective of reducing power transmission losses, it is necessary to construct the project in the suburbs of Ulaanbaatar. The initial cost will be high and the running cost will be about 50 million yen/year. As a result, the unit price of electricity will be very high, and the fees paid by residents will increase.

Profitability

The cost of power generation is high, so the burden on citizens will increase, and it is not sufficiently profitable to meet the purchase price.

(iii) Application of Japanese Technology

Possibility of future business development

If the scale of the facility is large, there is potential for business development.

Uniqueness and superiority of the technology

There are similar technologies in China for solar power generation.

Operation and maintenance by the local agency

A private company in Mongolia is engaged in the construction and maintenance of solar power generation in a provincial city. O&M in Ulaanbaatar is an unknown quantity.

Degree of interest by Japanese firms

Interest is relatively high.

(iv) Implementation Condition

Relevance with upper plans

The national plan calls for increased power generation from renewable energy sources.

Relevance with other plans

None.

Capacity of implementing agency

Since there are solar power generation facilities already in operation in Mongolia, the company has the operating technology. It is necessary to be able to maintain the power purchase price.

Situation of development of institutional frameworks

A feed-in tariff (FIT) system has been introduced for power generation from renewable energy sources. The purchase price is about 16¢ (cents)/kWh × 2800 MNT/UDS = around 450 MNT/kWh, and the unit price for coal-fired power generation in 2018 was 168.75 MNT/kWh, a difference of almost three times. The purchase price is 23.79 MNT/kWh, which is added to the electricity price as a renewable energy levy.

Request from the Mongolian Government

As a matter of national policy, there is a desire to increase power generation from solar power. However, although there will be an increase in power generation from renewable energy sources, the business potential in Ulaanbaatar is low due to low profitability.

c. Overall Evaluation

As for renewable energy, wind and hydropower are unlikely, and only solar power is possible. As for the heat supply required for central heating, it is difficult to supply hot water from the incineration plant, and there is a possibility of building a complex facility using large-scale boilers that use improved fuel.

As for photovoltaic power generation, the price of solar panels made in China is superior, and the competition among Japanese companies is not so high for yen loan projects.

d. Remarks

China has technological and price advantages in solar power generation and large-scale boilers, making it difficult for Japanese companies to consider these projects as yen loan projects. The interest of Japanese companies remains relatively high.

e. Comments by the Mongolian Government

The National Program on Reducing Environment Pollution has set a goal of increasing the share of renewable energy in total power generation to 30%; as of the end of 2020, the share of renewable energy has reached about 29%. Since solar power generation has problems with power supply at times of high power load and unstable power supply, Mr. Davaasuren, Director General of the Fuel Policy Bureau of the Ministry of Energy, said that the Ministry of Energy would not promote it that much in the future.

f. Consideration of Technical Assistance Related to Yen-Loan

There is a request from the Mongolian side for renewable energy, but due to the low business potential in Ulaanbaatar, no consideration will be given to paid account ancillary technology.

Table 5.12 Evaluation Result Summary (Air02)

No.	**Air02**
Project Name	Central heating using renewable energy
Implementing Agency	Ministry of Energy
Relating Agency	Ministry of Mining and Heavy Industry, Ulaanbaatar City
Project Cost	Approximately 3 billion Yen

Outline and Objective of the Project

In order to increase the share of renewable energy in the total power generation in Mongolia, a 10 MW class photovoltaic power generation system will be installed in the outskirts of Ulaanbaatar city.

Evaluation Item: Large	Evaluation Item: Medium	Evaluation Item: Small		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development impact	Resident's Life	Improvement of Public Services	Expansion of supply service area related to hot water for heating	High	Supply service is improved by supply of district heating facilities.	4.0	0.48	1.92	2.40
			Reduction of burden on citizen	Very Low	Increase burden (increase by coal fired HOB, renewable energy).	1.0	0.48	0.48	2.40
		Enlargement of Activity Range	Increased activities in public facilities	High	Increase in suburbs, status quo in downtown.	4.0	0.72	2.88	3.60
					As HOBs will be consolidated, the concentration of PM in the air will be reduced to some extent.				
		Enhancement of Amenity	Improvement of dwelling	High	There is no combustion in the indoor, dwelling environment is improved.	4.0	0.36	1.44	1.80
			Improvement of indoor	High	Infrastructure is improved. Indoor environment is improved.	4.0	0.36	1.44	1.80
	Sub-total							8.16	12.00
	Environment Improvement	Living Environment Conservation	Improvement of air pollution problem	High	Reduction of concentration of PM and SO2 in the air.	4.0	0.36	1.44	1.80
			Increase of coal ash	High	It has the effect of discontinuing the use of ger stoves.	4.0	0.36	1.44	1.80
		Natural Environment Conservation	Reduction of excessive water use	Low	Increased use of hot water for heating due to facility operation.	2.0	0.48	0.96	2.40
			Deterioration of the surrounding	Low	Destruction of nature due to construction and operation of facilities.	2.0	0.48	0.96	2.40
		Global Environment Conservation	Decrease of Green House Gas	High	Reduction of coal consumption through use of renewable energy.	4.0	0.36	1.44	1.80
			Climate change adaptation measurement	Normal	No effect.	3.0	0.36	1.08	1.80
	Sub-total							7.32	12.00
	Local Economy	Expansion of Production	Direct effect by JICA projects	Normal	There is low impact on local economy.	3.0	0.30	0.90	1.50
			Production in Mongolia	Very Low	There will be little direct impact in terms of increased production.	1.0	0.30	0.30	1.50
		Increase of Employment	Creation of new employment	Normal	New personnel will be needed for operation and maintenance of the facility, as the employment at the discontinued HOBs will be reduced.	3.0	0.60	1.80	3.00
	Sub-total							3.00	6.00
Sub-total								18.48	30.00
Investment Impact	Cost-Effectiveness			Ver Low	The unit price of electricity will be very high, and the fees paid by citizens will increase.	1.0	1.60	1.60	8.00
	Profitability			Ver Low	The cost of power generation is high, it is not sufficiently profitable to meet the purchase price.	1.0	0.40	0.40	2.00
Sub-total								2.00	10.00
Application for the Japanese technologies	Competitiveness of the Technology	Possibility of the Future Business Development		Normal	If the scale of the facility is large, there is potential for business development.	3.0	0.80	2.40	4.00
		Uniqueness and Superiority of the Technology		Normal	There are similar technologies in China for solar power generation.	3.0	1.60	4.80	8.00
		Operation and Maintenance by the Local Agency		Low	A private company in Mongolia is engaged in the construction and maintenance of solar power generation in a provincial city. O&M in Ulaanbaatar is an unknown quantity.	2.0	1.20	2.40	6.00
		Degree of Interest by the Japanese Firms		Normal	Interest of Japanese firms is relatively high, It is not very competitive with China in terms of cost.	3.0	0.40	1.20	2.00
Sub-total								10.80	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	As a matter of national policy, there is a desire to increase power generation from solar power.	4.0	1.00	4.00	5.00
		Relevance with Other Plans		Ver Low	None particular.	1.0	1.00	1.00	5.00
		Capacity of Implementing Agency		Low	Mongolian company has the operating technology, but Mongolian companies do not have financially maintenance for operating solar power generation.	2.0	1.00	2.00	5.00
		Situation of Development of Institutional Frameworks		Normal	A feed-in tariff (FIT) system has been introduced for power generation from renewable energy sources.	3.0	1.00	3.00	5.00
	Sub-total							10.00	20.00
	Requests from the Mongolian Government			Normal	There will be an increase in power generation from renewable energy sources, the business potential in Ulaanbaatar is low due to low profitability.	3.0	4.00	12.00	20.00
	Sub-total							12.00	20.00
Sub-total								22.00	40.00
					Ground Total			**53.28**	**100**

No.	**Air02**
Project Name	Central heating using renewable energy

Overall Evaluation

As for renewable energy, wind and hydropower are unlikely, and only solar power is possible. As for the heat supply required for central heating, it is difficult to supply hot water from the incineration plant, and there is a possibility of building a complex facility using large-scale boilers that use improved fuel.

Remarks

China has technological and price advantages in solar power generation and large-scale boilers, making it difficult for Japanese companies to consider these projects as yen loan projects. The interest of Japanese companies remains relatively high.

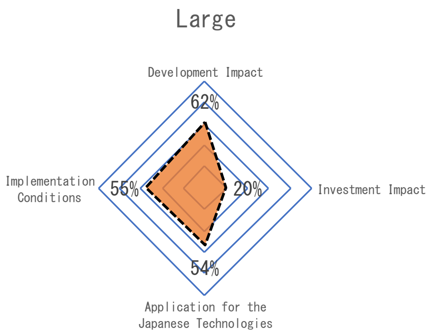
Comments by the Mongolian Government

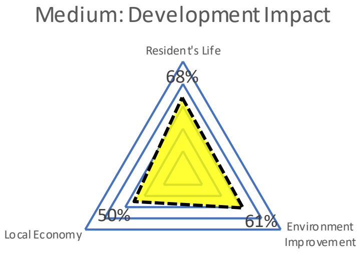
National Program on Reducing Environment Pollution has set a goal of increasing the share of renewable energy in total power generation. There are requests from the Ministry of Energy. We are reconfirming the requests from partner countries.

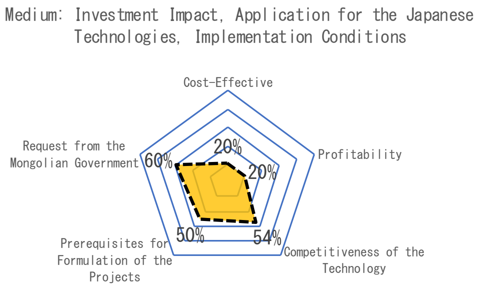
Consideration of Technical Assistance related to Yen Loan

There is a request from the Mongolian side for renewable energy, but due to the low business potential in Ulaanbaatar, no consideration will be given to paid account ancillary technology.

Charts







(3) Air03: LNG/CNG Introduction Infrastructure Development

a. Outline and Purpose of the Project

To promote the use of imported LNG as an alternative fuel to coal in Ulaanbaatar by considering the import of 100,000 tons of LNG per year as a model plant, the project aims to convert the No.2 power plant to a gas turbine (2×50MW) after the completion of the FS, and to supply buses and other public vehicles with LNG, which in turn will present the need for CNG storage facilities, CNG supply stations, and safety measure facilities. This is expected to reduce the air pollution at a significant level. This is also expected to be used as a household fuel in the future.

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.13** and the evaluation criteria are shown in **Table 5.14**.

Table 5.13 Individual Evaluation Items and Evaluation Criteria (Air03)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Expansion of hot water supply services	**Table 5.14**
			Reduction of resident's burden	**Table 5.14**
		Enlargement of Activity Range	Increased activities in public facilities	**Table 5.14**
		Enhancement of Amenity	Reduced heating service breakdowns	**Table 5.14**
			Easier temperature control	**Table 5.14**
	Environmental Improvement	Living Environment Conservation	Atmospheric PM concentration improvement	**Table 5.14**
			Improvement of SO_2 concentration in the atmosphere	**Table 5.14**
		Natural Environment Conservation	Landfill of incinerated ash	**Table 5.14**
		Global Environment Conservation	Global warming gas reduction	**Table 5.14**
			Climate change mitigation measures	**Table 5.14**
	Local Economy	Expansion of Production	Expansion of heat supply	**Table 5.14**
		Increase of Employment	Development of infrastructure for improved heat source	**Table 5.14**
Investment Impact		Cost-Effectiveness		**Table 5.14**
		Profitability		**Table 5.14**

Table 5.14 Evaluation Criteria (Air03)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Resident's life

Good for the environment. Fuel cost will be higher than of the existing improved fuels due to conversion to convenient fuels, thus increasing the burden on residents.

Environmental improvement

Fuel conversion will reduce air pollutants. In addition, the natural environment will be greatly improved since the incinerated ash will be eliminated. Furthermore, CO_2 emissions will be reduced in comparison to coal fuel.

Local economy

LNG as an alternative fuel will replace coal as an improved fuel, expanding the types of heat supply. Since the amount of consumption will be determined by cost-effectiveness, the scale of infrastructure development will affect the increase in employment.

(ii) Investment Impact

Cost-effectiveness

Since it is a cost-benefit relationship with the environmental pollution situation, it is related to the cost of environmental pollution and the effect of reducing health hazards for residents.

Profitability

Economies of scale in the infrastructure development costs can be expected depending on the amount of consumption.

(iii) Application of Japanese Technology

Possibility of future business development

Since Japan uses a large amount of imported LNG, there is a great potential for utilizing infrastructure technologies in many fields, from LNG/CNG storage and handling technologies to safety measures.

Uniqueness and superiority of the technology

Similar technology exists in China.

Operation and maintenance by the local agency

It is necessary to establish a new system.

Degree of interest by Japanese firms

Interest is high.

(iv) Implementation Condition

Relevance with upper plans

Related to the Five-Year Basic Policy of Mongolia.

Relevance with other plans

The project is highly related to the Environmental Improvement. Project for Ger Area (ADB, China).

Capacity of implementing agency

Since this is the initial introduction of LNG and CNG, there is no technical capacity, and the financial capacity is weak because the evaluation is unknown.

<u>Situation of development of institutional frameworks</u>

The system on the use of LPG is already in place.

<u>Request from the Mongolian Government</u>

The Mongolian Government's future implementation plan has not materialized.

c. Overall Evaluation

The future direction of alternative fuels to coal depends on many factors, and it is assumed that the government is still undecided. F/S for gas power generation using imported LNG at No.2 power plant, and the policy of converting public transport vehicles to CNG are becoming apparent. A pipeline project for CNG from Russia to China via Mongolia is also in progress.

d. Remarks

Since Japan uses a large amount of imported LNG, there is a great potential for utilization of infrastructure technology in many fields, from LNG and CNG storage and handling technology to safety measures.

e. Comments by the Mongolian Government

None.

f. Consideration of Technical Assistance Related to Yen-Loan

None.

Table 5.15 Evaluation Result Summary (Air03)

No.	**Air03**
Project Name	LNG and CNG Installation Infrastructure Development
Implementing Agency	Ministry of Energy — Relating Agency: Ulaanbaatar City
Project Cost	2-2.5 billion yen (assuming annual LNG imports of 100,000 tons)

Outline and Objective of the Project

To import 100,000 tons/year of imported LNG, to develop infrastructure such as LNG receiving facilities , CNG storage facilities, CNG supply stands and safety facilities to supply them a generation plant and other public vehicles for the time being.

Evaluation Item: Large	Medium	Small		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development inpact	Resident's Life	Improvement of Public Services	Expansion of hot water supply	High	Expansion of heat supply coverage in ger districts that are not connected to the central heat supply network.	4.0	0.48	1.92	2.40
			Reduction of citizen burden	Low	Increasing burden of higher fuel costs than existing improved fuels due to conversion to more convenient fuels	2.0	0.48	0.96	2.40
		Enlargement of Activity Range	Increased activity in public facilities	High	Increased in central and suburban cities	4.0	0.72	2.88	3.60
		Enhancement of Amenity	Reduced heating service breakdowns	High	Combustion equipment becomes simpler.	4.0	0.36	1.44	1.80
			Easier temperature control	Very High	Easy fuel adjustment allows infinitely variable temperature contro	5.0	0.36	1.80	1.80
	Sub-total							9.00	12.00
	Environment Improvement	Living Environment Conservation	Atmospheric PM concentration improvement	Very High	Reducing Air Pollutants through Fuel Conversion	5.0	0.36	1.80	1.80
			Improvement of SO_2 concentration in the atmosphere	Very High	Reducing Air Pollutants through Fuel Conversion	5.0	0.36	1.80	1.80
		Natural Environment Conservation	Landfill of incinerated ash	Very High	No more incinerator ash	5.0	0.96	4.80	4.80
		Global Environment Conservation	Global warming gas reduction	Very High	CO_2 reduction compared to coal combustion	5.0	0.36	1.80	1.80
			Climate change mitigation measures	Very High	CO_2 reduction compared to coal combustion	5.0	0.36	1.80	1.80
	Sub-total							12.00	12.00
	Local Economy	Expansion of Production	Expansion of heat supply	High	Expand the types of heat supply, although this will vary depending on the implementation steps	4.0	0.60	2.40	3.00
		Increase of Employment	Infrastructure development with improved heat sources	High	Improved from current situation Increased employment due to infrastructure development, although this will vary depending on	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
Sub-total								25.80	30.00
Investment Impact	Cost-Effectiveness			Normal	Varies with implementation steps	3.0	1.60	4.80	8.00
	Profitability			Normal	Varies with implementation steps	3.0	0.40	1.20	2.00
Sub-total								6.00	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Very High	Expectations for multifaceted use of infrastructure technologies ranging from LNG and CNG storage and handling technologies to safety measures	5.0	0.80	4.00	4.00
		Uniqueness and Superiority of the Technology		Normal	Similar technology exists in China	3.0	1.60	4.80	8.00
		Operation and Maintenance by the Local Agency		Very Low	Need to establish a new system	1.0	1.20	1.20	6.00
		Degree of Interest by the Japanese Firms		Very High	Interest is high	5.0	0.40	2.00	2.00
Sub-total								12.00	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	Relevant to the Five-Year Basic Policy for Mongolia	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	Relevance to the Ger Area Environmental Improvement Project (ADB, China) is high	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Very Low	Since this is the first time to introduce LNG and CNG, there is no technical capability and the financial capability is weak since the evaluation is unknown.	1.0	1.00	1.00	5.00
		Situation of Development of Institutional Frameworks		High	There is a system in place for LPG use	4.0	1.00	4.00	5.00
	Sub-total							13.00	20.00
	Requests from the Mongolian Government			Low	No request from the lead agency yet, as the future implementation plan for LNG has not been finalized	2.0	4.00	8.00	20.00
	Sub-total							8.00	20.00
Sub-total								21.00	40.00
					Ground Total			**64.80**	**100**

No.	**Air03**
Project Name	LNG and CNG Installation Infrastructure Development

Overall Evaluation

The future direction of alternative fuels to coal is a matter of many factors, and I suspect that the government is currently in a situation where it cannot make up its mind, but the use of gas is being considered as an alternative to the coal and improved coal-based fuels currently in use to combat air pollution.
F/S for coal gasification, F/S for gas power generation using imported LNG at No.2 power plant, and the policy of converting public transport vehicles to CNG are becoming apparent. Also, a pipeline project for CNG sent from Russia to China via Mongolia is in progress.

Remarks

Since Japan uses a large amount of imported LNG, there is a great potential for the use of infrastructure technology in many fields, from LNG and CNG storage and handling technology to safety measures.

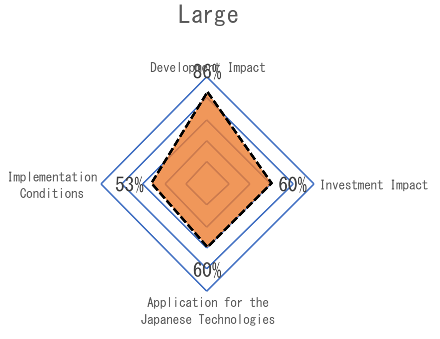
Comments by the Mongolian Government

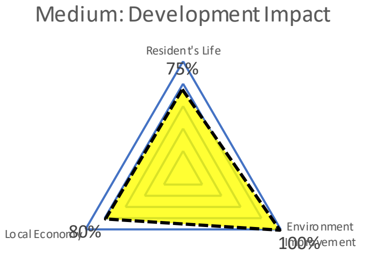
As the future implementation plan of the Mongolian government has not been materialized, there is no comment from the partner country.

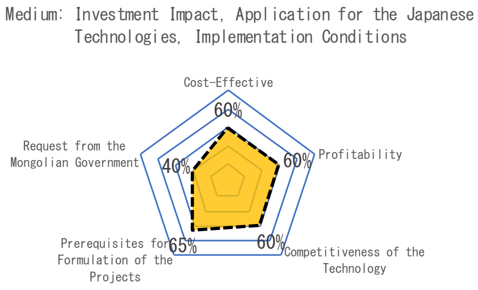
Consideration of Technical Assistance related to Yen Loan

None

Charts







(4) Air04: Construction of Improved Fuel Manufacturing Plant

a. Outline and Purpose of the Project

In UB City, two improved fuel production plants owned by Tawang Tolgoi Tulsh (TTT), a state-owned company established under the Government Decree No. 387, are currently in operation. The improved fuels that are currently being produced still have some issues to be addressed to reduce air pollution. Therefore, in order to improve the quality of the improved fuel that is currently being produced, equipment will be added to the existing plant facilities, and some equipment will be replaced. The improvement of the upgraded fuel will significantly reduce air pollution compared to the existing upgraded fuel.

Table 5.16 shows the major replacement and additional equipment. The number of units is based on the assumption that the annual production capacity of the improved fuel is 600,000 tons and the annual actual operation time is 5,000 hours. The number of crushers and grinding mills will be changed depending on the choice of materials to be mixed in the upgraded fuel, such as semi-coke and biomass, but the number of the expensive high-pressure molding machines will not be changed.

Table 5.16 Major Equipment Required for Upgrading the Improved Fuel Fabrication Plant

Items	Capacity	Number of Sets	Remarks
1. High pressure molding machine	15 ton/hour	8	Roll type
2. Crusher (A)	10 ton/hour	2	Hammer type Crusher
3. Crusher (B)	3 ton/hour	6	Pin type crusher
4. Hopper, conveyor etc.		1set	
5. Spare parts		1set	

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.17** and the evaluation criteria are shown in **Table 5.18**.

Table 5.17 Individual Evaluation Items and Evaluation Criteria (Air04)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Reduction of burden on residents	**Table 5.18**
		Enlargement of Activity Range	Increased activities in public facilities	**Table 5.18**
		Enhancement of Amenity	Increased activities in public facilities	**Table 5.18**
	Environmental Improvement	Living Environment Preservation	Atmospheric PM concentration improvement	**Table 5.18**
			Improvement of SO_2 concentration in the atmosphere	**Table 5.18**
		Natural Environment Conservation	Conservation of the natural environment in coal mining areas	**Table 5.18**
			Use of biomass as an additive	**Table 5.18**
		Global Environment Conservation	Gas reduction related to global warming	**Table 5.18**
			Climate change mitigation measures	**Table 5.18**

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
	Local Economy	Expansion of Production	Increase in production volume	**Table 5.18**
		Increase of Employment	Increased employment	**Table 5.18**
Investment Impact		Cost-Effectiveness		**Table 5.18**
		Profitability		**Table 5.18**

Table 5.18 Evaluation Criteria (Air04)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Resident's life

The improvement of public services and the expansion of the range of activities are improvements to the existing plant, so the evaluation is to maintain the current status. However, for the improvement of comfort, the combustion of the fuel is better than that of the existing improved fuel, so less combustion material such as wood is needed, and the temperature is going to rise faster due to better combustion, which is expected to be appreciated.

Environmental improvement

Atmospheric PM and SO_2 concentrations will be greatly improved by the improved fuel in the additional plant. In addition, the increased combustion efficiency of the improved fuel is expected to reduce the amount of coal used, and the addition of biomass will also reduce the amount of coal used, leading to a reduction in CO_2 emissions.

Local economy

The increased use of improved fuels will lead to an increase in production volume, which will in turn lead to an increase in employment, since there will be a need for personnel for the improved fuel manufacturing plant and personnel for the distribution of improved fuels.

(ii) Investment Effect

Cost-effectiveness

The direct beneficiary's investment effect will be the introduction of high-pressure molding machines, which will significantly reduce the addition rate of expensive binders or enable molding without binders, contributing to cost reduction.

Profitability

To increase profitability, subsidies from the Mongolian government are essential.

(iii) Application of Japanese Technology

Possibility of future business development

The high-pressure molding machine, which is the core of the Japanese technology, is used in a wide range of molding fields in Japan and has a high potential for business development.

Uniqueness and superiority of the technology

There are only a few companies outside of Japan that have high-pressure molding machine technology, and by using high-pressure molding machines to produce improved fuels, the rate of binder addition can be reduced, or molding can be done without binders, resulting in lower production costs.

Operation and maintenance by the local agency

The local O&M system is inadequate, and the existing plant system needs to be reinforced.

Degree of interest by Japanese firms

Interest is high.

(iv) Implementation Condition

Relevance with upper plans

Related to the Mongolian Five-Year Basic Policy to reduce air pollution by 80%.

Relevance with other plans

The project will be for the improvement of an existing plant.

Capacity of implementing agency

The company operates an existing plant, and has overall operation and management skills, but the high-pressure molding machines are expensive, and the company's financial situation for procurement is weak.

Situation of development of institutional frameworks

The existing plant is in operation as a public enterprise, so the institutional status is good.

Request from the Mongolian Government

There is a strong demand to improve the quality and reduce manufacturing costs.

c. Overall Evaluation

There will be no demand for a new production plant, since a plant with the production capacity to meet the demand was completed in December 2020. On the other hand, there are many issues with the existing improved fuel, and it is expected that quality measures for the improved fuel will be required in the future. In terms of improvements, it is expected that the results of the "Capacity Development Project for Air Pollution Control in Ulaanbaatar City (Phase 3)" for which JICA technical cooperation is currently underway, will be utilized in future business developments. As a project to promote the use of improved fuels to reduce air pollution in Mongolia, additional facilities are expected for production of improved fuels that would reduce production costs and environmental impact using Japanese technology.

d. Remarks

The high-pressure molding machine, which is the core of this technology in Japan, is used in a wide range of molding fields in Japan, so there is a high potential for business development. In addition, there are only a few countries other than Japan that have high-pressure molding machine technology, and the production of improved fuels using high-pressure molding machines has the advantage of reducing the rate of binder addition, which results in lower production costs, making it very competitive.

e. Comments by the Mongolian Government

There is a strong demand to improve quality and reduce manufacturing costs. On the other hand, the survey team's impression is that the air pollution status of the existing improved fuel will be assessed in the winter of 2020-2021, and the Mongolian side's intention to improve the plant may change depending on the results of the assessment.

f. Consideration of Technical Assistance Related to Yen-Loan

None.

Table 5.19 Evaluation Result Summary (Air04)

No.	**Air04**		
Project Name	Improvement of equipment in the production plant for upgrading the improved fuel		
Implementing Agency	Ministry of Energy	Relating Agency	
Project Cost	3.5 to 4 billion yen		

Outline and Objective of the Project

In order to improve the quality of the improved fuel currently being produced, equipment will be added to the existing plant facilities and some equipment will be replaced. The additional equipment will include a crusher, a high-pressure molding machine, and handling equipment such as conveyors, while the replacement equipment will include the existing molding machine.

Evaluation Items				Evaluation Result	Evaluation Grounds	Rating	Weight	Rating * Weight	Full Scale
Large	Medium	Small							
Development inpact	Resident's Life	Improvement of Public Services	Reduced burden on citizens	Normal	Same price as existing improved fuel	3.0	0.96	2.88	4.80
		Enlargement of Activity Range	Increase activities at public facilities	Normal	Same as existing improved fuel	3.0	0.72	2.16	3.60
		Enhancement of Amenity	Improving the living environment	High	Less ignition material such as wood is needed because of its good ignitability, and the temperature rises faster due to better combustion.	4.0	0.72	2.88	3.60
	Sub-total							7.92	12.00
	Environment Improvement	Maintenance of Living Environment	Improvement of atmospheric PM concentration	Very High	Improved living environment through improved and upgraded fuel produced by additional equipment	5.0	0.36	1.80	1.80
			Improvement of atmospheric SO2 concentration	Very High	Same as above	5.0	0.36	1.80	1.80
		Maintenance of Natural Environment	Preserving the natural environment of coal mining areas	High	Reducing the amount of coal mining	4.0	0.48	1.92	2.40
			Use of biomass as an additive	Normal	Use of waste biomass	3.0	0.48	1.44	2.40
		Maintenance of Global Environment	Decrease in coal use	High	Reduction of coal consumption by increasing combustion efficiency of improved fuels	4.0	0.36	1.44	1.80
			Climate change mitigation measures	High	Reduction of CO2 emissions by reducing the amount of coal by adding biomass	4.0	0.36	1.44	1.80
	Sub-total							9.84	12.00
	Local Economy	Expansion of Production	Increased production	High	Increased production due to increased use of improved fuel	4.0	0.60	2.40	3.00
		Increase of Employment	Increase in employment	High	Increase in employment of personnel at the improved fuel manufacturing plant and personnel to distribute the improved fuel (municipal office)	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
Sub-total								22.56	30.00
Investment Impact	Cost-Effectiveness			High	Easier to use than existing fuels due to better flammability	4.0	1.60	6.40	8.00
	Profitability			Low	Subsidies from the Mongolian government are essential	2.0	0.40	0.80	2.00
Sub-total								7.20	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		High	High possibility of deployment using Japanese technology	4.0	0.80	3.20	4.00
		Uniqueness and Superiority of the Technology		High	Introduction of Japanese technology can improve improved fuels and lower production costs.	4.0	1.60	6.40	8.00
		Operation and Maintenance by the Local Agency		Low	Need to reinforce the existing plant system.	2.0	1.20	2.40	6.00
		Degree of Interest by the Japanese Firms		Very High	High interest	5.0	0.40	2.00	2.00
Sub-total								14.00	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		Very High	Related to Mongolia's Five-Year Basic Policy to Reduce Air Pollution by 80%	5.0	1.00	5.00	5.00
		Relevance with Other Plans		Very High	This will be an improvement of the existing plant.	5.0	1.00	5.00	5.00
		Capacity of Implementing Agency		Normal	The plant is currently in operation and has operating technology, but the high-pressure molding machine is expensive and financially weak.	3.0	1.00	3.00	5.00
		Situation of Development of Institutional Frameworks		Very High	The existing plant is operated by a public company, so the institutional status is good.	5.0	1.00	5.00	5.00
	Sub-total							18.00	20.00
	Requests from the Mongolian Government			High	There is a strong demand for improvements to improve quality and reduce manufacturing costs.	4.0	4.00	16.00	20.00
	Sub-total							16.00	20.00
Sub-total								34.00	40.00
					Ground Total			**77.76**	**100**

No.	Air04
Project Name	Improvement of equipment in the production plant for upgrading the improved fuel

Overall Evaluation

There will be no demand for a new production plant, as a plant with the production capacity to meet the demand is already scheduled for completion in November 2020. On the other hand, there are many issues with the existing upgraded fuel, and quality measures for the upgraded fuel are expected to occur in the future.
As for the contents of the improvement, it is expected that the results of JICA's Technical Cooperation "Capacity Development of Project for Air Pollution Control in Ulaanbaatar City (Phase 3)" will be utilized in the future development of the project.
As a project to promote the use of improved fuels for reducing air pollution in Mongolia, additional facilities for the production of improved fuels for reducing production costs and environmental impact using Japanese technology are expected.

Remarks

The high-pressure molding machine, which is the core of Japanese technology, is used in a wide range of molding fields in Japan, so there is high potential for business development.
As for the uniqueness and superiority of the target technology, there are only a few companies outside of Japan that have high-pressure molding machine technology, and the production of improved fuels using high-pressure molding machines has the advantage of reducing the rate of binder addition, resulting in lower production costs."

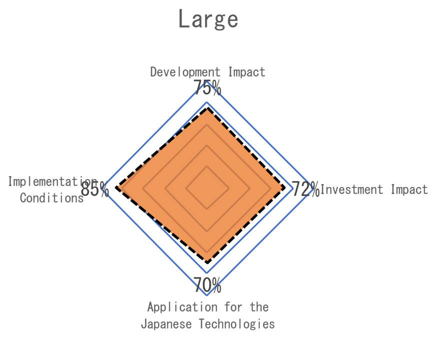
Comments by the Mongolian Government

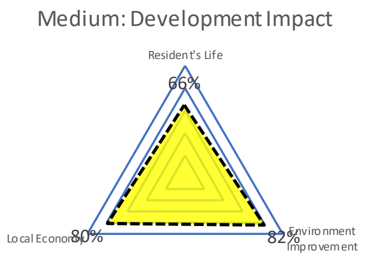
There is a strong demand for improvements to improve quality and reduce production costs. On the other hand, the survey team will evaluate the air pollution status of the existing improved fuel in the winter of 2020-2021, and the Mongolian side's intention to improve the plant may change depending on the results of the survey.

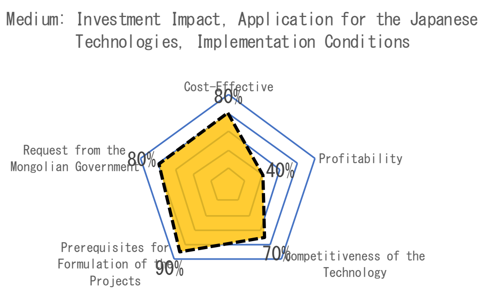
Consideration of Technical Assistance related to Yen Loan

Non

Charts







(5) Air05: Improvement of Intersections and Road Networks for the Mitigation of Traffic Congestion

a. Outline and Purpose of the Project

By grade separation of the intersection and connecting missing links, it is expected that average travel speed at intersections and adjacent roads is increased, and hazardous emissions such as NOx and PM and concentration in ambient air is reduced. Based on the UBRP, the following two projects were selected as the top priority projects with the highest environmental improvement effect and mitigation of traffic congestion.

(1) Ajilchin Flyover Project: 8 billion yen

(2) Green Avenue Project: 4 to 8.6 billion yen*

*Note：The construction cost of the Green Avenue Project is based on the estimation results of the UB Road Department (underpass with a length of 24m at the railway crossing and bridge length of about 440m at the crossing of the Tuul River). In some cases, the railroad crossing may be a flyover (bridge length about 500m) and the length of Tuul River crossing bridge may be about 800m, in which the construction cost may be about 2 times higher than original estimate.

b. Project Evaluation Results

Project evaluation has been conducted for this project. Individual evaluation items and evaluation criteria are shown in **Table 5.20** and **Table 5.21**, respectively.

Table 5.20 Individual Evaluation Items and Evaluation Criteria (Air05)

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
Development Impact	Residents' Life	Improvement of Public Services	Access to public facilities, etc.	**Table 5.21**
			Arterial traffic access	**Table 5.21**
		Enlargement of Activity Range	Residents' exchange opportunities	**Table 5.21**
			Access to recreational facilities	**Table 5.21**
		Enhancement of Amenity	Car traffic accident	**Table 5.21**
			Walking comfort	**Table 5.21**
	Environmental Improvement	Environment Conservation	PM concentration and NOx concentration in the target area	**Table 5.21**
		Natural Environment Conservation	Road flooding due to the maintenance of intersections	**Table 5.21**
		Global Environment Conservation	Generation of global warming gas	**Table 5.21**
	Local Economy	Expansion of Production	Logistics efficiency	**Table 5.21**
			Shortening of commuting time	**Table 5.21**
		Increase of Employment	Number of employees	**Table 5.21**
Investment Impact		Cost-Effectiveness		**Table 5.21**
		Profitability		**Table 5.21**

Table 5.21 Evaluation Criteria (Air05)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

By improving traffic congestion and adding a road network, the service level for traveling by car used by residents will be greatly improved. In addition, by integrating the grade separation project and street improvement, traffic safety and comfort for pedestrians and other vulnerable people will be greatly improved.

Environmental improvement

Hazardous Vehicle Emission (NOx, PM) along roads and its concentration in ambient air will be reduced by about 7%. Moreover, since road drainage is also integrated when the intersection is constructed, the city road drainage capacity during rainfall is enhanced and it will prevent the road from inundation by flood. In addition, it is possible to reduce CO_2 emission and reduce the impact to global warming by improving vehicle drivability and reducing fuel consumption.

Local economy

By strengthening the road network, the logistics function in UB City will be improved. Moreover, the productivity of business in the city will be increased by mitigating traffic congestion during commuting hours. In addition, it will contribute to the revitalization of the regional economy by increasing employment associated with large scale infrastructure public works projects.

(ii) Investment Impact

Cost-effectiveness

Economic benefit by the reduction of health hazard due to mitigation of vehicle emission, travel time saving and driving cost saving, as well as mitigation of traffic accident, are expected.

Profitability

Although maintenance costs are required for the year, it is considered that sufficient profitability can be secured. In the preparatory survey of the Ajilchin Flyover Project conducted in 2013, the economic internal rate of return (EIRR) of 15% has been estimated despite the complicated construction work on the railway track. The updated value of EIRR was not calculated in this survey; however, it could be the same value since the traffic volume in UB City has increased more than the forecast at the time of the FS in 2013, although it is expected that the unit price of materials, equipment and labour costs related to construction have increased.

(iii) Application of Japanese Technology

Possibility of future business development

Since the project is a large-scale infrastructure development project, it can be expected that Japanese firms (Contractors and Material Suppliers) will expand their business into the local market.

Uniqueness and superiority of the technology

Several advanced technologies required to construct a flyover on railways, such as bridge erection technology to cross railways, high durable structures that reduce maintenance costs, and quality control technology experienced in Japanese cold region, belong to Japanese firms.

In addition, with respect to seismicity in UB City which has been focused in recent years, it will be possible to construct high seismic resistance bridges by applying the design and structural know how developed in Japan, where many earthquake disasters have been experienced.

It is expected that Japanese technology developed under strict environmental regulations such as mitigation of noise and vibration in populated areas and precast pile work in environmental preservation areas such as water resources, will be utilized.

Operation and maintenance by the local agency

The "Project for Capacity Development of Bridge Maintenance (JICA: 2013 2015)" had transferred technology to the UBCG Road Department and MRTD staff regarding bridge inspection, diagnosis, and repair methods together with their manuals.

Degree of interest by Japanese firms

This is an infrastructure project in the capital city of Mongolia, and Japanese firms (contractors and material suppliers) are very interested in participating in the project. There are three past grant aid projects for the road sector in Mongolia, and Japanese companies showed interest in all of the projects.

(iv) Implementation Condition

Relevance with upper plans

The project is part of the road network development proposed under the Mid Term Road Development Plan in Ulaanbaatar City in compliance with UBMP2030, and has a high compatibility with the upper plans.

Relevance with other plans

Even though the continuity of the BRT project by ADB is not sure, subject projects are not located on the designed route of the BRT. In addition, there is less positional relationship with the METRO Project. Based on these facts, there will be less relationship with other projects to be coordinated except the railway underpass project planned by the DIIP with assistance from China.

Capacity of implementing agency

The project is a general public works project and does not require any special implementation capacity in terms of technology; however, financial burden for the Government of Mongolia will be large. It is expected that an organization, PMU (Project Management Unit), for implementing the project will be formed among the MRTD and the Road Department of UB City.

Situation of development of institutional frameworks

No new system is required to implement the construction work.

Requests from the Mongolian Government

The Government of Mongolia is concerned about the high cost although the demand by MRTD and UB City is very high.

c. Overall Evaluation

The two (2) projects have been selected as having high project effects from the six (6) projects that were proposed by Ulaanbaatar City as priority projects. The new road network and grade separation of intersection will improve the travel speed, save travel time and save vehicle operation cost, as well as improve air pollution by the reduction of vehicle emission.

Ajilchin Flyover Project:

High economic benefit and reduction of congestion are expected by diverting the traffic of Peace Avenue and Gulvaljin Street.

Green Avenue Construction Project:

This is to connect the existing road from south to north including railway crossing which is expected to distribute current traffic volume of the North-South direction. In addition, its functional importance will be very high since the new network will establish the shortest route from the new Ulaanbaatar City Government Building to the center of UB City. It will be required to use environment friendly construction method since it is located at the preservation area for water resources.

d. Remarks

It is expected that the following Japanese technologies will be utilized.

(i) Minimization of Lifecycle Cost by Using High Durable Material

"Steel-Concrete Composite Deck Slab" will be applied to the deck slab of bridge which has the highest potential to be deteriorated by traffic load, to increase durability and to minimize the lifecycle cost by reducing its maintenance cost.

(ii) Minimized Girder Bridge for Easy Maintenance

"Minimized Girder Bridge" developed in Japan is that number of members is reduced to minimize the time and cost for bridge maintenance.

(iii) Bridge Erection without Disturbance of Railway Operation and Existing Road Traffic

"Launching Method" that is commonly used in flyover construction in urban areas of Japan will be applied to railway/roadway flyover to construct the bridge girder without disturbance of traffic operation.

(iv) Minimum Disturbance of Round Condition by Special Steel Pile

"Rotary Penetration Steel Pipe Pile Method" can be applied for pile construction at the vicinity of railway and environmental preservation area at water resources to minimize the disturbance of the ground which will minimize the effect to railway as well as environmental conditions.

e. Comments by the Mongolian Government

As for the Ajilchin Flyover Project, it was understood that priority for UB City need to be discussed due to high construction cost although high project effect is expected.

The Green Avenue Construction Project is expected to be studied by JICA since the F/S of this project has not yet conducted.

f. Consideration of Technical Assistance Related to Yen-Loan

- The previous capacity development project, namely, the "Project for Capacity Development on Bridge Maintenance in Mongolia", have contributed to the sustainable maintenance of bridges in UB City; however, the expected expansion of road network and the structure will require more efficient maintenance. Technical transfer of advanced technology for bridge inspection and monitoring developed in recent years in Japan will be efficient to maintain the infrastructure by the limited human resources and maintenance budget.

- In UB City, the improvement of streets for pedestrians and bicycles is much focused in parallel with the improvement of traffic congestion. Technology transfer to improve the road safety and amenities, such as signalization, sidewalk and pedestrian crossing based on Japanese experience, will increase the efficiency of road construction projects.

Table 5.22 Evaluation Result Summary (Air05)

No.	**Air05**		
Project Name	Improvement of Intersections and Road Networks for the Mitigation of Traffic Congestion		
Implementing Agency	MRTD /Ulaanbaatar City	Relating Agency	
Project Cost	12～18 Billion JPY		

Outline and Objective of the Project

Hazard emission such as NOx and PM10 will be reduced by smooth travelling at intersection and its adjacent road due to grade separation and connection of missing link. (1) Ajilchin Flyover Project(8.0 Billion JPY), and (2) Green Avenue Construction Project (8.6 Billion JPY) have been selected as priority projects to be implemented.

Evaluation Item: Large	Evaluation Item: Medium	Evaluation Item: Small		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development impact	Resident's Life	Improvement of Public Services	Improvement of access to public facility	Very High	Travelling time to access public facility will be reduced and it will improve the access from Airport and urban area.	5.0	0.48	2.40	2.40
			Improvement of traffic flow	Very High	Traveling time of arterial road and secondly arterial road will be reduced.	5.0	0.48	2.40	2.40
		Enlargement of Activity Range	Intercommunication of Residents	High	Intercommunication opportunity for residents will be increased due to easy travelling.	4.0	0.36	1.44	1.80
			Improvement of access to recreation facility	Very Highly	Access to recreation facility and summer house in suburb of the Ulaanbaatar city will be convenient for the residents.	5.0	0.36	1.80	1.80
		Enhancement of Amenity	Resection of Traffic Accident	Very Highly	Risk on traffic accident will be mitigated due to grade separation.	5.0	0.36	1.80	1.80
			Improvement of Pedestrian's amenity	Very High	Amenity and safety of pedestrian will be improved due to construction of sidewalk, pedestrian crossing, and traffic signal under the project.	5.0	0.36	1.80	1.80
	Sub-total							11.64	12.00
	Environment Improvement	Living Environment Conservation	Reduction of PM and Nox	High	Travelling speed will be improved.	4.0	0.72	2.88	3.60
		Natural Environment Conservation	Reduction of inundation at intersection	High	Road drainage will be improved by road construction project.	4.0	0.96	3.84	4.80
		Global Environment Conservation	Reduction of CO2 Emission	High	Fuel consumption will be reduced.	4.0	0.72	2.88	3.60
	Sub-total							9.60	12.00
	Local Economy	Expansion of Production	Impact to effective logistic	Very High	Logistic Cost will be reduced due to the mitigation of traffic congestion.	5.0	0.30	1.50	1.50
			Travel time Saving	Very High	Travel time during commuting will be reduced.	5.0	0.30	1.50	1.50
		Increase of Employment	Expansion of employment	Very High	Large scale public works will increase a number of employee.	5.0	0.60	3.00	3.00
	Sub-total							6.00	6.00
Sub-total								27.24	30.00
Investment Impact	Cost-Effectiveness			High	Economic benefit by reduction of health hazard due to mitigation of vehicle emission, travel time saving and driving cost saving, as well as mitigation of traffic accident are expected	4.0	1.60	6.40	8.00
	Profitability			High	More than 15% of EIRR was estimated for the Ajilchin Flyover Project which is relatively high cost.	4.0	0.40	1.60	2.00
Sub-total								8.00	10.00
Application for the Japanese technology	Competitiveness of the Technology	Possibility of the Future Business Development		High	Japanese steel manufacturer and contactor will expand their business to Mongolia, together with advanced technology for future maintenance and so on	4.0	0.80	3.20	4.00
		Uniqueness and Superiority of the Technology		High	Japanese original technology such as steel bridge manufacturing, girder erection in urban area, and high durability structure made of special material will be effectively applied	4.0	1.60	6.40	8.00
		Capacity of operation and Maintenance by the Local Agency		Very High	"Project for Capacity Development on Bridge Maintenance (2013-2016 : JICA)"was implemented to transfer the technology of maintenance to MRTD and UBC	5.0	1.20	6.00	6.00
		Degree of Interest by the Japanese Firms		Very High	It is high interest by Japanese Contractor due to construction work at urban area by using Japanese advanced technology.	5.0	0.40	2.00	2.00
Sub-total								17.60	20.00
Implementation Condition	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		Very High	These projects have been planned as future road network in UB Master Plan 2030,	5.0	1.00	5.00	5.00
		Relevance with Other Plans		High	Public Transportation Plan in the future such as BRT Project and Metro Project is not affected by these project.	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Normal	Financial burden for the government of Mongolia is big due to high project cost.	3.0	1.00	3.00	5.00
		Smooth Development of Institutional Frameworks		High	No additional institutional system is required due to normal public construction works.	5.0	1.00	5.00	5.00
	Sub-total							17.00	20.00
	Requests from the Mongolian Government			Normal	It was concerned of high cost by the government of Mongolian although its demand have been very high.	3.0	4.00	12.00	20.00
	Sub-total							12.00	20.00
Sub-total								29.00	40.00
					Ground Total			**81.84**	**100**

No.	Air05
Project Name	Improvement of Intersections and Road Networks for the Mitigation of Traffic Congestion

Overall Evaluation

The two (2) projects were selected as high project effect from the six (6) projects that were proposed by Ulaanbaatar City as priority project. The new road network and grade separation of intersection will improve the traveling speed, save the travel time and save the vehicle operation cost, as well as improve air pollution by reduction of vehicle emission.

■Ajilchin Fly-over Project

High economic benefit and reduction of congestion are expected by diverting the traffic of Peace Avenue and Gulvaljin Street.

■Green Avenue Construction Project

This is to connect the existing road from south to north including railway crossing which is expected to distribute current traffic volume of north-south direction. In addition, its functional importance will be very high since the new network establish the shortest root from new Ulaanbaatar City Government Building to center of Ulaanbaatar City. It will be required to use environmental friendly construction method since it is located at the preservation area for water resource.

Remarks

Following Japanese Technologies will be applied;

(1) Minimization of the Life Cycle Cost by using High Durable Material

"Steel-Concrete Composite Deck Slab" will be applied to the deck slab of bridge where has the highest potential to be deteriorated by traffic load, to increase durability and to minimize the life cycle cost by reducing its maintenance cost.

(2) Minimized Girder Bridge for Easy Maintenance

"Minimized Girder Bridge" developed in Japan is that number of members is reduced to minimize the time and cost for bridge maintenance.

(3) Bridge Erection without Disturbance of Railway Operation and Existing Road Traffic.

"Launching Method" that is commonly used in flyover construction in urban area of Japan, will be applied to railway/road way flyover to construct the bridge girder without disturbance of traffic operation.

(4) Minimum Disturbance of Ground Condition by Special Steel Pile

"Rotary Penetration Steel Pipe Pile Method" can be applied for pile construction at the vicinity of railway and environmental preservation area at water resources to minimize the disturbance of ground which will minimize the effect to railway as well as environmental condition.

Comments by the Mongolian Government

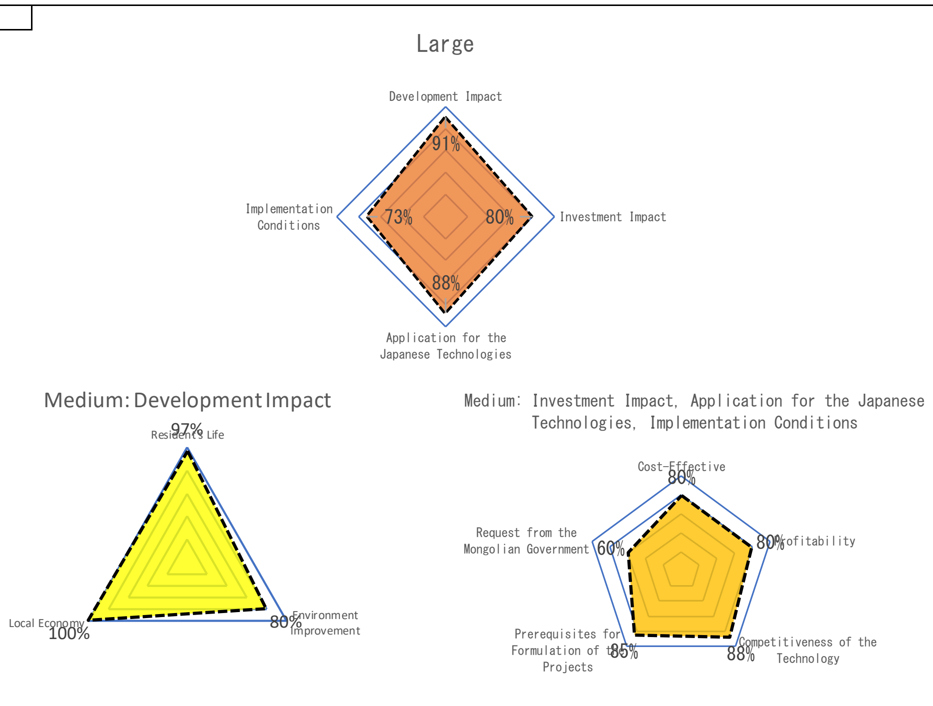
As for Ajilchin Fly-over Project, it was understood that priority for UB City need to be discussed due to high construction cost although high project effect is expected.
Green Avenue Construction Project is expected to be studied by JICA since F/S of this project has not yet conducted.

Consideration of Technical Assistance related to Yen Loan

・Previous capacity development project, namely "Project for Capacity Building on Bridge Maintenance in Mongolia" have been assisted the sustainable bridge maintenance in Ulaanbaatar City, However, expected expansion of road network and structure will require more efficient maintenance. Technical transfer of the advanced technology for bridge inspection and monitoring developed in recent year in Japan will efficient to maintain the infrastructure by limited human resource and maintenance budget.

・In Ulaanbaatar City, improvement of street for pedestrian and bicycle is much focused in parallel with improvement of traffic congestion. Technology transfer to improve the road safety and it amenity, such as signalization, sidewalk and pedestrian crossing based on Japanese experience will increase the efficiency of road construction project.

Charts



(6) Air06: Introduction of DPF for Public Buses

a. Outline and Purpose of the Project

In UB City, where traffic congestion is becoming serious, air pollution caused by public buses is becoming more and more serious, and in order to reduce PM, the Diesel Particulate Filter (hereinafter referred to as “DPF”), which collects dust directly from the exhaust gas, will be installed.

In UB City, there are many cases of public buses that were newly purchased within the last 10 years, but are still under EURO 2 regulation, an old regulation from 1996-1999. Therefore, DPFs will be installed on 240 out of approximately 1,000 public buses, regardless of vehicle age, that are under the old EURO 3 emission regulation. 1.25 million yen per DPF will be required, making the total project cost 300 million yen.

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.23** and the evaluation criteria are shown in **Table 5.24**.

Table 5.23 Individual Evaluation Items and Evaluation Criteria (Air06)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Improvement of Access to public facilities	**Table 5.24**
			Improvement of access to major transport	**Table 5.24**
		Enlargement of Activity Range	Expansion of the influx of population	**Table 5.24**
			Improvement of access to relaxation facilities	**Table 5.24**
		Enhancement of Amenity	Reduction of fatigue	**Table 5.24**
			Improved walking comfort	**Table 5.24**
	Environmental Improvement	Living Environment Conservation	PM concentration reduction at bus stops and intersections	**Table 5.24**
		Natural Environment Conservation	Flood reduction of development of intersection	**Table 5.24**
		Global Environment Conservation	Reduction of CO_2 emission	**Table 5.24**
	Local Economy	Expansion of Production	DPF operation and maintenance company	**Table 5.24**
		Increase of Employment	Number of employees for DPF operation and maintenance	**Table 5.24**
Investment Impact		Cost-Effectiveness		**Table 5.24**
		Profitability		**Table 5.24**

Table 5.24 Evaluation Criteria (Air06)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

Since this is a measure against bus emissions, there will be no change in terms of improvement of public services such as access and travel time, or expansion of the range of activities due to an increase or decrease in the influx of population. However, reduction of PM emissions will improve pedestrian comfort while waiting for buses and walking on sidewalks.

Environmental improvement

The introduction of DPF will reduce PM emissions from buses by 90%. However, CO_2 emissions will increase by a few percent due to a slight deterioration in fuel efficiency, as a result of the DPF operation.

Local economy

DPF maintenance and management companies will be established to carry out maintenance and management activities. These companies will also increase the employment.

(ii) Investment Impact

Cost-effectiveness

Although additional equipment as environmental measures must be installed, the effect of reducing PM emissions is high in relation to the cost of installing DPFs.

Profitability

Installation of DPF will reduce fuel consumption by a few percent.

(iii) Application of Japanese Technology

Possibility of future business development

The Ministry of Road Transport and Development is promoting the introduction of electric buses and CNG buses, and the prospects for business development in Mongolia are not very high.

Uniqueness and superiority of the technology

Japanese companies have non-catalytic DPF technology that uses ceramic (silicon carbide) filters that do not degrade or reduce the collection rate even with high-sulfur fuels.

Operation and maintenance by the local agency

The DPF production capacity in Japan is about 200 units/month. However, in order to install DPFs in buses in the local market, modification work is required for each bus, which in turn limits the number of DPFs installed, and the number of DPFs installed will be limited to about 20 per month. The establishment of the maintenance and management system will be a problem.

Degree of interest by Japanese firms

Japanese companies with the relevant technology are highly interested in the project.

(iv) Implementation Condition

Relevance with upper plans

DPF is included in the automobile measures of the National Program on Reducing Environment Pollution, which is highly consistent with the higher-level plan.

Relevance with other plans

This is related to the project for the diffusion of DPF to small and medium-sized enterprises.

Capacity of implementing agency

Through the DPF dissemination demonstration project for SMEs, the DPF maintenance company in Mongolia has the technology to install, operate and manage DPFs on buses. The running cost is borne by the electricity to run the filter regenerator, but since the filter of the DPF does not deteriorate, there is no special financial cost in the operation of the DPF.

Situation of development of institutional frameworks

DPF is included in the national program, and institutional support is available.

Request from the Mongolian Government

DPFs are included in the National Program for the Reduction of Environmental Pollution, and there is a strong demand for DPFs from the competent authorities.

c. Overall Evaluation

DPF has been listed as one of the national plans for vehicle control. Since the DPF is evaluated in the "Report on the Completion of the Dissemination and Demonstration Project on the Black Smoke Reduction Plan by DPF for Diesel Route Buses in Mongolia (August 2019)", the introduction of DPF in public buses is expected to reduce PM10 emissions by about 90%, which is expected to be very effective in preventing air pollution in the center of UB City. However, the scale of the DPF installation project is small as a yen loan project. In addition, there are some problems with the DPF installation, such as the fact that the state-owned bus company does not have a high capacity to operate and manage the DPFs.

d. Remarks

Japanese companies have non-catalytic DPF technology that can be applied to diesel oil containing high concentrations of sulfur, and have DPF technology that can be introduced for any type of fuel.

e. Comments by the Mongolian Government

The Ministry of Roads and Transport Development (MRTD), which is the lead agency for DPFs, has the understanding that DPFs will be effective, since the Law (Penal Code) requires large buses to have dust collectors installed. However, MRTD has changed its policy to convert them to electric or CNG buses by 2024, partly due to the unsuccessful gazetting of DPFs. 400 out of 788 public buses scheduled for disposal in 2020-2021 have been budgeted to be replaced by electric or CNG buses in 2020. The government is preparing a budget to replace 400 out of 788 public buses, which will be disposed of in 2020-2021, with electric or CNG buses. Since private bus companies cannot secure the budget to procure electric or CNG buses, they will have to purchase diesel buses. DPFs will not be installed in private buses in operation, but these private buses will be replaced gradually with buses made in China that possess Euro IV or later.

Mr. HAVI, MRTD's air pollution expert, judged that the possibility of introducing DPFs to public buses is low due to the limitations in daily filter replacement and regeneration work associated with the introduction of DPFs.

f. Consideration of Technical Assistance Related to Yen-Loan

None.

Table 5.25 Evaluation Result Summary (Air06)

No.	**Air06**		
Project Name	Introduction of DPF for public buses		
Implementing Agency	Public Transportation Agency of Capital City	Relating Agency	The Ministry of Roads and Transport Development (MRTD)
Project Cost	Approximately 300 million yen (1.25 million yen per DPF, 240 DPFs)		

Outline and Objective of the Project

DPFs will be installed on 240 out of approximately 1,000 public buses, regardless of vehicle age, that are under the old EURO 3 emission regulation.

Evaluation Item (Large)	Evaluation Item (Medium)	Evaluation Item (Small)		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development impact	Resident's Life	Improvement of Public Services	Improvement of Access to public facilities	Normal	DPF is emission control measures for buses, access to public facilities are not changed.	3.0	0.48	1.44	2.40
			Improvement of access to major transport	Normal	DPF is emission control measures for buses, travel time is not changed.	3.0	0.48	1.44	2.40
		Enlargement of Activity Range	Expansion of the influx of population	Normal	Bus travel is not changed, expansion of the influx of population is not effected.	3.0	0.36	1.08	1.80
			Improvement of access to relaxation facilities	Normal	Bus travel is not changed, improvement of access is not effected.	3.0	0.36	1.08	1.80
		Enhancement of Amenity	Reduction of fatigue	Normal	Bus travel is not changed, fatigue is normal status.	3.0	0.36	1.08	1.80
			Improved walking comfort	High	reduction of PM emissions will improve pedestrian comfort while waiting for buses and walking on sidewalks.	4.0	0.36	1.44	1.80
	Sub-total							7.56	12.00
	Environment Improvement	Living Environment Conservation	PM concentration reduction at bus stops	Very High	The introduction of DPF will reduce PM emissions from buses by 90%.	5.0	0.72	3.60	3.60
		Natural Environment Conservation	Flood reduction of development of	Normal	There is no change in impact on flooding.	3.0	0.96	2.88	4.80
		Global Environment Conservation	Reduction of CO2 emission	Low	The introduction of DPF will reduce PM emissions from buses. However, CO2 emissions will increase by a few percent due to a slight deterioration in fuel efficiency.	2.0	0.72	1.44	3.60
	Sub-total							7.92	12.00
	Local Economy	Expansion of Production	DPF operation and maintenance company	High	DPF maintenance and management companies will be established to carry out maintenance and management activities.	4.0	0.60	2.40	3.00
		Increase of Employment	Number of employee for DPF operation and	High	DPF installation and operation and maintenance companies will also increase the employment.	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
Sub-total								20.28	30.00
Investment Impact	Cost-Effectiveness			High	Although additional equipment as environmental measures must be installed, the effect of reducing PM emissions is high in relation to the cost of installing DPFs.	4.0	1.60	6.40	8.00
	Profitability			Low	Profitability is not high, installation of DPF will reduce air quality concentration, but fuel consumption reduce by a few	2.0	0.40	0.80	2.00
Sub-total								7.20	10.00
Application for the Japanese technologies	Competitiveness of the Technology	Possibility of the Future Business Development		Low	The Ministry of Road Transport and Development is promoting the introduction of electric buses and CNG buses, and the prospects for business development in Mongolia are not very high.	2.0	0.80	1.60	4.00
		Uniqueness and Superiority of the Technology		Very High	Japanese companies have non-catalytic DPF technology that uses ceramic (silicon carbide) filters that do not degrade or reduce the collection rate even with high-sulfur fuels.	5.0	1.60	8.00	8.00
		Operation and Maintenance by the Local Agency		Normal	The number of DPFs installed will be limited to about 20 per month. The establishment of the maintenance and management system will be a problem	3.0	1.20	3.60	6.00
		Degree of Interest by the Japanese Firms		Very High	Japanese companies with the relevant technology are highly interested in the project.	5.0	0.40	2.00	2.00
Sub-total								15.20	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		Very High	DPF is included in the automobile measures of National Program on Reducing Environment Pollution, which is highly consistent with the higher-level plan.	5.0	1.00	5.00	5.00
		Relevance with Other Plans		Normal	Through the DPF dissemination demonstration project for SMEs.	3.0	1.00	3.00	5.00
		Capacity of Implementing Agency		High	The DPF maintenance company in Mongolia has the technology to install, operate and manage DPFs on buses. There is no special financial cost in the operation of the DPF.	4.0	1.00	4.00	5.00
		Situation of Development of Institutional Frameworks		High	DPF is included in the national program, and institutional support is available.	4.0	1.00	4.00	5.00
	Sub-total							16.00	20.00
	Requests from the Mongolian Government			Very Low	MRTD has changed its policy to convert large buses to electric or CNG buses by 2024, partly due to the unsuccessful gazetting of DPFs.	1.0	4.00	4.00	20.00
	Sub-total							4.00	20.00
Sub-total								20.00	40.00
					Ground Total			**62.68**	**100**

No.	Air06
Project Name	Introduction of DPF for public buses

Overall Evaluation

DPF has been listed as one of the national plans for vehicle control. As the DPF is evaluated in the "Report on the Completion of the Dissemination and Demonstration Project on the Black Smoke Reduction Plan by DPF for Diesel Route Buses in Mongolia (August 2019)", the introduction of DPF in public buses is expected to reduce PM10 emissions by about 90%, which is expected to be very effective in preventing air pollution in the center of UB city. However, the scale of the DPF installation project is small as a yen loan project. In addition, there are some problems with the DPF installation, such as the fact that the state-owned bus company does not have a high capacity to operate and manage the DPFs.

Remarks

Japanese companies have non-catalytic DPF technology that can be applied to diesel oil containing high concentrations of sulfur, and have DPF technology that can be introduced for any type of fuel.

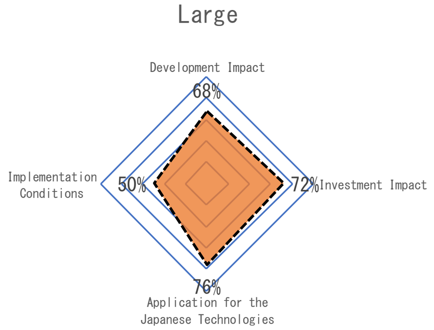
Comments by the Mongolian Government

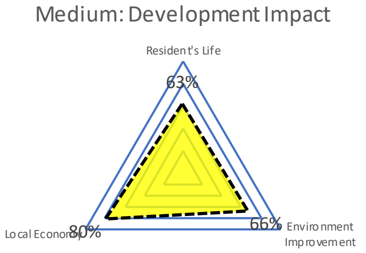
Mr. HAVI, MRTD's air pollution expert, judged that the possibility of introducing DPFs to public buses is low due to the limitations in daily filter replacement and regeneration work associated with the introduction of DPFs.

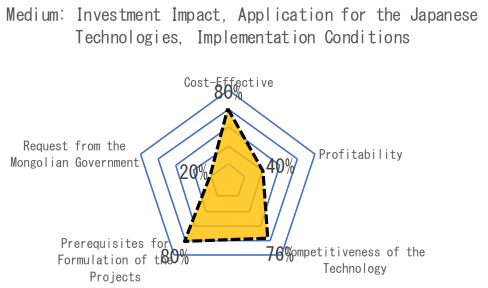
Consideration of Technical Assistance related to Yen Loan

None in particular.

Charts







CTI Engineering International Co., Ltd.
SUURI-KEIKAKU Co., Ltd.
TEC International Co., Ltd.

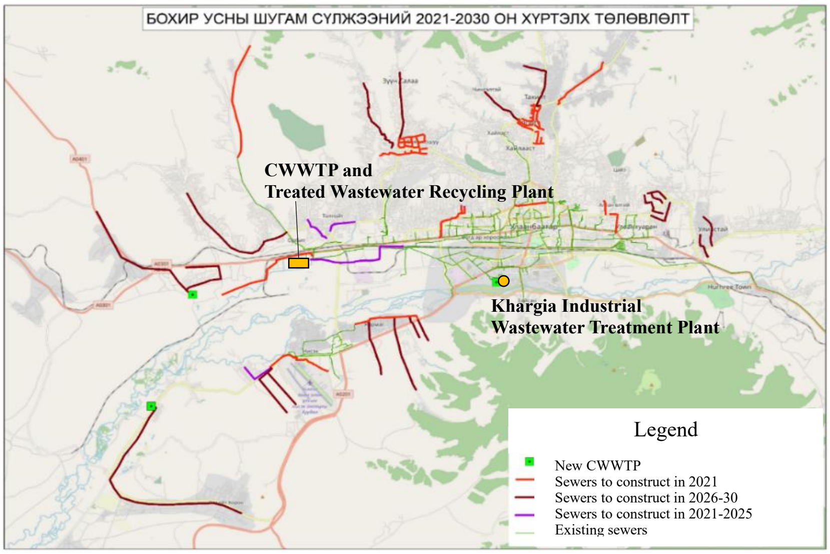
5.2.2 Water Pollution Control

(1) Wat01: Construction of Trunk Sewers in the Central Sewer District

a. Outline and Purpose of the Project

Along with the construction of branch sewers to collect sewage from the ger areas, it is important to develop trunk sewers as planned in the Water Supply and Sewerage Master Plan formulated in 2013. Once the trunk sewers are constructed, it will be possible to collect sewage in the ger areas upstream of the trunk sewers.

Based on the Sewerage Master Plan, USUG has developed a priority sewers construction plan up to 2030 (**Figure 5.3**). The plan is to extend the sewers to the areas that need sewerage such as the new residential areas under development in the northern districts of ger areas and Yarmag.



Source: USUG

Figure 5.3 Plan for Construction of Sewers by 2030

According to this plan, from 2021 to 2030, about 19 km of trunk sewers with diameters ranging from 400 mm to 1500 mm will be constructed. Based on the unit cost of the open-cut method in the Water Supply and Sewage Master Plan (2013), the estimated project cost for the construction of these trunk sewer using the open-cut method is about 1 billion yen. In the future, it will be necessary to carefully examine the estimated project cost, considering the actual construction results at the site.

b. Project Evaluation Results

Project evaluation of this project has been conducted. The individual evaluation items are shown in **Table 5.26** and the evaluation criteria are shown in **Table 5.27**.

Table 5.26 Individual Evaluation Items and Evaluation Criteria (Wat01)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Status of Sewerage Services	**Table 5.27**
			Inflow into CWWTP	**Table 5.27**
		Enlargement of Activity Range	Status of expansion of sewerage covered area	**Table 5.27**
		Enhancement of Amenity	Population using hygienic toilets	**Table 5.27**

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
	Environmental Improvement	Living Environment Conservation	Status of public health and local environment	**Table 5.27**
		Natural Environment Conservation	Water Pollution Status	**Table 5.27**
			Status of impact on drinking water (groundwater)	**Table 5.27**
		Global Environment Conservation	Status of water circulation	**Table 5.27**
	Local Economy	Expansion of Production	Regional production output	**Table 5.27**
		Increase of Employment	Employment of field workers	**Table 5.27**
Investment Impact		Cost-Effectiveness		**Table 5.27**
		Profitability		**Table 5.27**

Table 5.27 Evaluation Criteria (Wat01)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

The construction of trunk sewers will promote the construction of branch sewers and increase the number of sewerage users. As a result, the use of sanitary toilets will increase, and the living standard of residents will improve.

Environmental improvement

The construction of sewers will improve public health, improve the local environment (roadside ditches), reduce the infiltration of sewage into groundwater, and prevent water pollution in rivers and other water bodies. In addition, the proper treatment of sewage will lead to the improvement of water circulation.

Furthermore, if sewage pipes can be constructed at the same time as storm water drainage pipes, it will have an effect on reducing flood damage and improving the sanitary environment.

Local economy

The value of land on which sewers are constructed will increase, and the construction of sewers will lead to increased employment of field workers.

(ii) Investment Effect

Cost-effectiveness

For greater benefits, the construction of branch sewers is important.

Profitability

To increase profitability, it is necessary to create a system to ensure that users pay reasonable sewerage fees.

(iii) Application of Japanese Technology

Possibility of future business development

If the Japanese technology of the pipe jacking method is adopted, there is a possibility of business development.

Uniqueness and superiority of the target technology

The Japanese technology of pipe jacking method has an advantage in solving the potential needs of Ulaanbaatar (UB) City, such as traffic conditions.

Operation and maintenance by the local agency

Maintenance and management of trunk sewers constructed use the open-cut method [(no experience in using the pipe jacking method so far); c-4) Degree of interest by Japanese firms].

Degree of interest by Japanese firms

Interest will increase if the pipe jacking method is adopted in UB City.

(iv) Implementation Condition

Relevance with upper plans

This is related to the Five-Year Development Policy of Mongolia.

Relevance with other plans

The project is highly relevant to the Ger District Environmental Improvement Project (ADB, China) and New CWWTP Construction Project (China).

Capacity of implementing agency

UB City had already constructed and maintained trunk culverts, etc. and has the necessary technical capabilities.

Situation of development of institutional frameworks

Laws regarding sewage systems are in place.

Request from the Mongolian Government

USUG has formulated a plan for the construction of sewers until 2030, and based on this plan, it has secured its own budget and is continuously implementing the project, so interests of the Mongolian Government are not strong.

c. Overall Evaluation

The construction of trunk sewers is effective in improving sewerage services by promoting the construction of branch sewers. In addition, USUG has already constructed trunk sewers using the open-cut method. Therefore, there is no need to use Japanese technology when constructing trunk sewers using the open-cut method.

However, when it is difficult to construct trunk sewers using the open-cut method on roads with heavy traffic, it may be possible to use the pipe jacking method, a Japanese technology. There are specific requests from the Mongolian side, i.e., NDA regarding the construction of trunk sewers.

d. Remarks

When it is difficult to construct trunk sewers using the open-cut method on roads with heavy traffic, it may be possible to use the pipe jacking method.

e. Comments by the Mongolian Government

The construction of trunk sewers is underway, but progress is slow due to budget shortages, and some construction sections were not implemented.

f. Consideration of Technical Assistance Related to Yen-Loan

None.

Table 5.28 Evaluation Result Summary (Wat01)

No.	**Wat01**
Project Name	Construction of trunk sewers in Central Sewer District
Implementing Agency	USUG
Relating Agency	Ministry of Construction and Urban Development (MCUD)
Project Cost	Approx. 1 billion yen

Outline and Objective of the Project

Constuction of trunk sewers of 19 km length with diameter ranging from 400 mm to 1500 mm. It will promote the construction of branch sewers and increase the number of sewerage users. As a result, sanitary toilet use will increase and the inflow to CWWTP will increase.

Large	Medium	Small		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development inpact	Resident's Life	Improvement of Public Services	Status of Sewerage Services	High	Increase in the number of people using flush toilets and sewerage system	4.0	0.48	1.92	2.40
			Inflow into CWWTP	High	Currently, the treatment plant has enough capacity to handle the increased inflow.	4.0	0.48	1.92	2.40
		Enlargement of Activity Range	Status of expansion of sewerage covered area	Normal	No change in the area of total sewer district	3.0	0.72	2.16	3.60
		Enhancement of Amenity	Population using hygienic toilets	High	Flushing of tpilet will be possible	4.0	0.72	2.88	3.60
	Sub-total							8.88	12.00
	Environment Improvement	Living Environment Conservation	Status of public health and local environment	High	Graywater flows into sewer, contributing to improved public health and local environment	4.0	0.72	2.88	3.60
		Natural Environment Conservation	Water pollution status	High	Prevents water pollution in rivers and other water bodies	4.0	0.48	1.92	2.40
			Status of impact on drinking water	High	Reduced infiltration of sewage into groundwater	4.0	0.48	1.92	2.40
		Global Environment Conservation	Status of water circulation	High	Sewage will be properly treated, leading to improvement of the water circulation.	4.0	0.72	2.88	3.60
	Sub-total							9.60	12.00
	Local Economy	Expansion of Production	Increase in land prices	High	Land values will increase due to improvements in the local environment.	4.0	0.60	2.40	3.00
		Increase of Employment	Employment of field workers	High	Increase of employment of field workers	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
sub-total								23.28	30.00
Investment Impact	Cost-Effectiveness			Normal	Construction of branch sewers is important for greater benefits.	3.0	1.60	4.80	8.00
	Profitability			Normal	Users need to pay appropriate sewerage fees to ensure profitability	3.0	0.40	1.20	2.00
Sub-total								6.00	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Low	If the pipe jacking method is adopted, there is potential for business development.	2.0	0.80	1.60	4.00
		Uniqueness and Superiority of the Technology		High	Japanese technology has the advantage of being able to solve the potential needs of UB City.	4.0	1.60	6.40	8.00
		Operation and Maintenance by the Local Agency		High	USUG is constructing and maintaining trunk sewers, etc.	4.0	1.20	4.80	6.00
		Degree of Interest by the Japanese Firms		Low	If the pipe jacking method is adopted in UB City, the interest of Japanese companies will increase.	2.0	0.40	0.80	2.00
Sub-total								13.60	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	Related to the Five-Year Basic Policy for Mongolia	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	Highly relevant to the ger area environmental improvement project (ADB, China)	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		High	USUG is constructing and maintaining trunk sewers, etc. and has the capacity to do so.	4.0	1.00	4.00	5.00
		Situation of Development of Institutional Frameworks		High	Legal system related to sewerage system is in place.	4.0	1.00	4.00	5.00
	Sub-total							16.00	20.00
	Requests from the Mongolian Government			Low	No specific requests from UB City.	2.0	4.00	8.00	20.00
	Sub-total							8.00	20.00
Sub-total								24.00	40.00
					Ground Total			**66.88**	**100**

No.	**Wat01**
Project Name	Construction of trunk sewers in Central Sewer District

Overall Evaluation

The construction of trunk sewers is effective in improving sewerage services by promoting the construction of branch sewers. In addition, the USUG has already constructed trunk sewers using the open-cut method. Therefore, there is no need to use Japanese technology when constructing trunk sewers using the open-cut method.
However, when it is difficult to construct trunk sewers using the open-cut method on roads with heavy traffic, it may be possible to use the pipe jacking method, a Japanese technology.
There are no specific requests from Mongolian side regarding construction of trunk sewers.

Remarks

When it is difficult to construct trunk sewers using the open-cut method on roads with heavy traffic, it may be possible to use pipe jacking method, a Japanese technology.

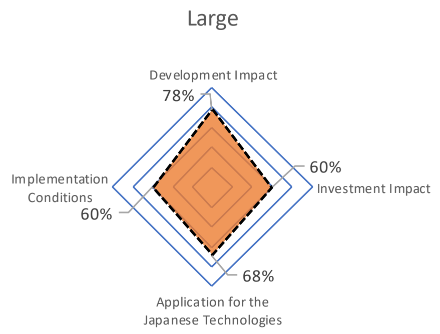
Comments by the Mongolian Government

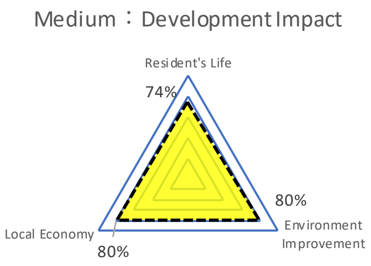
The construction of trunk sewers is underway, but progress has been slow due to budget shortages, and some construction sections have not been implemented.

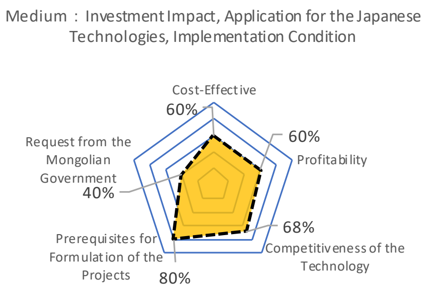
Consideration of Technical Assistance related to Yen Loan

None

Charts







(2) Wat02: Reconstruction of Aged Sewer Pipes in Central Sewer District

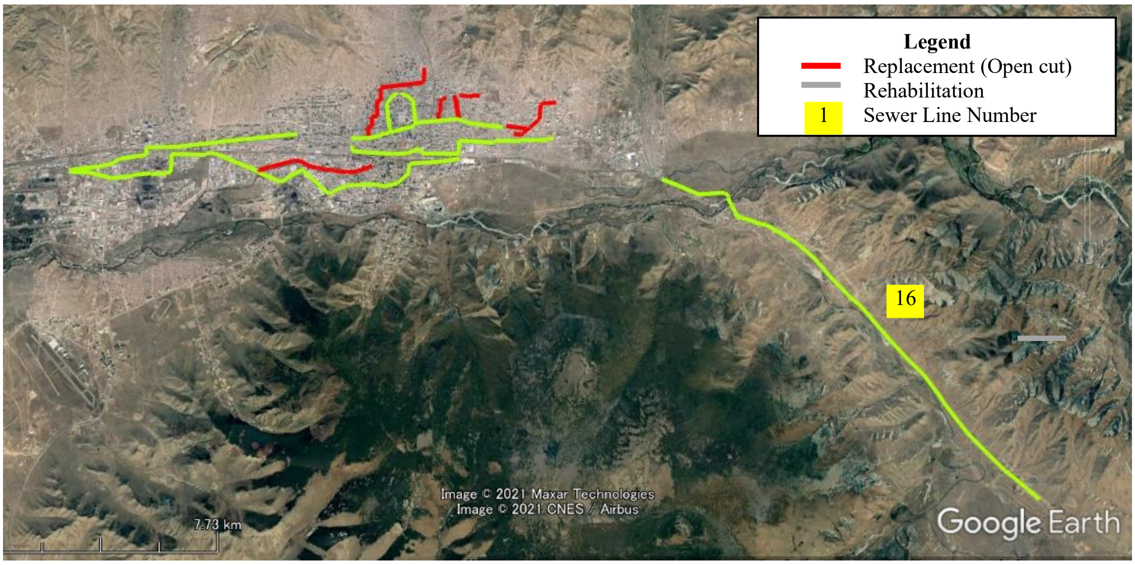
a. Outline and Purpose of the Project

In Japan, more than 3,000 cases of road cave-ins due to aged sewer pipes occur annually. In UB City, there has been no incident of road cave-ins caused by aged sewer pipes, but if the aged sewer pipes are not reconstructed, the following problems may occur:

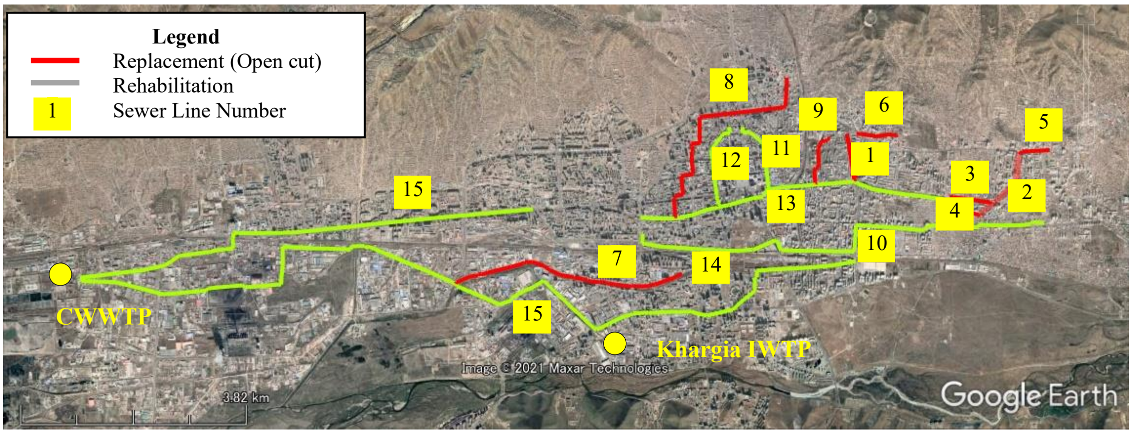
- Road cave-ins caused by broken aged sewer pipes.
- Due to blockage of aged sewer pipes, sewage overflows and sewerage service is stopped. In addition, foul odors is generated, worsening the living environment.
- Sewage leaks from cracks and damaged parts of aged sewer pipes, contaminating the soil around the sewers and groundwater.

Therefore, from the perspective of preventive maintenance, reconstructing aged sewer pipes before problems occur will lead to the continuation of sewerage services and the prevention of damage such as road cave-ins, thus enabling the sustainability of urban functions.

USUG has a plan to reconstruct approximately 50 km of aged sewer pipes, the breakdown of which is shown in **Table 5.29**. **Figure 5.4** shows the location map of aged sewer pipes in the reconstruction plan. The diameter of the aged pipes ranges from 150 mm to 1400 mm, the soil cover from 2.5 to 5.0 m, the pipe material types are mainly ceramic and asbestos pipes, and the year of construction is the 1960s. The problems include water infiltration, damage, and blockage. USUG plans to use the open-cut method for upgrade and reconstruction of No. 1 to No. 9 because they contain many sections with insufficient flow capacity, and the non-open-cut method for No. 10 to No. 17. The non-open-cut method is planned to be used in the central part of UB City where there is a lot of traffic and in the controlled green zone, where it is difficult to replace sewer pipes with the open-cut method. No.7 and No.14 are relatively new, having been constructed in 2009 and 2016, respectively, but are targeted for reconstruction due to problems with the pipe materials.



(a) Overall View (Including Nalaikh Collector)



(b) Enlarged Map of Downtown Ulaanbaatar

Source: USUG

Figure 5.4 Location Map of Aged Sewer Pipes in Reconstruction Plan

USUG plans to reconstruct No.1 to No.9 by open-cut method and No.10 to No.17 by non-open cut method. The non-open cut method is planned to be used in the central part of the city where there is a lot of traffic and in the controlled green belt where it is difficult to reconstruct with the open-cut method.

As with Wat01, the estimated project cost for the open-cut method is calculated based on the Water Supply and Sewerage Master Plan of 2013, and the estimated project cost for the non-open-cut method (pipe rehabilitation method) is calculated based on the research data of the National Institute for Land and Infrastructure Management. As a result, the estimated project cost is approximately 7.5 billion yen (approximately 7.1 billion yen for the non-excavation method alone). However, since the cost of temporary drainage required during construction is not included in the estimated project cost of approximately 7.1 billion yen for the non-excavation method, it is necessary to consider whether temporary drainage is required in the detailed study.

Table 5.29 Aged Sewer Pipes to Reconstruct

No.	Sewer Line Name	Pipe Length (m)	Pipe Diameter (mm)	Pipe Covering (m)	Pipe Material	Year of Construction	Problems	Possible Impacts in Case of Road Collapse and Sewage Pipe Blockages		Proposed Reconstruction Method
								Road Name	Public Facilities, etc., Where Sewerage Use is Restricted	
Downtown Ulaanbaatar										
1	12a, 126 line	1,450	200-300	3.5-4	Ceramic	1966	Brockage due to sediments	Ikh Toiruu	Banks, accommodations, etc.	Replacement (Open-cut)
2	Collector No. 1	1,390	200-600	3.5	Ceramic, Asbestos	1963	Cracked and broken	Municipal roads	Shopping malls, schools, etc.	Replacement (Open-cut)
3	Hospital line	730	200	3-3.5	Ceramic	1969	New users cannot connect	AH3, municipal roads	Government buildings, schools, etc.	Replacement (Open-cut)
4	3rd obstetrician line	280	200	3.5-4.5	Ceramic	1965	Inadequate capacity and broken	Municipal roads	Shopping malls, schools, etc.	Replacement (Open-cut)
5	16th khoroolol line	540	150	3.5-4	Ceramic	1980	Cracked and broken	Municipal roads	Supermarkets, shopping malls, etc.	Replacement (Open-cut)
6	124th Military unit line	700	150	3.5-5	Ceramic	1975	Cracked and broken	Municipal roads	Government buildings, supermarkets, etc.	Replacement (Open-cut)
7	Collector No. 24	4,000	300-600	3.5-4.5	Metal reinforced plastic	2009	Bad pipe quality, broken due to vertical earth pressure	Municipal roads	Police stations, aquariums, shopping malls, hospitals, etc.	Replacement (Open-cut)
8	Collector No. 9	4,140	300-400	4.5	Ceramic, Asbestos	1963	Infiltration of groundwater and inadequate capacity	Ikh Toiruu, municipal roads	Accommodations, museums, shopping malls, etc.	Replacement (Open-cut)
9	Collector No. 2	1,000	200-400	3-4.5	Ceramic, Cast iron	1963	Infiltration of groundwater, pipe blockage	Tokyo Street, municipal roads	Hotels, schools, hospitals, etc.	Replacement (Open-cut)
10	Collector No. 3	5,185	250-800	2.5-3	Ceramic, Asbestos, Concrete	1966	Infiltration of groundwater	Narnii, Nam Yan Ju Street, municipal roads	Shopping malls, hospitals, government agencies, etc.	Rehabilitation
11	Collector No. 7	1,300	150-400	3-3.5	Ceramic	1963	Infiltration of groundwater	Baga Toiruu	Government buildings, movie theatres, etc.	Rehabilitation
12	Collector No. 8a	1,535	200-300	3-3.5	Ceramic	1963	Infiltration of groundwater	Baga Toiruu	Banks, government buildings, etc.	Rehabilitation
13	Central Collector	5,350	600-800	3-3.5	Concrete	1963	Infiltration of groundwater	Seoul Street, Peace Avenue, municipal roads	Government buildings, police stations, hospitals and upstream public facilities	Rehabilitation
14	Collector No. 5	2,460	400-500	2.5-3	Asbestos	1976	Infiltration of groundwater	Narnii, Ikh Toiruu	Amusement parks, government buildings and upstream public facilities	Rehabilitation
15	Central and north collector	15,000	1000-1400	3-4.5	Concrete	1963-1987	Infiltration of groundwater	Peace Avenue, AH-3, Workers Street, Industrial Street, Chinggis Avenue, Municipal roads	Khargia IWTP, National Sports Stadium, upstream public facilities	Rehabilitation
Total Project Cost: 7 Billion Yen										
Nalaikh Collector										
16	Nalaikh collector	4,940	500	2.5-3.5	Metal reinforced plastic	2016	Bad pipe quality, broken due to vertical earth pressure	AH-3	Public facilities, factories in Nalaikh District	Rehabilitation
Total Project Cost: 0.5 Billion Yen										
	Total	**50,000**								

Source: USUG

b. Project Evaluation Results

Project evaluation of this project has been conducted. The individual evaluation items are shown in **Table 5.30** and the evaluation criteria are shown in **Table 5.31**.

Table 5.30 Individual Evaluation Items and Evaluation Criteria (Wat02)

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
Development Impact	Residents' Life	Improvement of Public Services	Status of reconstruction of aged sewer pipes	**Table 5.31**
			Status of water infiltration and sewage leakage	**Table 5.31**
		Enlargement of Activity Range	Status of expansion of sewerage service area	**Table 5.31**
		Enhancement of Amenity	Population using sanitary toilets	**Table 5.31**

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
	Environmental Improvement	Living Environment Conservation	Status of public health and local environment	**Table 5.31**
		Natural Environment Conservation	Water Pollution Status	**Table 5.31**
			Status of impact on drinking water (groundwater)	**Table 5.31**
		Global Environment Conservation	Status of water circulation	**Table 5.31**
	Local Economy	Expansion of Production	Regional production output	**Table 5.31**
		Increase of Employment	Employment of field workers	**Table 5.31**
Investment Impact		Cost-Effectiveness		**Table 5.31**
		Profitability		**Table 5.31**

Table 5.31 Evaluation Criteria (Wat02)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

Reconstruction of existing sewer pipes that are aging rapidly due to water infiltration, cracks, etc. will help maintain sewer services.

Environmental improvement

Leakage from old pipes can be prevented, leading to environmental conservation and improvement of water circulation.

Local economy

Reconstruction of old pipes will lead to higher land prices due to improved local environment and increased employment of field workers in construction projects.

(ii) Investment Impact

Cost-effectiveness

The cost-benefit ratio is high because residents can use sewerage services in a stable manner by renewing old pipes.

Profitability

Renewing old pipes will surely maintain sewerage services and lead to fee revenue.

(iii) Application of Japanese Technology

Possibility of future business development

If the usefulness of this Japanese technology is recognized, it may lead to continuous reconstruction projects for old pipes.

Uniqueness and superiority of the technology

There is a possibility to utilize Japanese technologies such as the SPR method.

Operation and maintenance by the local agency

Maintenance of sewers is already underway.

Degree of interest by Japanese firms

Since the water supply pipelines are being renewed using non-cutting methods, Japanese companies are likely to be highly interested in this project.

(iv) Implementation Condition

Relevance with upper plans

There is no mention of the replacement of aged pipes in the higher-level plans.

Relevance with other plans

The relevance to other businesses is moderate.

Capacity of implementing agency

USUG has the capability to carry out pipe rehabilitation work.

Situation of development of institutional frameworks

Laws regarding sewage systems are in place.

Request from the Mongolian Government

Recognizing the need to renew old pipes, USUG has a list of 50 km of aged pipes that need to be renewed, and there is a great demand from the relevant agencies (NDA, MCUD, USUG).

c. Overall Evaluation

USUG has a list of 50 km of old pipes that need to be renewed, and there is a great demand from the Mongolian side to recognize the need to renew old pipes. The reconstruction of asbestos cement pipes, which deteriorate quickly and lose strength over time, is an urgent matter. There is a possibility that the SPR method, a Japanese technology with a rich track record overseas, can be adopted as a rehabilitation method for old pipes.

d. Remarks

In cases where there is serious sagging in the vertical direction, the pipe rehabilitation method cannot be applied, and it will be necessary to renew the pipe using the pipe replacement method. Also, if the diameter of the pipe is less than 250mm, the pipe rehabilitation method cannot be applied, so it is necessary to use another reconstruction method. In addition, the materials and equipment used in the rehabilitation method for water supply pipelines are designed for water supply pipelines, so they cannot be used in the rehabilitation of sewer pipe.

e. Comments by the Mongolian Government

Reconstruction of sewage pipes (especially trunk sewer) is an important issue facing Ulaanbaatar City at present and is a high priority. It has been funded by the city since 2007, but progress is slow due to limited budget. Currently, there are restrictions on the implementation of USUG's external debt projects, which require consultation with UB City, Governor's Office, and the Ministry of Finance.

f. Consideration of Technical Assistance Related to Yen-Loan

None.

Table 5.32 Evaluation Result Summary (Wat02)

No.	**Wat02**		
Project Name	Rconstruction of aged sewer pipes in Central Sewer District		
Implementing Agency	USUG	Relating Agency	Ministry of Construction and Urban Development (MCUD)
Project Cost	Approx. 7.5 billion yen (Approx. 7.1 billion yen for the non-excavation method alone)		

Outline and Objective of the Project

In Ulaanbaatar City, the existing sewer pipes are aging rapidly and there is a high demand for reconstruction. In order to maintain the sewerage service, about 50 km of existing sewer pipes will be reconstructed.

Evaluation Item				Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Large	Medium	Small							
Development inpact	Resident's Life	Improvement of Public Services	Reconstructed sewers	High	Sewerage services will be maintained as old pipes are reconstructed.	4.0	0.48	1.92	2.40
			Reduction of water infiltration and leakage	High	Reduce water infiltration into existing pipes and leakage of sewage.	4.0	0.48	1.92	2.40
		Enlargement of Activity Range	Expanded sewer district	Normal	No change in the area of total sewer district	3.0	0.72	2.16	3.60
		Enhancement of Amenity	Increased use of sanitary toilets	Normal	No particular effect	3.0	0.72	2.16	3.60
	Sub-total							8.16	12.00
	Environment Improvement	Living Environment Conservation	Improvement of public health and environment	High	Leaks from old pipes and other problems will be prevented.	4.0	0.72	2.88	3.60
		Natural Environment Conservation	Improvement of water pollution	Very High	Leaks from old pipes and other problems will be prevented.	5.0	0.48	2.40	2.40
			Reducing the impact on drinking water	Very High	Leaks from old pipes and other problems will be prevented.	5.0	0.48	2.40	2.40
		Global Environment Conservation	Improvement of the water circulation	High	This will help prevent water leakage from old pipes, etc. As a result, water quality will be improved.	4.0	0.72	2.88	3.60
	Sub-total							10.56	12.00
	Local Economy	Expansion of Production	Increase in land value	Normal	No particular effect	3.0	0.60	1.80	3.00
		Increase of Employment	Increased employment of field workers	High	Employment of field workers	4.0	0.60	2.40	3.00
	Sub-total							4.20	6.00
Sub-total								22.92	30.00
Investment Impact	Cost-Effectiveness			High	Cost-benefit ratio is high because residents can use sewerage services stably by reconstructing aged pipes.	4.0	1.60	6.40	8.00
	Profitability			High	Reconstructing aged pipes will ensure that sewerage services can be maintained, leading to fee revenue.	4.0	0.40	1.60	2.00
Sub-total								8.00	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		High	If the usefulness of the Japanese technology is recognized, projects to reconstruct aged pipes will continue to be	4.0	0.80	3.20	4.00
		Uniqueness and Superiority of the Technology		High	Possibility to utilize Japanese technologies such as SPR method.	4.0	1.60	6.40	8.00
		Operation and Maintenance by the Local Agency		Very High	A maintenance management system is in place and O&M is being carried out.	5.0	1.20	6.00	6.00
		Degree of Interest by the Japanese Firms		High	Interest from Japanese companies is expected to be high.	4.0	0.40	1.60	2.00
Sub-total								17.20	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		Very Low	There is no mention of reconstructing aged pipes in the higher-level plan.	1.0	1.00	1.00	5.00
		Relevance with Other Plans		Normal	Moderate relevance.	3.0	1.00	3.00	5.00
		Capacity of Implementing Agency		High	USUG has the capacity to carry out pipe rehabilitation work.	4.0	1.00	4.00	5.00
		Situation of Development of Institutional Frameworks		Very High	Legal system related to sewerage system is in place.	5.0	1.00	5.00	5.00
	Sub-total							13.00	20.00
	Requests from the Mongolian Government			Very High	USUG is aware of the need to reconstruct aged pipes and has a list of 50 km of aged pipes that need to be reconstructed.	5.0	4.00	20.00	20.00
	Sub-total							20.00	20.00
Sub-total								33.00	40.00
					Ground Total			**81.12**	**100**

No.	**Wat02**
Project Name	Rconstruction of aged sewer pipes in Central Sewer District

Overall Evaluation

USUG has a list of 50 km of old pipes that need to be renewed, and there is a great demand from Mongolian side to recognize the need to renew old pipes. The reconstruction of asbestos cement pipes, which deteriorate quickly and lose strength over time, is an urgent matter. There is a possibility that the SPR method, a Japanese technology with a rich track record overseas, can be adopted as a rehabilitation method for old pipes.

Remarks

Depending on the condition of the existing pipe and the type of pipe, it may not be possible to adopt the Japanese technology.

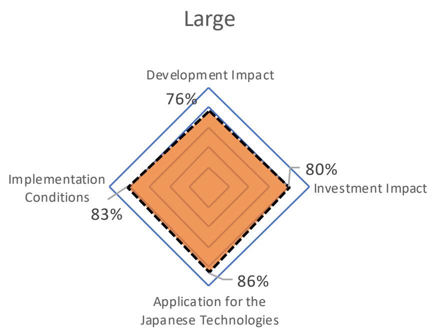
Comments by the Mongolian Government

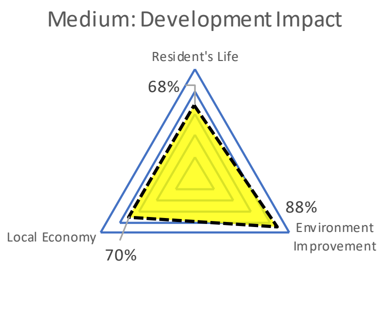
Reconstruction of sewage pipes (especially trunk sewer) is an important issue facing Ulaanbaatar City at present and is a high priority, and has been funded by the city since 2007, but progress is slow due to limited budget.

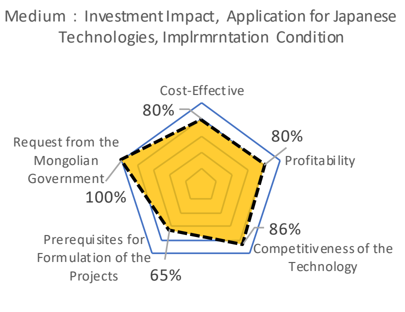
Consideration of Technical Assistance related to Yen Loan

None

Charts







(3) Wat03: Installation of Wastewater Pre-Treatment Facility at Factories

a. Outline and Purpose of the Project

Factories in UB City are discharging wastewater into the sewers more than the wastewater acceptance standard (MNS 6561). At CWWTP, inflow of this highly concentrated factory wastewater places a heavy load on the sewage treatment process, causing the treated water quality to greatly exceed the discharge water quality standard (MNS 6561), which in turn causes water pollution in the Tuul River.

Therefore, factories in UB City need to install pre-treatment facilities to properly treat factory wastewater and comply with the standards for discharging wastewater into sewers. In addition, in implementing the MCC project (Treated Wastewater Reuse Project), a prerequisite was impose, i.e., by the commencement of operation of the new CWWTP, the amount of pollutant load of factory wastewater flowing into the treatment plant must be reduced to 2013 levels (Factory Effluent Pre-Treatment Plan).

This project involves the installation of pre-treatment facilities at approximately 150 factories in UB City to ensure that factory wastewater into sewers is properly treated and complies with effluent standards. The following are outlines of the project cost, which was calculated by modeling the pre-treatment facilities under several conditions, setting the average amount of treated water, raw wastewater quality, and treatment method for each type of factory.

(i) Assumptions and Method of Calculating Estimated Project Cost

The installation cost of pre-treatment facilities was estimated assuming that leather factory, wool and cashmere factory, offal processing factory, milk and dairy products factory, meat and meat products factory, and alcohol factory in UB City will install pre-treatment facilities to meet the wastewater discharging standard (MNS 6561:2015).

Based on data of factories in UB City (January-November 2019), the average wastewater generation and quality for each of the six factory types are listed in **Table 5.33**, and based on interviews with water treatment equipment manufacturers, the standard wastewater treatment method for each plant type was selected as shown in **Table 5.34**. The cost of constructing pre-treatment facilities was calculated as follows.

- Leather 240 million yen/unit (treatment capacity 22 m^3/day)
- Wool and cashmere: 340 million yen/unit (treatment capacity 73 m^3/day)
- Offal processing: 130 million yen/unit (treatment capacity 7 m^3/day)
- Milk and dairy products: 250 million yen/unit (treatment capacity 156 m^3/day)
- Meat and meat products: 190 million yen/unit (treatment capacity 16 m^3/day)
- Alcohol: 350 million yen/unit (treatment capacity 222 m^3/day)

Using the cost function "Cost estimation technique based on the empirical method (approximation of the capacity-price curve) for the 0.6 multiplier proportion," the approximate construction cost of pre-treatment facility was calculated based on the average wastewater volume of each plant and the basic construction cost for each plant type above, as shown in **Table 5.35**.

(ii) Average Influent Flow and Water Quality of Pre-Treatment Facility by Factory Types

Table 5.33 shows the average influent flow and water quality of pre-treatment facilities by factory types.

Table 5.33 Average Influent Flow and Quality of Pre-treatment Facility by Factory Type

Factory Type	Average Flow (m^3/day)	Water Quality				
		pH (-)	SS (mg/l)	COD (mg/l)	Sulfide (mg/l)	Total Chromium (mg/l)
Leather Factory	22	8.8	3,036	4,811	46	24
Wool and Cashmere Factory	73	7.2	1,335	3,173	11	-
Offal Processing Factory	7	6.1	512	3,457	115	-
Meat and Meat Products Factory	16	6.3	10,653	8,589	-	-
Milk and Dairy Factory	156	5.8	805	1,697	-	-
Alcohol Factory	222	6.6	704	4,077	-	-

Source: JICA Survey Team (Wastewater flow and quality are median values of actual data)

(iii) Wastewater Treatment Methods for Pre-Treatment Facilities by Factory Types

Table 5.34 shows the typical wastewater treatment methods of pre-treatment facilities by factory types.

Table 5.34 Typical Wastewater Treatment Methods of Pre-Treatment Facilities

Factory Type	Typical Wastewater Treatment Method
Leather Factory	Influent → Screen → Oil separator → Reducton → Coagulation, Sedimentation → Biological Treatment → Discharging into Sewer
Wool and Cashmere Factory	Infuent → Sctreen → Oil Separator → Coagulation, Sedimentation → Aerobic Treatment → Discharging into Sewer
Offal Processing Factory	Influent → Screen → Aerobic Treatment → Discharging into Sewer
Meat and MeatProducts Factory	Influent → Screen → Anaerobic-Aerobic Treatment → Discharging into Sewer
Milk and Dairy Factory, Alcohol Factory	Influent → Anaerobic-Aerobic Treatment → Discharging into Sewer

Source: JICA Survey Team

(iv) Estimated Construction Cost of Pre-Treatment Facilities

Table 5.35 shows the estimated construction cost of pre-treatment facilities.

Table 5.35 Estimated Construction Cost of Pre-Treatment Facilities

Factory Type	Number of Factory *1	Total Wastewater Flow (m^3/day)	Construction Cost of Pre-treatment Facility (Billion Yen) *2
Leather Factory	37	577.8	5.69
Wool and Cashmere Factory	45	1,822.1	8.21
Offal Processing Factory	18	104.0	1.89
Meat and Meat Products Factory	63	737.1	6.84
Milk and Dairy Factory	14	1,360.2	2.00
Alcohol Factory	26	2,096.5	3.46
Total	203	6,697.6	28.09

Note: 1. In the case of multiple drains at the same factory, the number of drains was recorded as the number of factories.
2. These costs include survey, equipment, civil engineering, construction, transportation, customs, and general administrative costs.
Source: JICA Survey Team

(v) Total Estimated Construction Cost of Pre-Treatment Facilities

Based on the above results, **Table 5.36** shows the estimated total project cost of pre-treatment facilities. The total cost of the project, including contingency cost, will be about 30.9 billion yen.

Table 5.36 Estimated Total Project Cost of Pre-Treatment Facilities

	Cost (Billion yen)	Remarks
Construction cost	28.09	
Contingency cost	2.81	10% of construction cost
Total	30.90	

Source: JICA Survey Team

Since the construction cost of the detoxification facilities modeled for each type of plant is calculated by referring to the Japanese project, this is only an indication of the total project cost. The construction cost of each detoxification facility should be calculated based on the location of the facility (outdoors or indoors), the quality of the treated water volume, the procurement conditions of the equipment, and the intentions of the company owner.

b. Project Evaluation Results

Project evaluation of this project has been conducted. The individual evaluation items are shown in **Table 5.37** and the evaluation criteria are shown in **Table 5.38**.

Table 5.37 Individual Evaluation Items and Evaluation Criteria (Wat03)

<table>
<tr><th colspan="4">Evaluation Item</th><th rowspan="2">Evaluation Criteria</th></tr>
<tr><th>Large</th><th>Medium</th><th colspan="2">Small</th></tr>
<tr><td rowspan="5">Development Impact</td><td rowspan="4">Residents' Life</td><td rowspan="2">Improvement of Public Services</td><td>Hazardous substances load discharging into sewer</td><td>Table 5.38</td></tr>
<tr><td>Operating condition of CWWTP</td><td>Table 5.38</td></tr>
<tr><td>Enlargement of Activity Range</td><td>Activities of residents around factories</td><td>Table 5.38</td></tr>
<tr><td>Enhancement of Amenity</td><td>Comfort of life for residents living around factories</td><td>Table 5.38</td></tr>
<tr><td>Environmental Improvement</td><td>Living Environment Conservation</td><td>Status of public health and local environment</td><td>Table 5.38</td></tr>
</table>

Evaluation Item				Evaluation Criteria
Large	**Medium**	**Small**		
	Local Economy		Effects of hazardous substances	**Table 5.38**
		Natural Environment Conservation	Water Pollution Status	**Table 5.38**
			Status of impact on drinking water (groundwater)	**Table 5.38**
		Global Environment Conservation	Status of water circulation	**Table 5.38**
	Local Economy	Expansion of Production	Regional production output	**Table 5.38**
		Increase of Employment	Employment of field workers	**Table 5.38**
Investment Impact		Cost-Effectiveness		**Table 5.38**
		Profitability		**Table 5.38**

Table 5.38 Evaluation Criteria (Wat03)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

Appropriate pre-treatment of factory wastewater will prevent the inflow of harmful substances into sewer and lead to appropriate operation of CWWTP. Furthermore, the elimination of gutters through which factory wastewater flows will lead to improved comfort for residents living around factories.

Environmental improvement

The installation of pre-treatment facilities at each factory will improve the living environment of residents living around factories, prevent water pollution of the Tuul River, and protect the environment, including groundwater. Furthermore, the release of toxic substances into the environment can be controlled, leading to the improvement of water circulation.

Local economy

If each factory fails to meet the effluent standards, the water supply to the factory will be suspended, but the installation of pre-treatment facility will allow the business to continue.

(ii) Investment Impact

Cost-effectiveness

The installation of pre-treatment facilities will enable compliance with the standards for discharging water into sewer, but installation costs are high.

Profitability

Since many of the factories are small and medium-sized enterprises, support from public funds is essential for the installation of pre-treatment facilities.

(iii) Application of Japanese Technology

Possibility of future business development

Further research is needed to determine the feasibility of deploying Japanese technology for pre-treatment facilities in Mongolia.

Uniqueness and superiority of the technology

Since the technologies for factory wastewater treatment (pre-treatment facilities) are conventional, further research is needed to determine whether Japanese technologies are unique.

Operation and maintenance by the local agency

The management system at the factory side regarding factory wastewater is inadequate, and the management system at USUG and GASI should be improved.

Degree of interest by Japanese firms

The level of interest of Japanese companies is unknown.

(iv) Implementation Condition

Relevance with upper plans

The project is listed in the national policy (Vision 2050, etc.) and has a high priority.

Relevance with other plans

It is largely related to the leather industry, which is a major industry in Mongolia. It is also related to the MCC project (treated water reuse project).

Capacity of implementing agency

The capacity of UB City to install and properly operate and manage pre-treatment facilities is inadequate, and it does not have the financial capacity to do so. Therefore, it is necessary to build a maintenance and management system on the factory side, strengthen the capacity of the government side's monitoring system (refer to Technical Support via the Finance and Investment Account below), and provide financial support.

Situation of development of institutional frameworks

It is necessary to develop an effective system.

Request from the Mongolian Government

It is mentioned in the Minutes of Understanding of USUG, MCUD, and MOFALI, and the demand is great.

c. Overall Evaluation

This project envisages the installation of pre-treatment facilities at factories using two-step loans. By properly treating and managing the factory wastewater, the quality of factory wastewater will meet the effluent standard for discharging into sewer (MNS 6561:2015), and the planned inflow quality to CWWTP will be guaranteed. As a result, sewage will be properly treated at the treatment plant, leading to the conservation of water quality in public water bodies.

However, since most of the factories are small and medium-sized enterprises and do not have the financial resources to install abatement facilities, it is essential to support them with public funds such as easing of loan conditions for two-step loans, easing of tax systems (corporate income tax and equipment import tariffs), preferential treatment of drinking water rates, and subsidies. Financial support from the Mongolian government, such as the introduction of subsidies, will increase the effectiveness of the investment. Furthermore, to effectively implement this project, it is necessary to build a maintenance management system on the factory side and to strengthen the capacity of USUG and GASI management systems.

(For reference: Two-step Loan)

Two-step loan is a scheme in which funds are provided to development finance institutions in developing countries directly or through the governments of the countries concerned, which in turn lend to domestic small and medium-sized enterprises and the agricultural sector. In Mongolia, JICA launched the Small and Medium Enterprise Development and Environmental Conservation Two-Step Loan Project in 2006 (Phase I, about 3 billion yen), followed by Phase II (about 5 billion yen) in 2010. Currently, the Government of Mongolia has requested the Government of Japan/JICA to conduct Two-Step Loan Phase III. According to the JICA report on the "Two-Step Loan Project for SME Development and Environmental Conservation in Mongolia (Support for Institutional Building for SME Financing) [Technical Support via the Finance and Investment Account]", the outline of the proposed TSL Project Phase III is as follows.

Outline of the Proposed TSL Project Phase III:

- Lender / Borrower: JICA / Mongolian government
- Implementing Agency: Special purpose financial institution (SPE) to be established
- Total Loan Amount: approx. 10 billion yen (plus consultant fees)

  Of the total, approx. 9 billion yen for SME Development,
  approx. 1 billion yen for Environmental Protection
- Loan Terms:

  For SME, 1.5% interest, 30-year repayment period
  (including 10-year grace period)
  For EP Loan, 1.3% interest, 30-year repayment period
  (including 10-year grace period)
- Sub-Loan Loan Terms: Interest rate:

  11%, limit of USD 1 million per loan (no limit for EP Loan)

(For reference: Results of interviews with business owners regarding the installation of facilities)

Despite the limited circumstances of the remote field survey, the JICA Survey Team attempted to interview the owners of companies (several companies for each type of factory) that discharge wastewater into sewer regarding the installation of pre-treatment facilities. The main comments were as follows:

- Some factories have already installed pre-treatment facilities, but it is difficult to comply with effluent standards.
- There is not much incentive to finance pre-treatment facilities to comply with effluent standards.
- Little experience in obtaining bank loans so far. Loan terms are not good (high interest, short repayment period, etc.).
- In terms of desired loan conditions, the most common were loan amount of 1-to-10-million-yen, interest rate of 3-5%, and repayment period of 5-10 years.
- The estimated cost of installing pre-treatment facilities was mostly between 10 and 50 million yen.

d. Remarks

Mongolia is considering the possibility of continuous monitoring of factory wastewater by installing water quality measuring equipment in sewer that receive factory wastewater. There is room to consider the systematization of the pH meter, conductivity meter, and UV meter for the automatic continuous monitoring of factory wastewater, but the prerequisites for this are that there are no interfering substances in the factory wastewater that interfere with the measurement of the target measurement water parameters, and that the measurement sensors of the water quality meters work properly. For example, if the pollutant load in the factory effluent is high and the measurement sensor is not working properly due to scale adhesion, it is difficult to make accurate measurements. Therefore, continuous maintenance of the sensor (cleaning the scale that adheres to the sensing part, which is in constant contact with raw sewage, with an automatic cleaning device) or automatic sampling and later analysis is required.

The cost of equipment and systems consisting of these advanced precision devices is expensive, and the maintenance cost is high due to the short usable period of the devices. In addition, to maintain these systems, continuous and regular maintenance is required, and if this is not done, the reliability of the system will be compromised. In Japan, sewerage administrators have attempted to introduce such a system, but there are no cases where it has been realized as a permanent and comprehensive system. Considering the above, and in consideration of sustainability of the sewerage system, the survey team does not propose the introduction of this system.

As an alternative, the case of the Tokyo Metropolitan Government, introduced in the section on Japanese technology, can be used as a reference. If the Mongolian side strengthens its monitoring system and regulatory and supervisory capacity, this could be a target for consideration in technical cooperation projects.

e. Comments by the Mongolian Government

The Mongolian Government believes that each factory must have a pre-treatment facility. Japan has been solving the problem of water pollution caused by factory wastewater, and it is desirable for Japan to provide its knowledge and know-how. In addition, financial support measures to promote the installation of pre-treatment facility at each factory will be considered as a future issue.

f. Consideration of Technical Assistance Related to Yen-Loan

Consideration will be given to Technical Support via the Finance and Investment Account based on the introduction of the following factory wastewater monitoring system with reference to the case study of Tokyo Metropolitan Government. The details are described in **Section 5.5**.

Table 5.39 Evaluation Result Summary (Wat03)

No.	**Wat03**		
Project Name	Installation of Wastewater Pre-treatment Facility at Factories		
Implementing Agency	USUG	Relating Agency	MCUD and GASI
Project Cost	Approx. 30.9 billion yen		

Outline and Objective of the Project

Pre-treatmentfacilities will be installed in about 150 factories, excluding car washesTo ensure that each factory complies with factory wastewater quality standards to discharge into sewer.

Evaluation Item: Large	Medium	Small		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development inpact	Resident's Life	Improvement of Public Services	Hazardous substances load entering sewer	Very High	Proper pre-treatment of factory wastewater can prevent the inflow of harmful substances into sewer	5.0	0.48	2.40	2.40
			Operation of CWWTP	Very High	Improves water quality flowing into CWWTP, leading to proper operation at the plant.	5.0	0.48	2.40	2.40
		Enlargement of Activity Range	Expanding the scope of activities of residents	High	Elimination of gutters and other areas where factory wastewater accumulates will expand the range of activities of residents.	4.0	0.72	2.88	3.60
		Enhancement of Amenity	Improvement of comfort of life for residents	Very High	Reduction of bad odors from factories and other sources will improve the comfort of residents.	5.0	0.72	3.60	3.60
	Sub-total							11.28	12.00
	Environment Improvement	Living Environment Conservation	Improvement of public health and environment	Very High	Reduced odors from the gutters will help preserve the living environment of residents living around factories.	5.0	0.36	1.80	1.80
			Effects of hazardous substances	Very High	Pretreatment of factory wastewater can reduce the release of harmful substances into the environment.	5.0	0.36	1.80	1.80
		Natural Environment Conservation	Improvement of water pollution	Very High	Appropriate treatment of factory wastewater leads to the prevention of water pollution.	5.0	0.48	2.40	2.40
			Reducing the impact on drinking water	Very High	Appropriate treatment of factory wastewater leads to environmental conservation of groundwater and other resources.	5.0	0.48	2.40	2.40
		Global Environment Conservation	Improvement of the water circulation	Very High	Appropriate treatment of factory wastewater leads to improve water circulation	5.0	0.72	3.60	3.60
	Sub-total							12.00	12.00
	Local Economy	Expansion of Production	Increase in regional production value	Very High	Satisfying water quality standards for factory wastewater will lead to business continuity for each factory	5.0	0.60	3.00	3.00
		Increase of Employment	Increased employment of field workers	High	Increased employment of field workers	4.0	0.60	2.40	3.00
	Sub-total							5.40	6.00
Sub-total								28.68	30.00
Investment Impact	Cost-Effectiveness			Very Low	Installation of pre-treatment facilities would enable compliance with standards for wastewater into sewer, but the cost is high.	1.0	1.60	1.60	8.00
	Profitability			Very Low	Factories are small/medium-sized, so support from public funds is essential for the installation of pre-treatmentn facilities.	1.0	0.40	0.40	2.00
Sub-total								2.00	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Low	Further research is needed to determine the feasibility of deploying Japanese technology for pre-treatment facilities	2.0	0.80	1.60	4.00
		Uniqueness and Superiority of the Technology		Very Low	Technologies for pre-treatment facilities are conventional, further research regarding originality of Japanes tecnology is needed	1.0	1.60	1.60	8.00
		Operation and Maintenance by the Local Agency		Very Low	The management system at the factory side is inadequate, and the management system at USUG and GASI should be improved	1.0	1.20	1.20	6.00
		Degree of Interest by the Japanese Firms		Normal	The level of interest of Japanese companies is unknown.	3.0	0.40	1.20	2.00
Sub-total								5.60	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		Very High	The project is listed in the national policy (Vision 2050, etc.) and has a high priority	5.0	1.00	5.00	5.00
		Relevance with Other Plans		Very High	Largely related to the leather industry and the MCC project (treated water reuse project)	5.0	1.00	5.00	5.00
		Capacity of Implementing Agency		Very Low	Ulaanbaatar City has insufficient capacity and financial resources	1.0	1.00	1.00	5.00
		Situation of Development of Institutional Frameworks		Very Low	It is necessary to develop an effective system	1.0	1.00	1.00	5.00
	Sub-total							12.00	20.00
	Requests from the Mongolian Government			Very High	It is mentioned in the MOUs of USUG, MCUD, and MFALI,	5.0	4.00	20.00	20.00
	Sub-total							20.00	20.00
Sub-total								32.00	40.00
					Ground Total			**68.28**	**100**

No.	**Wat03**
Project Name	Installation of Wastewater Pre-treatment Facility at Factories

Overall Evaluation

Installation of pre-treatment facilities at each factory will lead to compliance with the effluent standard to sewer (MNS 6561:2015) and satisfy the planned inflow water quality to CWWTP. As a result, CWWTP will be able to conduct appropriate sewage treatment, leading to the conservation of water quality in public water bodies. However, as most of the factories are small and medium-sized enterprises, they do not have the financial capacity to install pre-treatment facilities, so public funding is essential to support them. Furthermore, for effective improvement of factory wastewater, it is necessary to establish a management system at the factory side and to strengthen the capacity of the factory supervision system of USUG and GASI.

Remarks

Mongolia is considering the possibility of continuous monitoring of factory wastewater by installing water quality measuring equipment in sewer that receive factory wastewater. There is room to consider the systematization of the pH meter, conductivity meter, and UV meter for the automatic continuous monitoring of factory wastewater, but the prerequisites for this are that there are no interfering substances in the factory wastewater that interfere with the measurement of the target measurement water parameters, and that the measurement sensors of the water quality meters work properly. For example, if the pollutant load in the factory effluent is high and the measurement sensor is not working properly due to scale adhesion, it is difficult to make accurate measurements. Therefore, continuous maintenance of the sensor (cleaning the scale that adheres to the sensing part, which is in constant contact with raw sewage, with an automatic cleaning device) is required.

The cost of equipment and systems consisting of these advanced precision devices is expensive, and the maintenance cost is high due to the short usable period of the devices. In addition, to maintain these systems, continuous and regular maintenance is required, and if this is not done, the reliability of the system will be compromised. In Japan, sewerage administrators have attempted to introduce such a system, but there are no cases where it has been realized as a permanent and comprehensive system. Considering the above, and in consideration of the sustainability of the sewerage system, the survey team does not propose the introduction of this system.

As an alternative, the Tokyo Metropolitan Government's case introduced in the section on Japanese technology can be used as a reference. If the Mongolian side decides to introduce such a monitoring system, this could be a subject for consideration in the technical cooperation project.

Comments by the Mongolian Government

The Mongolian government believes that each factory must have pre-treatment facility. Japan has been solving the problem of water pollution caused by factory wastewater, and we would like Japan to provide its knowledge and know-how.

Consideration of Technical Assistance related to Yen Loan

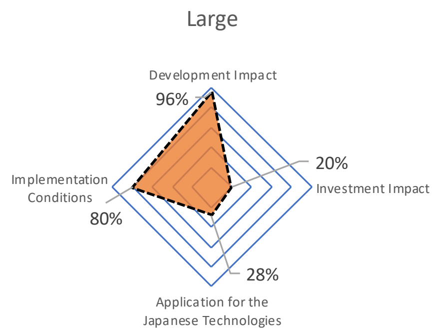
With reference to the case study of the Tokyo Metropolitan Government, the Technical Support via the Finance and Investment Account will be considered on the assumption that following factory wastewater monitoring system is installed.

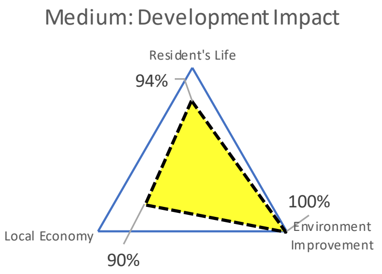
(1) Emergency response systems to maintain the functionality and safety of sewage facilities (Continuous automatic monitoring of pH and other parameters)

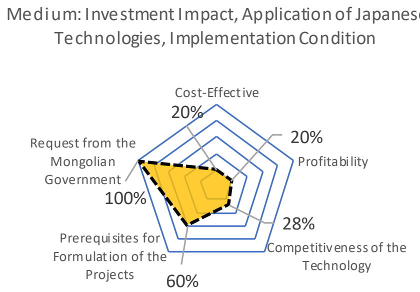
(2) Integrated monitoring system by combining wide-area (narrowed down) and individual monitoring of factory wastewater

(3) Establishment of a voluntary water quality monitoring system by the factory (water quality manager responsibility system)

Charts







(4) Wat04: Biogas Power Generation using Sewage Sludge

Currently, the construction of CWWTP in Ulaanbaatar City is being carried out with Chinese assistance, and the sludge digestion process and effective utilization of digestion gas are adopted in the facility plan. Therefore, this project candidate is excluded from the long list.

As a drastic measure for sewage sludge disposal, the Mongolian government had secured 22 ha of land for sludge treatment and disposal in 2019. To make effective use of this land in the future, it is necessary to consider reducing the amount of sludge disposal through effective utilization and incineration of sludge, as well as to consider the construction and operation of a controlled disposal facility.

(5) Wat05: Improvement of Urban Rainwater Drainage Facility

a. Outline and Purpose of the Project

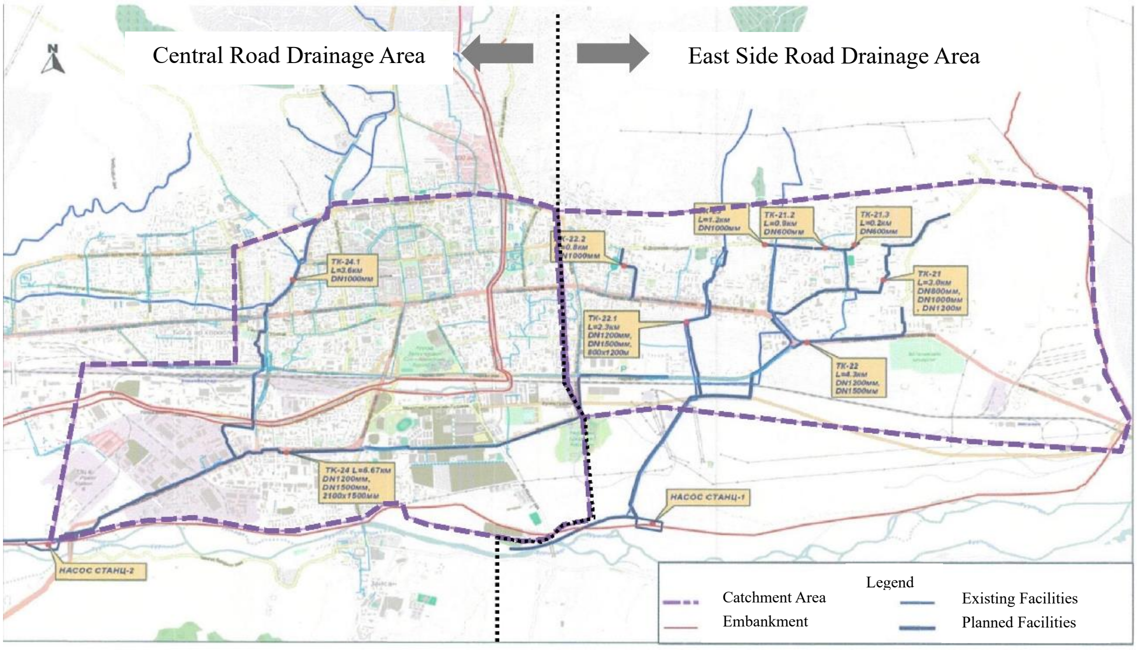
The main purpose of urban flood prevention is to "protect life," "secure urban functions," and "protect personal property," and there are two types of flood prevention measures: hardware and software. Hardware measures such as the construction of storm sewers and storm open channels are effective as flood prevention measures, but they are very expensive and take a long time to complete. Therefore, as a software measure, thorough maintenance, and management of existing drainage systems, including regular cleaning, is also necessary.

Geodesy Hydraulic Facility Agency (GUBBG) is planning a project for flood control (storm drainage plan for the Central Road and East Side Road) with a project cost of about 68 billion MNT (about 2.7 billion yen). The following is an overview of the project, project cost, map of rainwater pumping station and rainwater drainage pipe.

Table 5.40 Rainwater Drainage Facilities Improvement Plan for Two Drainage Areas

<table>
<tr><th>Item</th><th colspan="2">Project Description</th><th>Project Cost</th></tr>
<tr><td>Project Area</td><td>Central Road Drainage Area (486 ha)</td><td>East Side Road Drainage Area (700 ha)</td><td>—</td></tr>
<tr><td>Length of Rainwater Drainage Pipe</td><td>12.3 km</td><td>14.6 km</td><td rowspan="2">58.2 Billion MNT</td></tr>
<tr><td>Diameter of Pipes or Box Culvert</td><td>1000 - 1500 mm
2100×1500 mm</td><td>800 – 1500 mm
800×1200 mm,
1500×2000 mm</td></tr>
<tr><td>Rainwater Pumping Station</td><td>Rainwater Pump (5 m^3/s × 5)
Rainwater Pump (8 m^3/s × 2)
Retention Pond (30,000 m^3)</td><td>Rainwater Pump (5 m^3/s × 5)
Rainwater Pump (8 m^3/s × 2)
Retention Pond (30,000 m^3)</td><td>9.8 Billion MNT</td></tr>
</table>

Source: USUG, GUBBG



Source: USUG, GUBBG

Figure 5.5 Map of Rainwater Pumping Station and Rainwater Drainage Pipe

b. Project Evaluation Results

Project evaluation of this project has been conducted. The individual evaluation items for this project are shown in **Table 5.41**, and the evaluation criteria are shown in **Table 5.42**.

Table 5.41 Individual Evaluation Items and Evaluation Criteria (Wat05)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Status of flooding damage	**Table 5.42**
		Enlargement of Activity Range	Status of Urban dysfunction reduction	**Table 5.42**
		Enhancement of Amenity	Hygienic conditions	**Table 5.42**
	Environmental Improvement	Living Environment Conservation	Status of public health and local environment	**Table 5.42**
		Natural Environment Conservation	Improvement of water pollution	**Table 5.42**
		Global Environment Conservation	Status of water circulation	**Table 5.42**
	Local Economy	Expansion of Production	Regional production value	**Table 5.42**
		Increase of Employment	Employment of field workers	**Table 5.42**
Investment Impact		Cost-Effectiveness		**Table 5.42**
		Profitability		**Table 5.42**

Table 5.42 Evaluation Criteria (Wat05)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

The construction of rainwater drainage facilities will reduce damage from flooding, reduce urban dysfunction, and maintain the comfort of residents' lives.

Environmental improvement

When flooding occurs, sewage overflows with rainwater, which may lead to deterioration of the natural environment, but environmental deterioration can be prevented by reducing flooding damage.

Local economy

The construction of rainwater drainage facilities will lead to increased employment of field workers.

(ii) Investment Impact

Cost-effectiveness

Hardware measures to mitigate flooding damage are very costly and time consuming.

Profitability

Without systematic implementation of flood control measures, it will be difficult to achieve sufficient results.

(iii) Application of Japanese Technology

Possibility of future business development

Further research is needed to see if Japanese technology can be used.

Uniqueness and superiority of the technology

Pump gates and rainwater retention facilities, which are Japanese technologies, have their own uniqueness and advantages.

Operation and maintenance by the local agency

Due to lack of proper maintenance of ditches, etc., existing facilities are clogged with garbage, etc.

Degree of interest by Japanese firms

The level of interest of Japanese companies is unknown.

(iv) Implementation Condition

Relevance with upper plans

Vision 2050 and Mongolia's Five-Year Basic Policy include measures against flooding, which are highly relevant.

Relevance with other plans

This project is especially related to the road maintenance project.

<u>**Capacity of implementing agency**</u>

Proper maintenance of rainwater drainage facilities is not being implemented and needs to be improved, and there is a track record of support by other donors.

<u>**Situation of development of institutional frameworks**</u>

Maintenance and management systems have been established to some extent, but there are still issues to be addressed.

<u>**Request from the Mongolian Government**</u>

There is support from donors other than Japan, and the demand from the Mongolian Government is moderate.

c. Overall Evaluation

The main reason for flooding damage in areas where rainwater drainage facilities have been constructed is that the existing rainwater drainage facilities were designed based on urban planning surveys conducted in the 1970's and are currently inadequate. In addition, flooding damage occurs in areas where rainwater drainage facilities have not been constructed (including gel areas), or where rainwater drainage facilities such as gutters are not functioning properly during rainfall due to trash. Since it takes a great deal of money and time to implement hardware measures as part of the rainwater drainage facility development, it is essential to formulate a development plan to implement effective measures. In addition, since UB City does not have a master plan for rainwater drainage and flood embankment facilities, its planning is urgently needed. Furthermore, as a software measure, it is necessary to properly maintain the existing rainwater drainage facilities such as ditches.

d. Remarks

The possibility of adopting pump gates and rainwater retention facilities, which are Japanese technologies, needs to be further investigated.

e. Comments by the Mongolian Government

UB City believes that the improvement and maintenance of urban rainwater drainage is important from the perspective of protecting the lives, health, and assets of Ulaanbaatar residents, and believed that rainwater drainage pipe improvement plan for the Central Road and East Side Road will be effective in preventing flooding, but the planned route of the rain drainage pipe needs to be changed to consider obstructions.

f. Consideration of Technical Assistance Related to Yen-Loan

None.

Table 5.43 Evaluation Result Summary (Wat05)

No.	**Wat05**
Project Name	Urban Rainwater Drainage Plan and Facility Improvement Management
Implementing Agency	USUG
Relating Agency	MRTD, GUBBG
Project Cost	Apporox. 2.7 billion yen

Outline and Objective of the Project

In Ulaanbaatar City, flooding and inundation damage occurs frequently during the summer season when rainfall is high. For this reason, rainwater drainage facilities (rainwater pipes: 26.9 km, two rainwater pumping stations: 25 m^3/s each) will be constructed to eliminate flooding damage.

Evaluation Item: Large	Medium	Small		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development inpact	Resident's Life	Improvement of Public Services	Reduction of flooding damage	High	Flooding damage will be reduced.	4.0	0.96	3.84	4.80
		Enlargement of Activity Range	Urban dysfunction reduction	High	Reduced damage from flooding will reduce urban dysfunction.	4.0	0.72	2.88	3.60
		Enhancement of Amenity	Improvement of sanitary conditions	Normal	Reduced damage from flooding will help maintain the comfort of residents' lives.	3.0	0.72	2.16	3.60
	Sub-total							8.88	12.00
	Environment Improvement	Living Environment Conservation	Improvement of public health and environment	High	Reduction of sewage overflow due to flood damage, leading to the preservation of the living environment.	4.0	0.72	2.88	3.60
		Natural Environment Conservation	Improvement of the natural environment	High	Reduction of sewage overflow due to flooding damage, leading to conservation of the natural environment	4.0	0.96	3.84	4.80
		Global Environment Conservation	Improvement of the water circulation	High	Reduction of sewage overflow due to flooding damage, leading to improvement of water circulation	4.0	0.72	2.88	3.60
	Sub-total							9.60	12.00
	Local Economy	Expansion of Production	Increase in land value	High	Land values will increase due to reduced flooding damage.	4.0	0.60	2.40	3.00
		Increase of Employment	Increased employment of field workers	High	Increased employment of field workers	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
Sub-total								23.28	30.00
Investment Impact	Cost-Effectiveness			Very Low	Hardware measures to mitigate flooding damage are very expensive and time-consuming.	1.0	1.60	1.60	8.00
	Profitability			Very Low	Without systematic implementation of flood control measures, it will be difficult to achieve sufficient results.	1.0	0.40	0.40	2.00
Sub-total								2.00	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Low	Further research is needed to see if Japanese technology can be used.	2.0	0.80	1.60	4.00
		Uniqueness and Superiority of the Technology		Normal	Rainwater retention, etc. are unique and superior.	3.0	1.60	4.80	8.00
		Operation and Maintenance by the Local Agency		Very Low	Due to lack of proper maintenance of ditches, etc., existing facilities are clogged with garbage, etc.	1.0	1.20	1.20	6.00
		Degree of Interest by the Japanese Firms		Normal	The level of interest of Japanese companies is unknown.	3.0	0.40	1.20	2.00
Sub-total								8.80	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		Very High	Related to Vision 2050 and Mongolia Five-Year Basic Policy	5.0	1.00	5.00	5.00
		Relevance with Other Plans		High	It is related to road improvement projects.	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Normal	Proper maintenance of rain water drainage facilities is not being implemented, and there is a track record of support by other	3.0	1.00	3.00	5.00
		Situation of Development of Institutional Frameworks		Normal	Maintenance and management systems have been established to some extent, but there are still issues to be addressed.	3.0	1.00	3.00	5.00
	Sub-total							15.00	20.00
	Requests from the Mongolian Government			Normal	There is support from donors other than Japan, and the demand from partner countries is moderate.	3.0	4.00	12.00	20.00
	Sub-total							12.00	20.00
Sub-total								27.00	40.00
				Ground Total				**61.08**	**100**

No.	**Wat05**
Project Name	Urban Rainwater Drainage Plan and Facility Improvement Management

Overall Evaluation

The main reason for flooding damage in areas where rainwater drainage facilities have been constructed is that the existing rainwater drainage facilities were designed based on urban planning surveys conducted in the 1970's and are currently inadequate. In addition, flooding damage occurs in areas where rainwater drainage facilities have not been constructed (including gel areas), or where rainwater drainage facilities such as gutters are not functioning properly during rainfall due to trash. Since it takes a great deal of money and time to implement hardware measures as part of the rainwater drainage facility development, it is essential to formulate a development plan to implement effective measures. Since Ulaanbaatar City does not have a master plan for rainwater drainage and flood embankment facilities, its planning is urgently needed. Furthermore, as a software measure, it is necessary to properly maintain existing rainwater drainage facilities such as ditches.

Remarks

The possibility of adopting pump gates and rainwater retention facilities, which are Japanese technologies, needs to be further investigated.

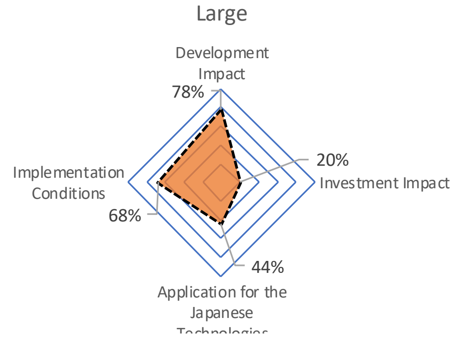
Comments by the Mongolian Government

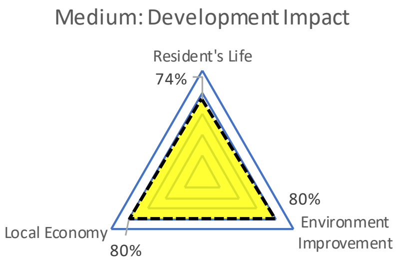
Ulaanbaatar City believes that the improvement and maintenance of urban rainwater drainage is important from the perspective of protecting the lives, health, and assets of Ulaanbaatar citizens, and believed that rainwater drainage pipe improvement plan for the Central Road and East Side Road will be effective in preventing flooding, but the planned route of the rain drainage pipe needs to be changed to consider obstructions.。

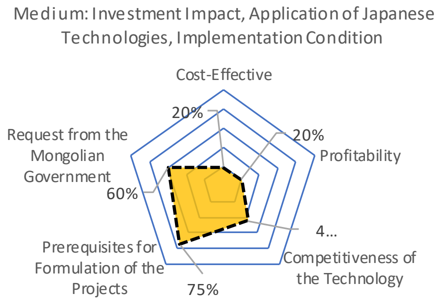
Consideration of Technical Assistance related to Yen Loan

None

Charts







CTI Engineering International Co., Ltd.
SUURI-KEIKAKU Co., Ltd.
TEC International Co., Ltd.

5.2.3 Solid Waste Management

(1) WM01: Construction of WtE Facility (Waste Power Generation/Heat Supply Facility)

a. Outline and Purpose of the Project

The tightness of the final disposal site has become a serious problem for the ever-increasing amount of waste in UB City. Therefore, for the purpose of prolonging the life of the final disposal site, the introduction of an incineration facility that reduces the volume of solid waste as a paid candidate project is proposed. By making this facility a WtE facility (waste power generation and heat supply facility), it will be possible to supply energy to the region. **Table 5.44** shows a draft business plan of the WtE project.

Based on the survey results of the annual waste collection amount (250,000 tons/year) of UB City, the incineration facility was set to 800 tons/day. The project method will be a publicly owned private system, financing will be carried out by Mongolia through yen-loan, and design, construction, management, and operation will be implemented by Japanese companies and partner companies. The source of income at this time shall be the purchase of waste and the sale of electricity. The project implementation structure is illustrated in **Figure 5.6**.

Table 5.44 Draft Business Plan of the WtE Project

Item	Contents	Remarks
Waste disposal amount	250,000 t/year	Low fever 1,600 kcal/kg
Reactor type / Reactor scale	Stalker type incinerator 800 t/day (400 t × 2 furnaces)	312.5 working days
Pretreatment equipment	Consultation required (depending on the sorting situation)	Needs investigation
Power generation output	Steam turbine: 12.4 MW Annual power generation: 93,000 MWh	Back pressure turbine
Heat supply	Heat supply: 37.2 MW Annual heat supply: 223,200 MWh	Hot water supply Effective heat utilization rate 80%
Exhaust gas treatment	Dry type (activated carbon / slaked lime spray), non-catalytic denitration	
Ash treatment	Landfill	A managed final disposal site is required
Required site area	About 3ha	
Construction period	3 years (depending on local conditions)	
Approximate construction cost	About 13 billion yen	Does not include construction and pile construction
Maintenance fee	Approximately 13 billion yen (total for 20 years)	Driver's personnel expenses, utility expenses, maintenance expenses (excluding SPC operating expenses)
Source of income	Waste purchase price: 20 USD/ton Selling price: 0.15USD/kWh	UB City and Distribution Corporation Current price undecided

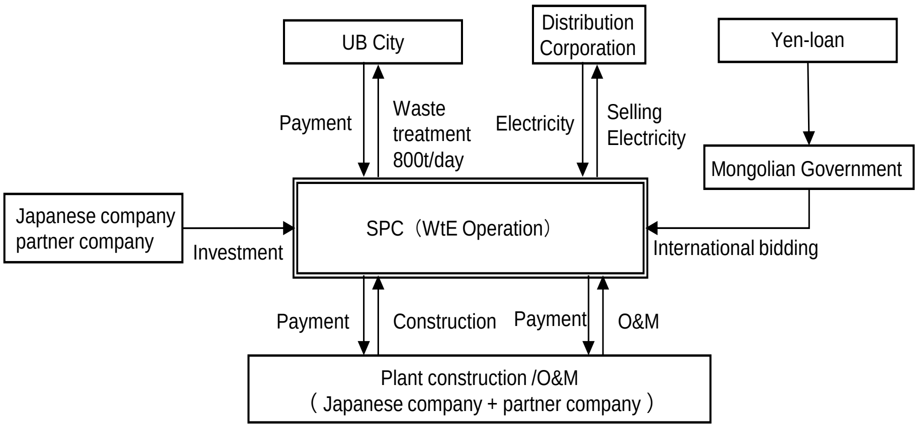


Figure 5.6 Project Implementation Structure (WM01)

b. Project Evaluation Results

Project evaluation has been conducted for this project. The individual evaluation items are shown in **Table 5.45**, and the evaluation criteria are shown in **Table 5.46**.

Table 5.45 Individual Evaluation Items and Evaluation Criteria (WM01)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Waste collection service	**Table 5.46**
			Utility charges	**Table 5.46**
		Enlargement of Activity Range	Power supply area	**Table 5.46**
			Heat supply area	**Table 5.46**
		Enhancement of Amenity	Sanitary environment in the city	**Table 5.46**
	Environmental Improvement	Living Environment Conservation	Sanitary environment in the city	**Table 5.46**
		Natural Environment Conservation	Sanitary environment of landfill	**Table 5.46**
		Global Environment Conservation	Generation of global warming gas	**Table 5.46**
	Local Economy	Expansion of Production	Revitalization of local production activities	**Table 5.46**
		Increase of Employment	Number of employees	**Table 5.46**
			Increase in surrounding offices	**Table 5.46**
Investment Impact		Cost-Effectiveness		**Table 5.46**
		Profitability		**Table 5.46**

Table 5.46 Evaluation Criteria (WM01)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

The WtE (waste power generation and heat supply) facility is a facility that contributes to extending the life of the final disposal site and modernizing SWM, and it is considered to play an important role in improving the sanitary environment in the city. On the other hand, since it is not a facility that leads to the expansion of waste collection services, it is unlikely that UB City residents will directly benefit from the improvement of public services and the expansion of the scope of activities. Moreover, when operated by the private works method, the burden on the residents will increase compared to when it is operated by the public works method because the waste purchase price includes corporate profits.

Environmental improvement

Regarding environmental improvement, this facility is considered to have a very positive effect on improving the sanitary environment in the city and landfills. However, it is indispensable to improve the management capacity of the disposal site because the landfill that has not been incinerated up to now, and will be changed to the landfill of incinerated ash. Since the ash (main ash, fly ash) discharged from the incineration facility is concentrated with heavy metals, it is necessary to take measures to prevent pollution of groundwater from the landfill and surrounding public water areas. In terms of global environment, the incineration of waste can significantly reduce global warming gas compared to coal-fired power generation and landfill at final disposal sites.

Local economy

As for the regional economy, new employment will be generated for the construction and maintenance of WtE facilities. Waste power generation and heat supply can supply infrastructure to the surrounding area, which may lead to expansion of production activities. On the other hand, the electricity and heat supply in UB City is not insufficient due to abundant coal resources, but it is important to thoroughly investigate the consumption destinations of electricity and heat supply generated in WtE facilities and to make the facilities of an appropriate size.

(ii) Investment Impact

Cost-Effectiveness

Under the assumption of this project, the waste to be treated is all general waste discharged from UB City. Therefore, from the perspective of direct beneficiaries, it can be said that the investment effect of WtE as a public facility is high.

Profitability

Since the waste purchase price and power sale price, which are the basis of business profit, have not been decided, the risk to project operation is very large. At present, profitability is low and Japanese companies cannot operate the business.

(iii) Application of Japanese Technology

Possibility of future business development

As a result of questionnaire surveys with Japanese companies regarding WtE overseas business experience, their answer was that implementing a WtE operation project in Mongolia is extremely risky given the situation where the waste purchase price and power generation purchase price have not been determined. Unless the basic legal arrangements and sorting accuracy related to WtE operation are high and a certain amount of waste can always be collected, it is unlikely that Japanese companies will develop their business in the country.

Uniqueness and superiority of the technology

Japan has more than 50 years of experience in the construction and operation of municipal waste incineration facilities, and it has incineration technology that is safe and secure and can handle various types of waste, from low-calorie to high-calorie waste. In addition, it has high power generation efficiency technology in energy recovery.

On the other hand, in recent years, technological innovations of Chinese and Korean companies have progressed, and their technological uniqueness and superiority are fading.

Operation and maintenance by the local agency

Currently, there is no municipal waste incineration facility in Mongolia. In terms of the operation of incinerators, thermal power generation facilities are being operated, so any company that undertakes these operations may be able to collaborate with partners, including Chinese and Korean companies.

Degree of interest by Japanese firms

Results from a questionnaire to Japanese companies that are developing WtE overseas project, showed that Japanese companies are cautious because of high political risk and contractual risk to operate their business independently.

(iv) Implementation Condition

Relevance with upper plans

In the Mongolian five-year investment program, there is no plan for WtE facilities, but it is listed in the national concession list by the Mongolian National Development Agency (NDA) and has a relevance to the higher-level plan.

The concession method (right to operate public facilities, etc.) is premised on independent profitability based on the profits from SWM, but during interviews with the SWM and Regulation Division of UB City, construction and operation support (EPC business) with yen-loan fund was adopted, and there was an opinion that the operation cost can be reduced by carrying out the operation in UB City.

Relevance with other plans

The concession project, which is premised on an independently profitable business, has received proposals from companies from multiple countries, such as China, South Korea, Germany and Austria. Currently, a company is being selected, but has not yet been selected because the waste and electricity purchase price has not been decided.

Another related project is the "UB City Solid Waste Treatment Facility Development Project", and EBRD is currently planning to construct a recycling facility and a final disposal site facility. This means that the final disposal site problem, which is currently tight in recent years, will be resolved even temporarily, and it is considered that the urgency of introducing WtE facilities is low.

Capacity of implementing agency

According to an interview survey with the SWM and Regulation Division of UB City, the WtE facility is recognized as a necessary facility for UB City in the future, but the city does not have the technical knowledge to manage the operation, it is necessary for Japan's support.

When implementing a WtE project, the government agency in charge of the partner country is the City Landscaping and Cleaning Service Department (CLCSD), which is engaged in the practice of final disposal site management and waste collection services. According to an interview survey on the current budget situation, equipment such as heavy machinery required for SWM is always in short supply due to lack of budget.

Situation of development of institutional frameworks

The waste purchase price and the electricity purchase price are not currently fixed and may fluctuate due to political factors. It is considered that the system development status for the WtE project is low, which poses a business operation risk for Japanese companies.

Request from the Mongolian Government

There is a strong need for waste incineration facilities, and Japan's support, including maintenance, is expected.

c. Overall Evaluation

The WtE project is a core technology in SWM in Japan and has accumulated a wealth of experience. In UB City, where the land used for the final disposal site is scarce due to population growth, there is a strong need from the government to reduce the volume of landfill waste, and there are voices expecting Japan's excellent technology and driving support. On the other hand, since this project is a publicly-owned private enterprise that is premised on independent profitability, it involves a great deal of business risk, and none of the Japanese companies interviewed said that there is a possibility of entering the market. Based on the above, it is judged that it is difficult to form a yen-loan fund project under this project scheme.

d. Remarks

None.

e. Comments by the Mongolian Government

It turned out that there is a high demand for reliable Japanese support in Mongolia. However, the financial situation of UB City is not abundant, so it hopes to introduce facilities that do not burden the residents.

f. Consideration of Technical Assistance Related to Yen-Loan

Since the construction and operation business of WtE facilities has a high project risk for Japanese companies, it is judged that it is difficult to formulate a project.

Table 5.47 Evaluation Result Summary (WM01)

No.	**WM01**		
Project Name	Construction of WtE facility (waste power generation/heat supply facility)		
Implementing Agency	WMCD	Relating Agency	
Project Cost	123 Million USD		

Outline and Objective of the Project

We propose a solid waste incineration facility (800ton/day) for the purpose of reducing the volume of solid waste in order to prolong the tight final disposal site. Japan has a high level of experience and technology in waste incineration power generation. The business method will be publicly-owned private system.

Large	Medium	Small		Evaluation Result	Evaluation Grounds	Rating	Weight	Rating * Weight	Full Scale
Development inpact	Resident's Life	Improvement of Public Services	Collection service	Normal	Maintain the status quo	3.0	0.48	1.44	2.40
			Public utility charge	Low	Little be higher than now	2.0	0.48	0.96	2.40
		Enlargement of Activity Range	Power supply area	Normal	No major changes	3.0	0.36	1.08	1.80
			Heat supply area	Normal	No major changes	3.0	0.36	1.08	1.80
		Enhancement of Amenity	Sanitary environment	Normal	No major changes	3.0	0.72	2.16	3.60
	Sub-total							6.72	12.00
	Environment Improvement	Maintenance of Living Environment	Sanitary environment	Normal	No major changes	3.0	0.72	2.16	3.60
		Maintenance of Natural Environment	Landfill environment	Very High	Incineration of waste creates a more hygienic landfill environment	5.0	0.96	4.80	4.80
		Maintenance of Global Environment	Global warming gas	High	Contributes to a significant reduction in global warming gas	4.0	0.72	2.88	3.60
	Sub-total							9.84	12.00
	Local Economy	Expansion of Production	Local production activity	Normal	No major changes	3.0	0.60	1.80	3.00
		Increase of Employment	Employment status	High	Expansion due to facility management	4.0	0.30	1.20	1.50
			Number of establishments	High	Slight increase in business establishments due to expansion of power supply area	4.0	0.30	1.20	1.50
	Sub-total							4.20	6.00
Sub-total								20.76	30.00
Investment Impact	Cost-Effectiveness			High	Direct beneficiaries are all citizens because it targets general waste	4.0	1.60	6.40	8.00
	Profitability			Very Low	Profitability is low at present due to lack of legal system	1.0	0.40	0.40	2.00
Sub-total								6.80	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Very Low	It is unlikely that Japanese companies will enter this business	1.0	0.80	0.80	4.00
		Uniqueness and Superiority of the Technology		High	In recent years, the technology of other countries has also improved	4.0	1.60	6.40	8.00
		Operation and Maintenance by the Local Agency		Normal	Partner collaboration with companies operating thermal power generation facilities is possible	3.0	1.20	3.60	6.00
		Degree of Interest by the Japanese Firms		Very Low	Not aggressive due to high business risk	2.0	0.40	0.80	2.00
Sub-total								11.60	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	Listed on the national concession list	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	Multiple foreign companies propose concession-based business implementation	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Low	UB city has a certain level of the technology	2.0	1.00	2.00	5.00
		Situation of Development of Institutional Frameworks		Very Low	Waste purchase and power sales system is not in place	1.0	1.00	1.00	5.00
	Sub-total							11.00	20.00
	Requests from the Mongolian Government			High	High need for waste iniciration facility, and Japan's support	4.0	4.00	16.00	20.00
	Sub-total							16.00	20.00
Sub-total								27.00	40.00
					Ground Total			**66.16**	**100**

No.	**WM01**
Project Name	Construction of WtE facility (waste power generation/heat supply facility)

Overall Evaluation

WtE technology is a central technology in waste management in Japan and has accumulated a wealth of experience. In UB City, where land used for final disposal sites is scarce due to population growth, there is a strong need from the government to reduce the volume of landfill waste. Japan's support with excellent technology is expected. On the other hand, since this project is based on the premise of independent profitability, it involves a great deal of business risk, and it is unlikely that Japanese companies will enter the market.
Based on the above, it is judged that it is difficult to form a loan-financing cooperation project under this project scheme.

Remarks

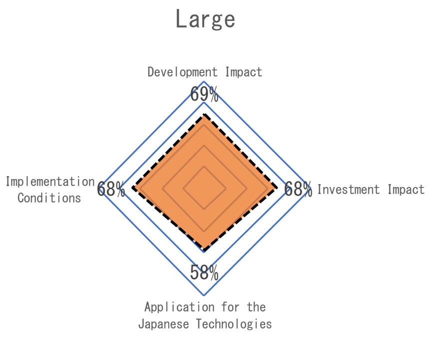
Comments by the Mongolian Government

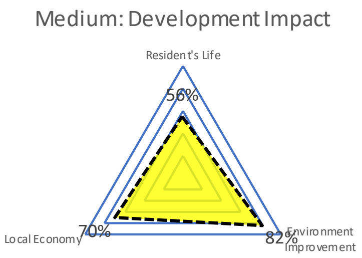
Mongolia is seeking support for the construction and operation of highly reliable WtE facilities, and it has been found that there is a high demand for support for Japan's high technology. However, the financial situation of UB City is not abundant, so we hope to introduce facilities that do not burden the citizens.

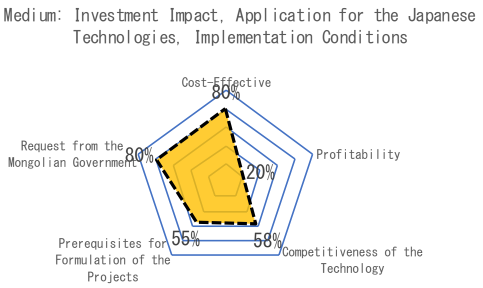
Consideration of Technical Assistance related to Yen Loan

Since the construction and operation business of WtE facilities has a high business risk for Japanese companies, it is judged that it is difficult to make a business project.

Charts







(2) WM02: Construction of Intermediate Treatment Facility (Recycling Facility)

a. Outline and Purpose of the Project

To improve the waste recycling situation in UB City, an intermediate treatment (recycling facility) project for solid waste is proposed. The main items to be recycled are itemized below. A recycling factory will be constructed with yen-loan fund, and the business will be operated with the profits associated with recycling.

- Waste home appliances, E-Waste
- Fluorescent lamp recycling
- Recycled plastic material
- PET bottle recycling

b. Project Evaluation Results

Project evaluation has been conducted for this project. The individual evaluation items are shown in **Table 5.48**, and the evaluation criteria are shown in **Table 5.49**.

Table 5.48 Individual Evaluation Items and Evaluation Criteria (WM02)

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
Development Impact	Residents' Life	Improvement of Public Services	Improvement of waste collection service	**Table 5.49**
			Reduction of utility charges	**Table 5.49**
		Enlargement of Activity Range	Expansion of waste collection service area	**Table 5.49**
		Enhancement of Amenity	Improvement of sanitary environment in the city	**Table 5.49**
	Environmental Improvement	Living Environment Conservation	Improvement of sanitary environment in the city	**Table 5.49**
		Natural Environment Conservation	Reduction of illegal dumping	**Table 5.49**
		Global Environment Conservation	Depletion of the ozone layer	**Table 5.49**
	Local Economy	Expansion of Production	Expansion of production activities	**Table 5.49**
		Increase of Employment	Increased employment due to improvement	**Table 5.49**
Investment Impact		Cost-Effectiveness		**Table 5.49**
		Profitability		**Table 5.49**

Table 5.49 Evaluation Criteria (WM02)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

<u>**Residents' life**</u>

With the establishment of recycling facilities, it is expected that private sector recyclable resource collection services will become widespread. Although it is not a public service, it can be evaluated in terms of expanding the waste collection service. On the other hand, it is not a facility that leads to the reduction in utility charges related to waste treatment.

Environmental improvement

If the recycling system becomes widespread, waste that was previously unnecessary can be treated as valuable resources, so illegal dumping can be expected to decrease. Japan's recycling technology has been developed and advanced for the purpose of effective use of resources and safety of harmful substances, and safe and efficient recycling of home appliances has become possible. As an example, it is possible to recover liquid chlorofluorocarbons and chlorofluorocarbons of heat insulating materials for chlorofluorocarbons that destroy the ozone layer contained in refrigerators and air conditioners.

Local economy

By constructing and operating a recycling factory, expansion of regional economic activities can be expected. On the other hand, the recovery of valuable resources can compete with the local informal sector. Therefore, it is necessary to actively employ waste pickers in places where human resources are required, such as the sorting work.

(ii) Investment Impact

Cost-effectiveness

In the assumption of this project, wastes to be treated are all the target waste generated by UB City. Therefore, from the perspective of direct beneficiaries, it can be said that the investment effect of recycling facilities is high.

Profitability

In the current situation where the recycling system is not in place, it is considered difficult to secure the profitability of Japanese companies, because it is not possible to collect and earn sufficient recycled resources.

(iii) Application of Japanese Technology

Possibility of future business development

For the following reasons, it is unlikely that Japanese companies will enter the recycling business for solid waste.

- Due to the underdeveloped industry, the amount of waste that can be recycled is small, and the market size is small.
- Used electrical and electronic equipment discharged from ordinary households are likely to be recovered in the informal sector and are not recycled resources.
- Since solid waste recycling is mainly done by human power, it cannot compete with local companies and companies in other countries in terms of cost.
- There is no obligation to consider the safety and environmental aspects stipulated in the Japanese recycling system.

Uniqueness and superiority of the target technology

Since the main technology for solid waste recycling is manual selection, it is not possible to secure an advantage over local companies and companies in other countries. Although there is an advantage in the technology for recovering harmful substances such as fluorocarbons contained in refrigerators and air conditioners, it is not an advantage in UB City because there is no obligation to recover fluorocarbons.

Operation and maintenance by the local agency

Since there are recycling companies in UB City, it is possible to build an O&M implementation system for business operations.

Degree of interest by Japanese firms

Japanese companies are not interested in it because it is not profitable in terms of cost.

(iv) Implementation Condition

Relevance with upper plans

Mongolia's five-year basic policy sets a goal of satisfying the waste recycling rate from the baseline of 7.6% to 27% by 2025.

Relevance with other plans

None.

Capacity of implementing agency

This waste is mainly hand-sorted and does not require high technologies for sorting. Besides, the recycling project is mainly handled by a private company, and the financial situation depends on the company.

Situation of development of institutional frameworks

There is a lack of recycling systems, and there is a problem in building a sound recycling system.

Request from the Mongolian Government

There is a strong need for recycling of solid waste, including E-Waste, which is expected to increase, and policies to support the activities of private companies such as the Eco-park concept are being promoted. On the other hand, there is awareness that the system is inadequate, and hope for Japan's support.

c. Overall Evaluation

UB City has high recycling needs and awareness and encourages private companies to participate in recycling projects. As an example, the "Eco-park concept" is being promoted to consolidate recycling companies. On the other hand, the local technical level is not high, and Japanese technical support is required for the recycling technology of waste home appliances and E-Waste.

However, for Japanese recycling companies to enter UB City and operate their businesses, it is considered that they cannot compete with local companies and companies in other countries, especially in terms of cost, due to the small market size and lack of recycling system. To carry out the recycling business in UB City, the priority should be given to support for improving the recycling system.

d. Remarks

None.

e. Comments by the Mongolian Government

During interviews with the UB SWM and Regulation Division, it was explained that technical support was needed especially for E-Waste recycling technology.

f. Consideration of Technical Assistance Related to Yen-Loan

Since it is considered difficult to construct and operate a recycling factory of a Japanese company with yen-loan fund, paid incidental technical assistance is not suitable. However, as a general technical cooperation project, it is beneficial to carry out a support project based on Japan's recycling system.

Table 5.50 Evaluation Result Summary (WM02)

No.	**WM02**
Project Name	Construction of intermediate treatment facility (recycling facility) for solid waste
Implementing Agency	WMCD Relating Agency:
Project Cost	475 million USD
Outline and Objective of the Project	The purpose is to improve the recycling rate of UB city. This project is assumed to be operated independently.

Evaluation Items: Large	Medium	Small		Evaluation Result	Evaluation Grounds	Rating	Weight	Rating * Weight	Full Scale
Development inpact	Resident's Life	Improvement of Public Services	Collection service	High	Expansion of private-sector recycled product collection services	4.0	0.48	1.92	2.40
			Public utility charge	Normal	No major changes	3.0	0.48	1.44	2.40
		Enlargement of Activity Range	Collection service	High	Expansion of private-sector recycled product collection services	4.0	0.72	2.88	3.60
		Enhancement of Amenity	Sanitary environment	High	Recycling of waste that has an adverse effect on the environment	4.0	0.72	2.88	3.60
	Sub-total							9.12	12.00
	Environment Improvement	Maintenance of Living Environment	Sanitary environment	High	Waste collection processing is improved by promoting recycling	4.0	0.72	2.88	3.60
		Maintenance of Natural Environment	Illegal dumping	High	Illegal dumping of waste home appliances is reduced by promoting recycling	4.0	0.96	3.84	4.80
		Maintenance of Global Environment	Ozone layer protection	High	It is possible to properly treat chlorofluorocarbons	4.0	0.72	2.88	3.60
	Sub-total							9.60	12.00
	Local Economy	Expansion of Production	Local production activity	High	Expected to expand economic activity	4.0	0.60	2.40	3.00
		Increase of Employment	Employment status	High	Active employment in the informal sector	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
Sub-total								23.52	30.00
Investment Impact	Cost-Effectiveness			High	Direct beneficiaries are all citizens because it targets general waste	4.0	1.60	6.40	8.00
	Profitability			Very Low	It is difficult to secure profitability because the recycling system is not in place	1.0	0.40	0.40	2.00
Sub-total								6.80	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Very Low	The market size is small and it is difficult for Japanese companies to enter the market	1.0	0.80	0.80	4.00
		Uniqueness and Superiority of the Technology		Very Low	Cannot secure superiority over local companies and companies in other countries	1.0	1.60	1.60	8.00
		Operation and Maintenance by the Local Agency		Normal	It is possible to build a cooperative system with local company	3.0	1.20	3.60	6.00
		Degree of Interest by the Japanese Firms		Very Low	Not aggressive due to high business risk	1.0	0.40	0.40	2.00
Sub-total								6.40	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		Normal	the 5-year development basic policy states that the recycling rate should be improved	3.0	1.00	3.00	5.00
		Relevance with Other Plans		Normal	Eco-park concept by UB city (recycling facility)	3.0	1.00	3.00	5.00
		Capacity of Implementing Agency		Low	Mainly hand sorting, not high technique	2.0	1.00	2.00	5.00
		Situation of Development of Institutional Frameworks		Very Low	Lack of legal system for recycling	1.0	1.00	1.00	5.00
	Sub-total							9.00	20.00
	Requests from the Mongolian Government			High	There is a high demand for recycling, but system development is an urgent issue	4.0	4.00	16.00	20.00
	Sub-total							16.00	20.00
Sub-total								25.00	40.00
					Ground Total			**61.72**	**100**

No.	**WM02**
Project Name	Construction of intermediate treatment facility (recycling facility) for solid waste

Overall Evaluation

UB City has high recycling needs and awareness, and encourages private companies to participate in recycling projects. As an example, the "eco-park concept" is being promoted to consolidate recycling companies. On the other hand, the local technical level is not high, and Japanese technical support is required for recycling technology of waste home appliances and E-waste. However, in order for Japanese recycling companies to enter UB City and operate their businesses, it is considered that they cannot compete with local companies and companies in other countries, especially in terms of cost, due to the small market size and lack of recycling system. In order to carry out the recycling business in UB City, priority should be given to support for improving the recycling system.

Remarks

Comments by the Mongolian Government

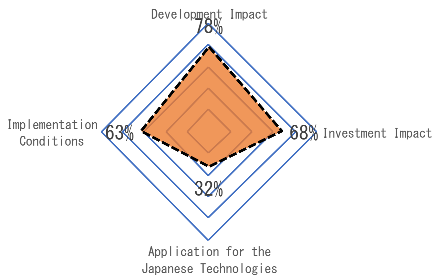
In the hearing with WMCD, it was said that technical support was needed especially for E-waste recycling technology.

Consideration of Technical Assistance related to Yen Loan

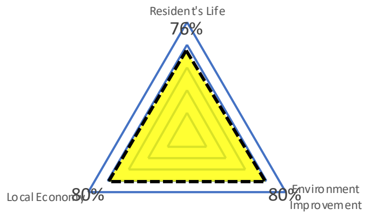
As a general technical cooperation project, it is beneficial to carry out a support project based on Japan's recycling system.

Charts

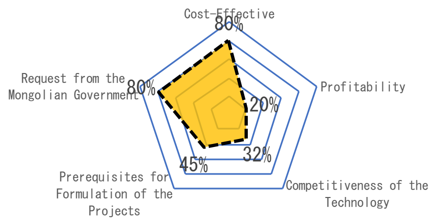
Large



Medium: Development Impact



Medium: Investment Impact, Application for the Japanese Technologies, Implementation Conditions



(3) WM03: Construction of Recycling Facility for Automobile Parts

a. Outline and Purpose of the Project

The recycling project for automobile recycled parts has high support needs from the Mongolian side. As a yen-loan fund project, it is assumed that a Japanese company will build a recycling factory locally and operate it independently. The purpose of this project is to revitalize the recycling market in UB City and improve technology.

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.51**, and the evaluation criteria are shown in **Table 5.52**.

Table 5.51 Individual Evaluation Items and Evaluation Criteria (WM03)

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
Development Impact	Residents' Life	Improvement of Public Services	Car disposal procedure	**Table 5.52**
			Utility charges	**Table 5.52**
		Enlargement of Activity Range	Citizen activity	**Table 5.52**
		Enhancement of Amenity	Sanitary environment in the city	**Table 5.52**
	Environmental Improvement	Living Environment Conservation	Sanitary environment in the city	**Table 5.52**
		Natural Environment Conservation	Illegal dumping	**Table 5.52**
		Global Environment Conservation	Ozone layer protection	**Table 5.52**
	Local Economy	Expansion of Production	Production activity	**Table 5.52**
		Increase of Employment	Number of employees	**Table 5.52**
Investment Impact		Cost-Effectiveness		**Table 5.52**
		Profitability		**Table 5.52**

Table 5.52 Evaluation Criteria (WM03)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

<u>Residents' life</u>

Since the automobile recycling project is carried out by the private sector, it does not directly lead to improvement of public services or reduction of utility charges. However, with the improvement of the scrap car recycling system in UB City, citizens may receive benefits such as simplification of scrap car procedures in the future.

<u>Environmental improvement</u>

In recent years, the number of automobiles has been increasing in UB City. In addition, in order to reduce the impact on air pollution, the preferential treatment system for eco-cars, which emits less exhaust gas and has less impact on the environment, was started in 2007, and the number of hybrid vehicles is increasing. Number of scrapped vehicles is also increasing due to replacement of old vehicles and purchase of hybrid vehicles. Since scrapped automobiles are difficult to scrap, there are many cases of illegal dumping, and in addition to spoiling the aesthetics, there are concerns about environmental pollution by harmful substances such as chlorofluorocarbons.

By promoting this recycling business, it is expected that illegal dumping of scrapped automobiles will be reduced, leading to environmental improvement. On the other hand, the method of treating the recovered harmful substances becomes a new issue.

Local economy

The automobile recycling project, which targets the increasing number of scrapped automobiles, is expected to expand as a market, so economic activities and employment are expected to increase.

(ii) Investment Impact

Cost-effectiveness

Since it is intended for car owners, the number of direct beneficiaries is medium.

Profitability

Considering the increase in the number of scrapped cars in the future, it is considered that it has a certain market. However, since the automobile recycling system is underdeveloped in Mongolia, only valuable resources are collected, and harmful substances are likely to be dumped illegally where it is difficult to secure the technological superiority of Japanese companies and the profitability of the business. In order to ensure profitability, it is necessary to improve the system for recycling and illegal dumping.

(iii) Application of Japanese Technology

Possibility of future business development

Although the market size is a certain level, it is unlikely that Japanese companies will carry out project development because the system for waste automobile recycling system is not yet developed.

Uniqueness and superiority of the target technology

Japan has high technology for processing technology such as CFC recovery. However, since UB City is not obliged to apply the above technology at present, it cannot secure its uniqueness and superiority.

Operation and maintenance by the local agency

Although it is small, there are automobile recycling companies in UB City, so there is a possibility that partner companies can be trained by providing technical guidance.

Degree of interest by Japanese firms

If the recycling system is not in place, the project will not be profitable. It is therefore evaluated that the degree of interest in the advancement of Japanese companies is low.

(iv) Implementation Condition

Relevance with upper plans

Mongolia's five-year basic policy sets a goal of satisfying the waste recycling rate from the baseline of 7.6% to 27% by 2025.

Relevance with other plans

The Ministry of Roads and Transport Development (MRTD) is supporting the automobile parts recycling business in cooperation with the NPO "Waste Recycling Federation", which has 300 domestic companies.

Capacity of implementing agency

The recycling technology of private companies is not high and may cause environmental pollution. The financial situation depends on the private company.

Situation of development of institutional frameworks

The system related to the recycling system is not in place. For Japanese companies to enter the recycling business, it is necessary to develop systems such as penalties for illegal dumping, registration system for scrapped vehicles, and recycling fee system.

Request from the Mongolian Government

None.

c. Overall Evaluation

Proper disposal of scrapped automobiles, which is increasing in UB City, has become an important environmental issue. There is a strong need for support from Japan regarding proper treatment of scrapped vehicles. On the other hand, it is judged that it is premature for Japanese companies to enter UB City if the recycling system has not been established. Therefore, it is necessary to support the construction of an automobile recycling system through a technical cooperation project rather than a yen-loan fund project.

d. Remarks

None.

e. Comments by the Mongolian Government

MRTD is considering promoting the automobile recycling project in collaboration with Korean companies, but the scope of the project is limited to iron scrap processing and resale of usable parts. It is desirable to introduce Japanese technology such as hazardous waste treatment.

f. Consideration of Technical Assistance Related to Yen-Loan

Since the recycling system is not in place, it is considered difficult to construct and operate a recycling factory through a Japanese company with yen-loan fund, so examination of technical support incidental to the yen-loan fund is not considered. However, as a technical cooperation project, it is beneficial to carry out projects such as automobile recycling system maintenance support.

Table 5.53 Evaluation Result Summary (WM03)

No.	**WM03**		
Project Name	Construction of recycling facility for automobile parts		
Implementing Agency	MRTD	Relating Agency	WMCD
Project Cost	475 million USD		

Outline and Objective of the Project

The recycling project for automobile recycled parts is that has high support needs from the Mongolian side. As a yen-loan fund project, it is assumed that a Japanese company will build a recycling factory locally and operate it independently. The purpose of this project is to revitalize the recycling market in UB City and improve technology.

Evaluation Items: Large	Medium	Small		Evaluation Result	Evaluation Grounds	Rating	Weight	Rating * Weight	Full Scale
Development impact	Resident's Life	Improvement of Public Services	scrap car procedure	Normal	It is expected that private sector recycling services will expand in the future	3.0	0.48	1.44	2.40
			public utilities charge	Normal	It does not lead to a reduction in utility charges	3.0	0.48	1.44	2.40
		Enlargement of Activity Range	Citizen activity	Normal	Citizen's activities will not expand due to this project	3.0	0.72	2.16	3.60
		Enhancement of Amenity	Sanitary environment	High	Illegal dumping of scrapped cars can be reduced	4.0	0.72	2.88	3.60
	Sub-total							7.92	12.00
	Environment Improvement	Maintenance of Living Environment	Sanitary environment	High	Illegal dumping of scrapped cars can be reduced	4.0	0.72	2.88	3.60
		Maintenance of Natural Environment	Illegal dumping	High	Illegal dumping of scrapped cars can be reduced	4.0	0.96	3.84	4.80
		Maintenance of Global Environment	Ozone layer protection	High	It is possible to properly treat chlorofluorocarbons	4.0	0.72	2.88	3.60
	Sub-total							9.60	12.00
	Local Economy	Expansion of Production	Local production activity	High	Expected to expand economic activity	4.0	0.60	2.40	3.00
		Increase of Employment	Employment status	High	Expected to increase employment at related factories	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
Sub-total								22.32	30.00
Investment Impact	Cost-Effectiveness			Normal	Moderate direct beneficiaries as it targets car owners only	3.0	1.60	4.80	8.00
	Profitability			Very Low	It is difficult to secure profitability because the recycling system is not in place	1.0	0.40	0.40	2.00
Sub-total								5.20	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Very Low	It is difficult to secure profitability because the recycling system is not in place	1.0	0.80	0.80	4.00
		Uniqueness and Superiority of the Technology		Low	Unable to secure technical advantage	2.0	1.60	3.20	8.00
		Operation and Maintenance by the Local Agency		Normal	It is possible to build a cooperative system with local businesses	3.0	1.20	3.60	6.00
		Degree of Interest by the Japanese Firms		Very Low	Japanese companies have low interest	1.0	0.40	0.40	2.00
Sub-total								8.00	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	the 5-year development basic policy states that the recycling rate should be improved	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	Support for automobile recycling companies by MRTD	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Very Low	Mainly hand sorting, not high technique	1.0	1.00	1.00	5.00
		Situation of Development of Institutional Frameworks		Very Low	Insufficient recycling system	1.0	1.00	1.00	5.00
	Sub-total							10.00	20.00
	Requests from the Mongolian Government			High	There is a high demand for recycling, but system development is an urgent issue	4.0	4.00	16.00	20.00
	Sub-total							16.00	20.00
Sub-total								26.00	40.00
					Ground Total			**61.52**	**100**

No.	**WM03**
Project Name	Construction of recycling facility for automobile parts

Overall Evaluation

Proper disposal of scrapped automobiles, which is increasing in UB city, has become an important environmental issue. There is a strong need for support for Japan regarding proper treatment of scrapped vehicles. On the other hand, it is judged that it is premature for Japanese companies to enter UB city if the recycling system has not been established. Therefore, we think that it is necessary to support the construction of an automobile recycling system through a technical cooperation project rather than a yen-loan fund project.

Remarks

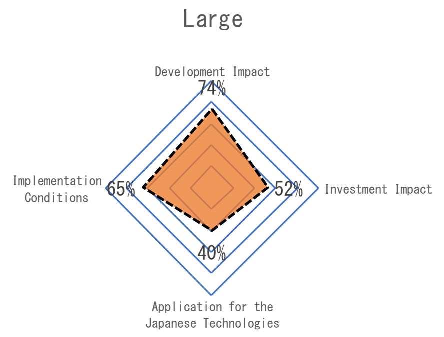
Comments by the Mongolian Government

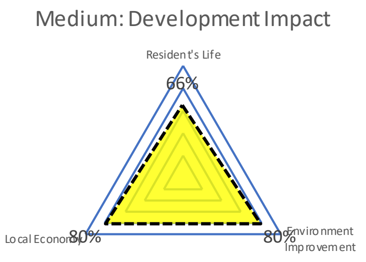
MRTD is considering promoting the automobile recycling project in collaboration with Korean companies, but the scope of the project is limited to iron scrap processing and resale of usable parts. It is desirable to introduce Japanese technology such as hazardous waste treatment.

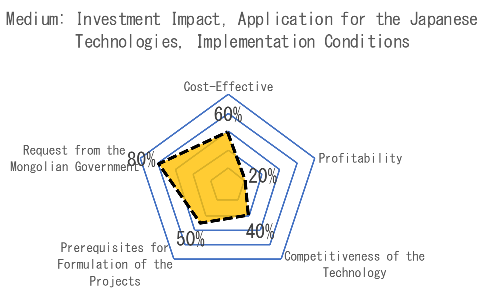
Consideration of Technical Assistance related to Yen Loan

Since the recycling system is not in place, it is considered difficult to construct and operate a recycling factory of a Japanese company with Yen-loan fund, so it is not consider examination of technical support incidental to Yen-loan fund. However, as a technical cooperation project, it is beneficial to carry out projects such as automobile recycling system maintenance support.

Charts







(4) WM04: Hazardous Waste Final Disposal Site (Managed Final Disposal Site)

a. Outline and Purpose of the Project

In UB City, the treatment of heavy metal contaminated sludge from factories has become a problem. Since the final disposal destination of medical waste and hazardous waste is the same disposal site as general waste, there are problems on the surrounding environment and health hazards to disposal site workers. Additionally, proper disposal of ash (main ash, fly ash) is also required when incinerating waste. Therefore, the project envisioned to be a business that constructs and operates a facility for final disposal of hazardous waste, corresponding to a managed final disposal site in Japan and designed to prevent groundwater pollution in the surrounding area such as impermeable works.

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.54**, and the evaluation criteria are shown in **Table 5.55**.

Table 5.54 Individual Evaluation Items and Evaluation Criteria (WM04)

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
Development Impact	Residents' Life	Improvement of Public Services	Utility charges	**Table 5.55**
			Hazardous waste disposal costs	**Table 5.55**
		Enlargement of Activity Range	Residents' activity range	**Table 5.55**
		Enhancement of Amenity	Sanitary environment in the city	**Table 5.55**
	Environmental Improvement	Living Environment Conservation	Sanitary environment in the city	**Table 5.55**
		Natural Environment Conservation	Conservation of the natural environment in the city	**Table 5.55**
		Global Environmental Conservation	Generation of global warming gas	**Table 5.55**
	Local Economy	Expansion of Production	Expansion of production activities due to facility operation	**Table 5.55**
		Increase of Employment	Number of employees	**Table 5.55**
Investment Impact		Cost-Effectiveness		**Table 5.55**
		Profitability		**Table 5.55**

Table 5.55 Evaluation Criteria (WM04)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

<u>Residents' life</u>

The final disposal facility for hazardous waste is a facility that prevents damage to the local environment and human health and contributes to the modernization of SWM in UB City. On the other hand, it is unlikely that residents will directly feel the benefits of improving public services, rather than facilities that lead to the expansion of waste collection services and reductions in utility charges.

<u>Environmental improvement</u>

If the hazardous waste final disposal site facility is put into operation, it will be possible to reduce environmental pollution and human health damage caused by hazardous waste, which will play an important role in improving the environment of UB City.

<u>Local economy</u>

The establishment of a hazardous waste treatment system is thought to lead to sustainable industrial development in UB City and is expected to improve the regional economy over the medium to long term. In the short term, employment will increase due to facility construction and operation.

(ii) Investment Impact

<u>Cost-effectiveness</u>

There are many indirect beneficiaries because it is a project related to the treatment of hazardous waste, but the direct beneficiaries are the owners of the hazardous waste or the projects that handle the hazardous waste, so the direct benefit is judged as moderate.

<u>Profitability</u>

Since the costs will be high, it is considered difficult for Japanese companies to secure profitability in project operations on the premise that waste treatment costs will be collected from the disposer. It is also necessary to strengthen legal arrangements such as penal provisions for illegal dumping as well.

(iii) Application of Japanese Technology

<u>Possibility of future business development</u>

Although there is a high need for hazardous waste treatment in UB City, it is considered difficult for a Japanese company to operate the business, which will increase the burden on users.

<u>Uniqueness and superiority of the target technology</u>

Japan has a track record of quickly introducing a method, namely, Fukuoka method, that promotes the stabilization of waste by keeping the landfill area semi-aerobic and has a wealth of experience. In UB City, a final disposal site was built through past a Japan’s grant aid program. Although the technical superiority is higher than that of other countries, local companies and companies in other countries are superior in terms of construction and maintenance costs.

<u>Operation and maintenance by the local agency</u>

The maintenance of the final disposal site in UB City is carried out by the UB City Landscaping and Cleaning Service Department (CLCSD), and the final disposal site operation project by a private company was not carried out. For this reason, it is currently unclear whether a local O&M system can be established.

<u>Degree of interest by Japanese firms</u>

When it comes to independent business profitability, it is considered difficult to stably secure hazardous waste from industry, which is the main source of income and the degree of interest as a business is low due to the high maintenance costs of Japanese companies.

(iv) Implementation Condition

Relevance with upper plans

Mongolia's SWM Strategy and Action Plan 2017-2030 shows the improvement of final disposal sites.

Relevance with other plans

In the 5-year investment program under the Five-Year Development Policy of Mongolia, the "UB City Solid Waste Treatment Facility Development Project" is being promoted with the support of EBRD. This is a construction project for a final disposal site for solid waste and a recycling facility. Since it is similar to the proposed project, it may affect the establishment of the project.

Capacity of implementing agency

Since the maintenance of final waste disposal is carried out by UB City, the technical level of private companies is low.

Situation of development of institutional frameworks

There is the "Law of Mongolia about Waste" as a system for managing hazardous waste, which was revised in 2017. The law provides for the containment, temporary storage, transportation, collection, storage, recycling and disposal of hazardous waste. The law also provides for the containment, temporary storage, transportation, collection, storage, recycling and disposal of hazardous waste. Penalties for illegal dumping are stipulated, but their effectiveness in the real world is low.

Request from the Mongolian Government

During interviews, UB City Environmental Pollution and Waste Management Division (EPWMD) and the Ministry of Environment and Tourism (MET), expressed a strong need for the construction of a hazardous waste disposal site.

c. Overall Evaluation

This project is not for general waste, but construction and project operation of facilities for final disposal of heavy metal-contaminated sewage sludge and various harmful substances. For general waste, the construction of a solid waste final disposal site is underway with the support of EBRD, but the proposed project has an impermeable structure and a leachate treatment facility and is a facility with enhanced measures to prevent pollution to the surrounding environment. With the changes in the social environment of UB City and the diversification of industries, the importance of hazardous waste treatment facilities is cited by the UB City EPWMD and the MET, so the contribution of UB City to the environment is considered to be high.

On the other hand, assuming independent profitability by Japanese companies, there is a risk that hazardous waste from industry, which is a source of profit, cannot be stably secured, and profitability is considered to be extremely low. In addition, maintenance costs are higher than those of local companies and companies in other countries, which is another factor that hinders business expansion. From the above, the contribution to UB City as a project is high, but it breaks when it is difficult for Japanese companies to enter the project.

d. Remarks

None.

e. Comments by the Mongolian Government

Proper treatment of heavy metal-contaminated sewage sludge and the Tuul riverbed mud derived from factory wastewater is an urgent issue. The importance of a comprehensive waste treatment facility, including a final disposal site for hazardous waste, is being emphasized by MET.

f. Consideration of Technical Assistance Related to Yen-Loan

Assuming an independently profitable project, it is difficult for Japanese companies to enter the market because profitability cannot be ensured. For this reason, technical support incidental to yen-loan fund is not assumed in connection with this project proposal.

Table 5.56 Evaluation Result Summary (WM04)

No.	**WM04**		
Project Name	Hazardous waste final disposal site (managed final disposal site)		
Implementing Agency	WMCD、MET	Relating Agency	CLCSD
Project Cost	28 Million USD		

Outline and Objective of the Project

In UB city, the treatment of heavy metal contaminated sludge from factories has become a problem. In addition, the final disposal destination of medical waste and hazardous waste has become a problem. Therefore, we envision a business that constructs and operates a facility for final disposal of hazardous waste.

Evaluation Items: Large	Medium	Small		Evaluation Result	Evaluation Grounds	Rating	Weight	Rating * Weight	Full Scale
Development inpact	Resident's Life	Improvement of Public Services	public utilities charge	Normal	Hazardous waste final disposal site business does not lead to reduction of waste charges	3.0	0.48	1.44	2.40
			Hazardous waste disposal costs	Low	Processing costs are higher than traditional methods	2.0	0.48	0.96	2.40
		Enlargement of Activity Range	Citizen activity	Normal	It does not lead to expansion of the range of activities of residents	3.0	0.72	2.16	3.60
		Enhancement of Amenity	Sanitary environment	High	It leads to improvement of sanitary environment in the city and improves comfort	4.0	0.72	2.88	3.60
	Sub-total							7.44	12.00
	Environment Improvement	Maintenance of Living Environment	Sanitary environment	High	It leads to improvement of sanitary environment in the city and improves comfort	4.0	0.72	2.88	3.60
		Maintenance of Natural Environment	Natural environment	High	The effect of preserving the natural environment is high	4.0	0.96	3.84	4.80
		Maintenance of Global Environment	Global warming gas	Normal	Since it will be disposed of in landfill, the effect of reducing global warming gas is low	3.0	0.72	2.16	3.60
	Sub-total							8.88	12.00
	Local Economy	Expansion of Production	Local production activity	High	It will lead to sustainable industrial development	4.0	0.60	2.40	3.00
		Increase of Employment	Employment status	High	Employment may increase due to facility construction and operation	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
Sub-total								21.12	30.00
Investment Impact	Cost-Effectiveness			Normal	The number of direct beneficiaries is moderate	3.0	1.60	4.80	8.00
	Profitability			Very Low	Difficult to secure profitability of Japanese companies	1.0	0.40	0.40	2.00
Sub-total								5.20	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Very Low	The possibility of business development of Japanese companies is very low	1.0	0.80	0.80	4.00
		Uniqueness and Superiority of the Technology		Normal	High technical advantage, but inferior to local companies in terms of cost	3.0	1.60	4.80	8.00
		Operation and Maintenance by the Local Agency		Normal	There is no private company operating the final disposal site	3.0	1.20	3.60	6.00
		Degree of Interest by the Japanese Firms		Very Low	Low interest of Japanese companies due to low profitability	1.0	0.40	0.40	2.00
Sub-total								9.60	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	Improvement of final disposal site is shown in Mongolia's waste management strategy	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	Construction of a waste disposal site is underway	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Very Low	There is no private company operating the final disposal site	1.0	1.00	1.00	5.00
		Situation of Development of Institutional Frameworks		Low	There are basic legal system provisions, but crackdowns are not thorough	2.0	1.00	2.00	5.00
	Sub-total							11.00	20.00
	Requests from the Mongolian Government			高い	There is a strong request from the partner country organization	5.0	4.00	20.00	20.00
	Sub-total							20.00	20.00
Sub-total								31.00	40.00
					Ground Total			**66.92**	**100**

No.	**WM04**
Project Name	Hazardous waste final disposal site (managed final disposal site)

Overall Evaluation

This project is construction and operation support of facilities for final disposal of heavy metal-contaminated sewage sludge and various harmful substances. The proposed project has an impermeable structure and a leachate treatment facility, and is a facility with enhanced measures to prevent pollution to the surrounding environment. On the other hand, assuming independent profitability by Japanese companies, there is a risk that hazardous waste from industry, which is a source of profit, cannot be stably secured, and profitability is considered to be extremely low. And, maintenance costs are higher than those of local companies and companies in other countries, which is another factor that hinders business expansion.
From the above, the contribution to UB city as a project is high, but it breaks when it is difficult for Japanese companies to enter the project.

Remarks

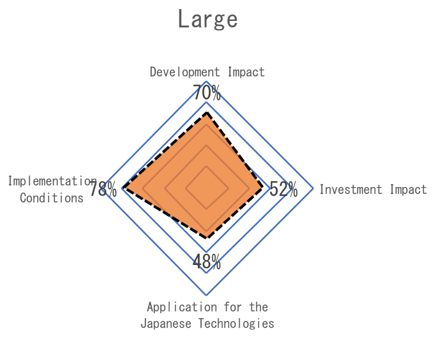
Comments by the Mongolian Government

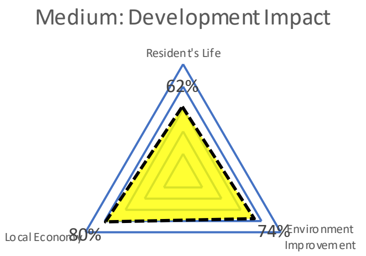
We recognize that the treatment of hazardous waste from diversifying and increasing industries and E-waste is more important than WMCD, and we look forward to Japan's support. In addition, proper treatment of heavy metal-contaminated sewage sludge and Tora riverbed mud derived from factory wastewater is an urgent issue.
The importance of a comprehensive waste treatment facility, including a final disposal site for hazardous waste, is being emphasized by MET.

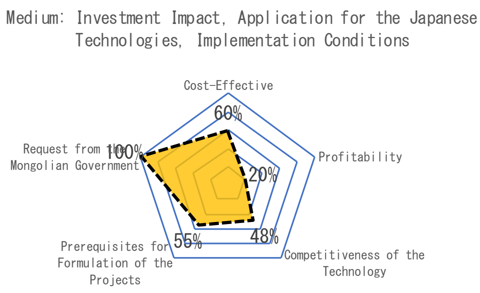
Consideration of Technical Assistance related to Yen Loan

Assuming an independently profitable business, it is difficult for Japanese companies to enter the market because profitability cannot be ensured. For this reason, technical support for paid accounts is not assumed in connection with this project proposal.

Charts







(5) WM05: Introduction of Hazardous Waste Treatment Facility

a. Outline and Purpose of the Project

Disposal of hazardous waste has become an important issue for UB City due to changes in social conditions and diversifying industries. For example, CFCs leaking from illegally dumped abandoned automobiles cause air pollution and have a tremendous impact on the surrounding environment. For the modernization of Mongolia's industry, it is necessary to establish not only a municipal waste treatment facility but also a hazardous waste treatment system.

Therefore, an EPC (engineering, procurement, construction) project and operation support project for incineration facilities for the purpose of intermediate treatment (detoxification) of hazardous waste is proposed. The reason for the EPC business is that it is difficult for Japanese companies to enter the business due to the high-country risk and the small market size of Mongolia, despite the high needs of the partner country.

Table 5.57 shows a draft business plan of the hazardous waste treatment facility project. **Figure 5.7** is a similar case of a medical waste incineration facility operating in Dubai. The proposed project implementation structure is illustrated in **Figure 5.8**, but although the jurisdiction of hazardous waste is MET’s, the actual project operation may be conducted by UB City together with MET.

<Waste to be treated>

Plastic waste, sludge, waste oil, glass waste, wood waste, metal waste, waste alkali, waste acid, paper waste, rubber waste, animal and vegetable residues, animal-based solid waste, and fiber waste.

Table 5.57 Draft Business Plan of the Hazardous Waste Treatment Facility Project

Item	Contents	Remarks
Waste disposal amount	62,000 t/year	
Reactor type / Reactor scale	Kiln stalker type incinerator (200 t/day × 1 furnace)	312.5 working days
Pretreatment equipment	Consultation required (depending on the sorting situation)	Needs investigation
Exhaust gas treatment	Dry type (activated carbon / slaked lime spray), non-catalytic denitration	
Ash treatment	Landfill	A managed final disposal site is required
Required site area	About 2ha	
Construction period	3 years (however, depending on local conditions)	
Approximate construction cost	5 billion yen	Does not include construction and pile construction
Maintenance fee	5 billion yen (total for 20 years)	Driver's staff fee, service fee, maintenance fee
Driving support costs	Approximately 500 million yen (5 years)	

Source: Ministry of the Environment (2013), Japan's Waste Treatment and Recycling Technology

Figure 5.7 Medical Waste Incineration Facility Operating in Dubai

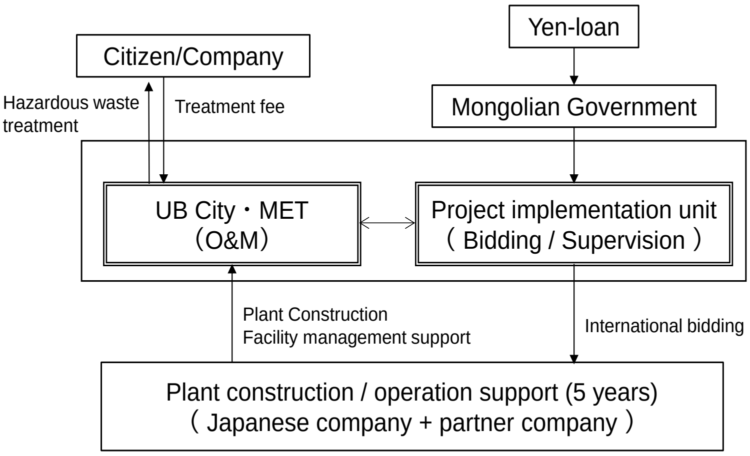


Figure 5.8 Project Implementation Structure (WM05)

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.58**, and the evaluation criteria are shown in **Table 5.59**.

Table 5.58 Individual Evaluation Items and Evaluation Criteria (WM05)

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
Development Impact	Residents' Life	Improvement of Public Services	Waste collection service	**Table 5.59**
			Utility charges	**Table 5.59**
		Enlargement of Activity Range	Resident activity range	**Table 5.59**
		Enhancement of Amenity	Sanitary environment in the city	**Table 5.59**
	Environmental Improvement	Living Environment Conservation	Sanitary environment in the city	**Table 5.59**
		Natural Environment Conservation	Natural environment in the city	**Table 5.59**
		Global Environmental Conservation	Generation of global warming gas	**Table 5.59**

Evaluation Items				Evaluation Criteria
	Local Economy	Expansion of Production	Expansion of production activities due to facility operation	**Table 5.59**
		Increase of Employment	Number of employees	**Table 5.59**
Investment Impact		Cost-Effectiveness		**Table 5.59**
		Profitability		**Table 5.59**

Table 5.59 Evaluation Criteria (WM05)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

Residents' life

Hazardous waste treatment facilities (detoxification facilities) are facilities that prevent damage to the local environment and human health and contribute to the modernization of SWM in UB City. On the other hand, it is unlikely that residents will directly feel the benefits of improving public services, rather than facilities that lead to the expansion of waste collection services and reductions in utility charges.

Environmental improvement

If the hazardous waste treatment facility is put into operation, it will be possible to reduce environmental pollution and human health damage caused by hazardous waste, which will play an important role in improving the environment of UB City.

Local economy

The establishment of a hazardous waste treatment system is thought to lead to sustainable industrial development in UB City, and it is expected that the regional economy will improve in the medium to long term. In the short term, employment will increase due to facility construction and operation.

(ii) Investment Impact

Cost-effectiveness

There are many indirect beneficiaries because it is a project related to the treatment of hazardous waste. However, since the direct beneficiary is the owner or business operator of the hazardous waste, it is judged to be moderate as a direct benefit.

Profitability

If this project is independently profitable based on project profits, the cost of Japanese companies will be higher than that of other countries, and since it is assumed that waste will not be collected to secure sufficient profits, it will be difficult to secure profitability. For this reason, in this project proposal, the EPC project and the driving support project with yen-loan funds are adopted.

(iii) Application of Japanese Technology

Possibility of future business development

At this stage, it is considered difficult for Japanese companies to operate their projects locally, but the experience of constructing this facility may be put to good use in markets in other countries.

Uniqueness and superiority of the target technology

Japan's incineration technology is excellent worldwide and has many achievements. However, in recent years, the technologies of other countries have improved, and it is not possible to secure clear uniqueness and superiority. In terms of cost, it is difficult to compete with local companies and companies in other countries.

Operation and maintenance by the local agency

Since the thermal power plant is in operation, there is a possibility that it will be possible to collaborate with the company that maintains it as a partner company.

Degree of interest by Japanese firms

Hazardous waste treatment facilities are often smaller than general waste incineration facilities, and it is difficult to secure profitability, so the degree of interest of Japanese companies is low.

(iv) Implementation Condition

Relevance with upper plans

A comprehensive facility for hazardous waste is listed as a list of projects that should solve the funding source of Mongolia's five-year development policy.

Relevance with other plans

A hazardous waste treatment facility has been planned in the Bagnuur district, but it was cancelled due to opposition from residents.

Capacity of implementing agency

Since there is a thermal power plant, it is considered that it has a certain level of maintenance technology.

Situation of development of institutional frameworks

Although there are regulations on hazardous waste based on the Law of Mongolia about Waste, there are many problems in their application to the real world.

Request from the Mongolian Government

There is a strong request from MET for the introduction of hazardous waste treatment facilities.

c. Overall Evaluation

MET recognizes the importance of hazardous waste treatment facilities for the sustainable development of UB City and seeks the support of other countries including Japan. Japan has abundant achievements in hazardous waste treatment with development of the industry, but it is smaller and more specialized than general waste incineration facilities. Due to the country risk of Mongolia and the small scale of the industry, it is considered difficult for Japanese companies to continue to make profits. Therefore, this project is designated as an EPC project and an operation support project for hazardous waste treatment facilities with yen-loan fund. However, when examining facility specifications, it is necessary to conduct a matching survey of companies (processing technologies that can be provided) that can carry out this EPC project, in addition to the basic survey on local hazardous waste.

d. Remarks

None.

e. Comments by the Mongolian Government

EPWMD recognizes the importance of diversifying and increasing industrial and E-Waste-derived hazardous waste treatment and expects Japan's support. Additionally, proper treatment of heavy metal-contaminated sewage sludge and the Tuul riverbed mud derived from factory wastewater is an urgent issue. Moreover, MET, which has jurisdiction over hazardous waste, is studying a comprehensive waste treatment facility including a final disposal site for hazardous waste and is strongly requested to support the construction of the project.

f. Consideration of Technical Assistance Related to Yen-Loan

Since the driving support project does not provide technical support incidental to yen-loan fund, it is not assumed in connection with this project proposal.

Table 5.60 Evaluation Result Summary (WM05)

No.	**WM05**		
Project Name	Introduction of hazardous waste treatment facility		
Implementing Agency	MET/WMCD	Relating Agency	CLCSD
Project Cost	47 Million USD		

Outline and Objective of the Project

This proposed project proposes an EPC (engineering, procurement, construction) project and operation support project for incineration facilities for the purpose of intermediate treatment (detoxification) of hazardous waste.

Evaluation Items (Large)	Evaluation Items (Medium)	Evaluation Items (Small)		Evaluation Result	Evaluation Grounds	Rating	Weight	Rating * Weight	Full Scale
Development inpact	Resident's Life	Improvement of Public Services	Collection service	Normal	Garbage collection services are not expanding	3.0	0.48	1.44	2.40
			public utilities charge	Normal	Hazardous waste treatment business does not lead to reduction of waste charges	3.0	0.48	1.44	2.40
		Enlargement of Activity Range	Citizen activity	Normal	Hazardous waste treatment does not expand the range of activities of residents	3.0	0.72	2.16	3.60
		Enhancement of Amenity	Sanitary environment	High	It leads to improvement of sanitary environment in the city and improves comfort	4.0	0.72	2.88	3.60
	Sub-total							7.92	12.00
	Environment Improvement	Maintenance of Living Environment	Sanitary environment	High	It leads to improvement of sanitary environment in the city and improves comfort	4.0	0.72	2.88	3.60
		Maintenance of Natural Environment	Natural environment	High	The effect of preserving the natural environment is high	4.0	0.96	3.84	4.80
		Maintenance of Global Environment	Global warming gas	Normal	It does not have much effect of reducing global warming gas.	3.0	0.72	2.16	3.60
	Sub-total							8.88	12.00
	Local Economy	Expansion of Production	Local production activity	High	It will lead to sustainable industrial development	4.0	0.60	2.40	3.00
		Increase of Employment	Employment status	High	Employment may increase due to facility construction and operation	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
Sub-total								21.60	30.00
Investment Impact	Cost-Effectiveness			Normal	The number of direct beneficiaries is moderate	3.0	1.60	4.80	8.00
	Profitability			High	A certain level of profitability can be secured.	4.0	0.40	1.60	2.00
Sub-total								6.40	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Low	The possibility of business development of Japanese companies is low	2.0	0.80	1.60	4.00
		Uniqueness and Superiority of the Technology		Low	Japan's technical level are high, but other countries has also improved.	2.0	1.60	3.20	8.00
		Operation and Maintenance by the Local Agency		Low	Collaboration with thermal power plant related companies is possible	2.0	1.20	2.40	6.00
		Degree of Interest by the Japanese Firms		Low	Limited number of Japanese companies that can expand overseas	2.0	0.40	0.80	2.00
Sub-total								8.00	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	the 5-year development basic policy states that the recycling rate should be improved	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	Hazardous waste treatment facility was planned at the Bagnuur district	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Normal	There is a certain level of technology	3.0	1.00	3.00	5.00
		Situation of Development of Institutional Frameworks		Low	Basic legal system is in place, but there is a problem in operation	2.0	1.00	2.00	5.00
	Sub-total							13.00	20.00
	Requests from the Mongolian Government			Very High	There is a strong request from the partner country organization	5.0	4.00	20.00	20.00
	Sub-total							20.00	20.00
Sub-total								33.00	40.00
					Ground Total			**69.00**	**100**

No.	**WM05**
Project Name	Introduction of hazardous waste treatment facility

Overall Evaluation

MET recognizes the importance of hazardous waste treatment facilities for the sustainable development of UB city and seeks the support of other countries including Japan. Japan has abundant achievements in hazardous waste treatment with the development of industry, but it is smaller and more specialized than general waste incineration facilities. Due to the country risk of Mongolia and the small scale of the industry, it is considered difficult for Japanese companies to continue to make profits. Therefore, this project was designated as an EPC project and an operation support project for hazardous waste treatment facilities with yen-loan fund. However, when examining facility specifications, it is necessary to conduct a matching survey of companies (processing technologies that can be provided) that can carry out this EPC project, in addition to the basic survey on local hazardous waste.

Remarks

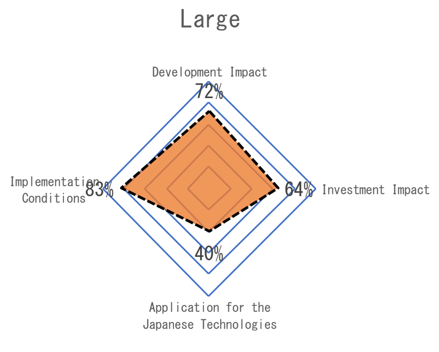
Comments by the Mongolian Government

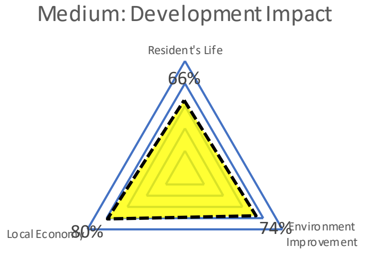
WMCD recognizes the importance of diversifying and increasing industrial and E-waste-derived hazardous waste treatment, and expects Japan's support. And, proper treatment of heavy metal-contaminated sewage sludge and Tuul riverbed mud derived from factory wastewater is an urgent issue. In addition, MET, which has jurisdiction over hazardous waste, is studying a comprehensive waste treatment facility including a final disposal site for hazardous waste, and is strongly requested to support the construction of the project.

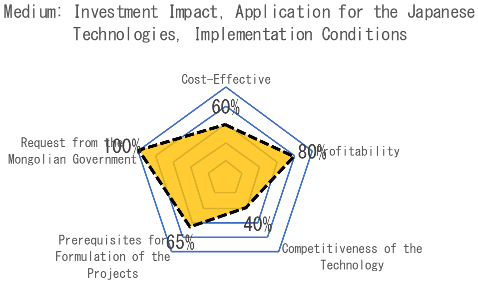
Consideration of Technical Assistance related to Yen Loan

Since the driving support project does not provide technical support incidental to Yen-loan fund, it is not assumed in connection with this project proposal.

Charts







(6) WM06: Construction of a Comprehensive Waste Treatment Facility

a. Outline and Purpose of the Project

In Mongolia, the WtE waste incineration project is being promoted by a concession system that assumes the independent profitability of private companies. However, this project method may increase the burden on the residents because the corporate profit is added to the waste charge. According to the interview with EPWMD, it is rather effective to construct the facility with yen-loan fund and maintained UB City to minimize the burden on the residents.

Additionally, according to the interview at MET, there is a problem that it is difficult to supply national funds in businesses such as recycling businesses that are mainly conducted by private companies, and also in order to improve waste treatment, it is desirable to build a comprehensive waste treatment facility as a national project as mentioned. Furthermore, regarding the construction of the final disposal site for hazardous waste, the next Moringiin Davaa Disposal Site (MDDS) project is being promoted by the EBRD project, and it is believed that a collaborative project is preferable to the implementation under Japan’s ODA.

Based on the above situation, a "comprehensive waste treatment facility" is proposed as a project candidate for SWM that matches Mongolian and Japanese companies. This is the EPC project of incineration facilities that can perform "general waste incineration (volume reduction)" and "hazardous waste treatment (detoxification)" and it is a combination of maintenance work by UB City and support by dispatching supervising engineers from Japanese companies. This facility construction and dispatch of supervising engineers will be implemented as a yen-loan fund project.

Table 5.61 shows a draft business plan of the comprehensive waste treatment facility project, and **Figure 5.9** depicts the project implementation structure. According to the Law of Mongolia about Waste, UB City has the jurisdiction over general waste and MET has the jurisdiction over hazardous waste; therefore, it is necessary to adjust the project system in the future.

Table 5.61 Draft Business Plan of Comprehensive Waste Treatment Facility Project

Item	Contents	Remarks
General waste + hazardous waste incineration power generation and heat supply facility		
Waste disposal amount	Solid waste 200,000 t/year, Hazardous waste 40,000 t/year	General waste + hazardous waste
Reactor type / Reactor scale	Stalker kiln type incinerator 800 t/day (400 t × 2 furnaces)	300 working days
Pretreatment equipment	Consultation required (depending on the sorting situation)	Needs investigation
Power generation output	Steam turbine: 12.4 MW Annual power generation: 93,000 MWh	Back pressure turbine
Heat supply	Heat supply: 37.2 MW Annual heat supply: 223,200 MWh	Hot water supply Effective heat utilization rate 80%
Exhaust gas treatment	Dry type (activated carbon / slaked lime spray), non-catalytic denitration	
Ash treatment	Landfill	To the final disposal site for hazardous waste
Required site area	About 3ha	
Construction period	3 years (however, depending on local conditions)	
Approximate construction cost	20 billion yen	
Maintenance fee	20 billion yen (20 years)	Driver's staff fee, service fee, maintenance fee
Driving support costs	Approximately 500 million yen (5 years)	

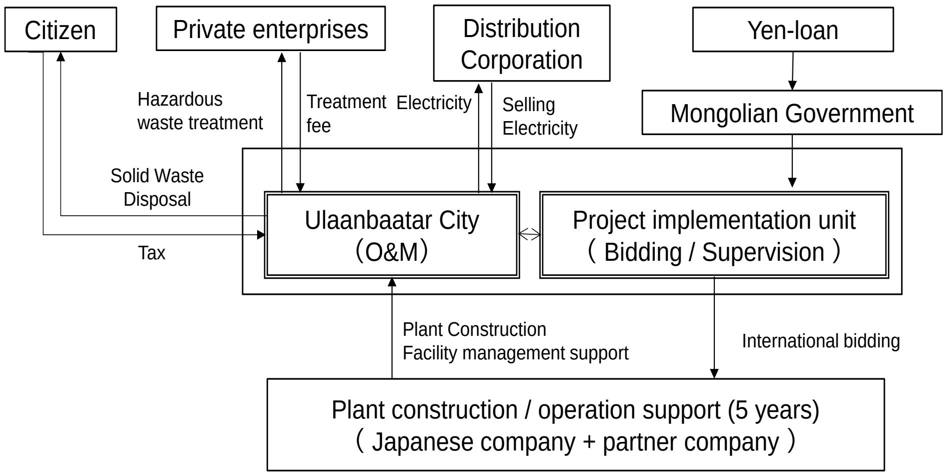


Figure 5.9 Project Implementation Structure (WM06)

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.62**, and the evaluation criteria are shown in **Table 5.63**.

Table 5.62 Individual Evaluation Items and Evaluation Criteria (WM06)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Waste collection service	**Table 5.63**
			Utility charges	**Table 5.63**
		Enlargement of Activity Range	Resident activity range	**Table 5.63**
		Enhancement of Amenity	Sanitary environment in the city	**Table 5.63**
	Environmental Improvement	Living Environment Conservation	Sanitary environment in the city	**Table 5.63**
		Natural Environment Conservation	Natural environment in the city	**Table 5.63**
		Global Environment Conservation	Generation of global warming gas	**Table 5.63**
	Local Economy	Expansion of Production	Expansion of production activities due to facility operation	**Table 5.63**
		Increase of Employment	Number of employees	**Table 5.63**
Investment Impact		Cost-Effectiveness		**Table 5.63**
		Profitability		**Table 5.63**

Table 5.63 Evaluation Criteria (WM06)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will improve from the current situation

(i) Development Impact

<u>Residents' life</u>

Hazardous waste treatment facilities are facilities that prevent damage to the local environment and human health and contribute to the modernization of SWM in UB City. On the other hand, it is unlikely that residents will directly feel the benefits of improving public services, rather than facilities that lead to the expansion of waste collection services and reductions in utility charges.

<u>Environmental improvement</u>

If the hazardous waste final disposal site facility is put into operation, it will be possible to reduce environmental pollution and human health damage caused by hazardous waste, which will play an important role in improving the environment of UB City.

<u>Local economy</u>

The establishment of a hazardous waste treatment system is thought to lead to sustainable industrial development of UB City, and it can be expected to improve the regional economy over the medium to long term. In the short term, employment will increase due to facility construction and operation.

(ii) Investment Impact

<u>Cost-effectiveness</u>

There are many indirect beneficiaries because it is a project related to the treatment of hazardous waste, but since the direct beneficiary is the owner of the hazardous waste or the project operator handling the hazardous waste, the direct benefit is moderate.

<u>Profitability</u>

Since this project is an EPC project and a supervising engineer dispatch project with yen-loan fund, a certain level of profitability can be ensured.

(iii) Application of Japanese Technology

<u>Possibility of future business development</u>

This project consists of a construction project for a waste incineration power generation facility and a detoxification facility for hazardous waste, but it is difficult to develop business in Mongolia, where the market size is small, but since experience and achievements for overseas expansion of Japan's vein industry can be gained, it is evaluated that the possibility of business expansion is moderate or higher in the long run.

<u>Uniqueness and superiority of the target technology</u>

Japan's technology level and the number of achievements related to waste incineration power generation technology and hazardous waste treatment are high in the world, but in recent years, technological improvements in other countries have progressed, and the technological superiority is being lost.

<u>Operation and maintenance by the local agency</u>

There is a possibility of partnering with companies that maintain and manage coal-fired power plants.

<u>Degree of interest by Japanese firms</u>

Japanese companies such as waste incineration manufacturers are showing interest because the EPC and supervising engineer dispatch project can avoid project operation risks and secure a certain level of profitability.

(iv) Implementation Condition

Relevance with upper plans

The WtE project is listed on the national concession list by the National Development Agency (NDA) of Mongolia. Mongolia's 5-year development policy includes the construction of a comprehensive facility for hazardous waste in the list of projects that should be resolved.

Relevance with other plans

WtE waste incineration power generation facilities are being proposed by concessions from multiple countries, and a solid waste treatment facility project supported by EBRD is underway.

Capacity of implementing agency

Since UB City operates a thermal power plant and a final disposal site facility, it is considered that it has a certain level of technology. Interviews with UB City have confirmed that the financial situation for SWM is fragile, and it is necessary to try to reduce the maintenance cost of the facility as much as possible.

Situation of development of institutional frameworks

Although the Law of Mongolia about Waste stipulates basic SWM regulations, there are problems in applying them in the real world, and it is necessary to establish penal regulations.

Request from the Mongolian Government

During interviews, EPWMD and MET expressed a strong need for the construction of a hazardous waste disposal site. MET cited the need for a comprehensive waste treatment facility as a national project.

c. Overall Evaluation

This proposed project is an EPC project and operation support project for facilities that reduce the volume of waste and detoxify hazardous waste by waste incineration power generation, which is in high demand in UB City. By adopting the publicly owned system, it is possible to reduce the project risk to Japanese companies. It will also be possible for UB City to aim for sustainable development without relying on other countries to modernize SWM. By making it a public enterprise, it is possible to suppress project profits, and it is possible to reduce the cost for waste services of the public compared to the case of the concession method. As an issue, since UB City has the jurisdiction over general waste and hazardous waste is MET’s, it is necessary to adjust the project operation system for the facility that combines the two. Due to the lack of basic information on hazardous waste, additional research is needed to study the facility.

d. Remarks

None.

e. Comments by the Mongolian Government

According to EPWMD, a project related to waste incineration power generation has been proposed by a concession method from other countries, and the project is under consideration. For this reason, it was advised that if a publicly owned yen-loan fund project is to be proposed, its merits and specific details should be proposed as soon as possible. Additionally, MET, which has jurisdiction over hazardous waste, considers the construction of a detoxification facility for hazardous waste to be a very important issue, and strongly requests Japan's support.

f. Consideration of Technical Assistance Related to Yen-Loan

Since the driving support project does not provide technical support incidental to yen-loan fund and, it is not assumed in connection with this project proposal.

Table 5.64 Evaluation Result Summary (WM06)

No.	**WM06**		
Project Name	Construction of comprehensive waste treatment facility		
Implementing Agency	WMCD	Relating Agency	MET, CLCSD
Project Cost	189 Million USD		

Outline and Objective of the Project

It provides comprehensive waste treatment facility construction and operation support (SV dispatch) for hazardous waste, which is a problem in UB city, and does not include operation projects.

Large	Medium	Small		Evaluation Result	Evaluation Grounds	Rating	Weight	Rating * Weight	Full Scale
Development impact	Resident's Life	Improvement of Public Services	Collection service	Normal	Garbage collection services are not expanding	3.0	0.48	1.44	2.40
			public utilities charge	Normal	Hazardous waste treatment business does not lead to reduction of waste charges	3.0	0.48	1.44	2.40
		Enlargement of Activity Range	Citizen activity	Normal	Hazardous waste treatment does not expand the range of activities of residents	3.0	0.72	2.16	3.60
		Enhancement of Amenity	Sanitary environment	High	It leads to improvement of sanitary environment in the city and improves comfort	4.0	0.72	2.88	3.60
	Sub-total							7.92	12.00
	Environment Improvement	Maintenance of Living Environment	Sanitary environment	High	It leads to improvement of sanitary environment in the city and improves comfort	4.0	0.72	2.88	3.60
		Maintenance of Natural Environment	Natural environment	High	The effect of preserving the natural environment is high	4.0	0.96	3.84	4.80
		Maintenance of Global Environment	Global warming gas	Normal	It does not have much effect of reducing global warming gas.	3.0	0.72	2.16	3.60
	Sub-total							8.88	12.00
	Local Economy	Expansion of Production	Local production activity	High	It will lead to sustainable industrial development	4.0	0.60	2.40	3.00
		Increase of Employment	Employment status	High	Employment may increase due to facility construction and operation	4.0	0.60	2.40	3.00
	Sub-total							4.80	6.00
Sub-total								21.60	30.00
Investment Impact	Cost-Effectiveness			Normal	The number of direct beneficiaries is moderate	3.0	1.60	4.80	8.00
	Profitability			High	A certain level of profitability can be secured.	4.0	0.40	1.60	2.00
Sub-total								6.40	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Normal	The possibility of business development of Japanese companies is low	3.0	0.80	2.40	4.00
		Uniqueness and Superiority of the Technology		Normal	Japan's technical level are high, but other countries has also improved.	3.0	1.60	4.80	8.00
		Operation and Maintenance by the Local Agency		High	Collaboration with thermal power plant related companies is possible	4.0	1.20	4.80	6.00
		Degree of Interest by the Japanese Firms		High	Relatively high interest because profitability can be secured	4.0	0.40	1.60	2.00
Sub-total								13.60	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	the 5-year development basic policy states that the recycling rate should be improved	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	Hazardous waste treatment facility was planned at the Bagnuur district	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Normal	There is a certain level of technology	3.0	1.00	3.00	5.00
		Situation of Development of Institutional Frameworks		Low	Basic legal system is in place, but there is a problem in operation	2.0	1.00	2.00	5.00
	Sub-total							13.00	20.00
	Requests from the Mongolian Government			Very High	There is a strong request from the partner country organization	5.0	4.00	20.00	20.00
	Sub-total							20.00	20.00
Sub-total								33.00	40.00
					Ground Total			**74.60**	**100**

No.	**WM06**
Project Name	Construction of comprehensive waste treatment facility

Overall Evaluation

This proposed project is an EPC project and operation support project for facilities that reduce the volume of waste and detoxify hazardous waste by waste incineration power generation, which is in high demand in UB city. By adopting the publicly-owned system, it is possible to reduce the project risk of Japanese companies. It will also be possible for UB city to aim for sustainable development without relying on other countries to modernize SWM. And, by making it a public enterprise, it is possible to suppress project profits, and it is possible to reduce the cost for waste services of the general public compared to the case of the concession method. As an issue, since the jurisdiction of general waste is UB city and the hazardous waste is MET, it is necessary to adjust the project operation system for the facility that combines the two. In particular, due to the lack of basic information on hazardous waste, additional research is needed to study the facility.

Remarks

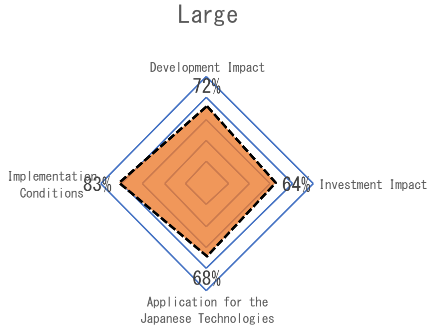
Comments by the Mongolian Government

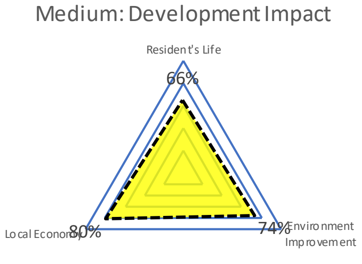
According to WMCD, a project related to waste incineration power generation has been proposed by a concession method from other countries, and the project is under consideration. For this reason, it was advised that if a publicly-owned yen-loan fund project is to be proposed, its merits and specific details should be proposed as soon as possible. And, MET, which has jurisdiction over hazardous waste, considers the construction of a detoxification facility for hazardous waste to be a very important issue, and strongly requested Japan's support.

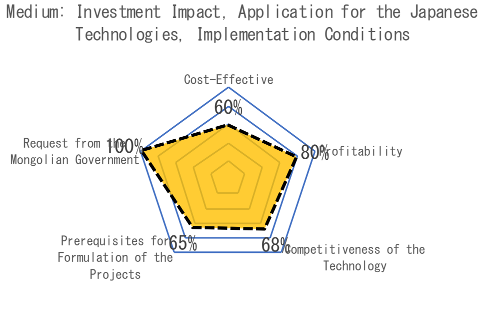
Consideration of Technical Assistance related to Yen Loan

Since the driving support project does not provide technical support incidental to Yen-loan fund, and is not assumed in connection with this project proposal.

Charts







CTI Engineering International Co., Ltd.
SUURI-KEIKAKU Co., Ltd.
TEC International Co., Ltd.

5.2.4 Climate Change Mitigation

(1) CIC01: Introduction of Energy Saving Technology (Hot Water Valve Control System for Heating)

a. Outline and Purpose of the Project

This is a project that aims to renovate old buildings in UB City by installing better heat insulation materials and introducing the hot water valve control system for heating. This will achieve a 20% reduction of heat loss of the buildings.

GGGI is implementing projects to renew the insulation of 355 old buildings in UB City. According to the Energy Regulation Committee, there are still 722 old buildings in UB City, and these old buildings are set as target of the project. The financial scale of the GGGI project for the 355 old buildings was estimated at 18 million Euro, but according to the resurvey by UB City 28 million Euro is needed. Therefore, the project financial scale will be around 57 million Euro (722 / 355 × 28 million Euro = 57 million Euro), or around 7.2 billion Yen.

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.65**, and the evaluation criteria are shown in **Table 5.66**.

Table 5.65 Individual Evaluation Items and Evaluation Criteria (ClC01)

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
Development Impacts	Residents' Life	Improvement of Public Services	Expansion of supply service area related to hot water for heating	**Table 5.66**
			Reduction of burden on residents	**Table 5.66**
		Enlargement of Activity Range	Increased activities in public facilities	**Table 5.66**
			Increased opportunities gained for welfare services	**Table 5.66**
		Enhancement of Amenity	Reduction of breakdown in hot water supply services	**Table 5.66**
			Improvement of dwelling environment / indoor environment	**Table 5.66**
	Environmental Improvement	Living Environment Conservation	Improvement of air pollution problem	**Table 5.66**
			Improvement of waste problem	**Table 5.66**
		Natural Environment Conservation	Improvement of water pollution problem	**Table 5.66**
			Impact on natural environment conservation	**Table 5.66**
		Global Environment Conservation	Climate Change Mitigation	**Table 5.66**
			Climate Change Adaptation	**Table 5.66**
	Local Economy	Expansion of Production	Direct effect by the JICA project	**Table 5.66**
			Introduction of production technology	**Table 5.66**
		Increase of Employment	Creation of new employment	**Table 5.66**
			Acquisition of operation technology	**Table 5.66**
		Cost-Effectiveness		**Table 5.66**

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
Investment Impact		Profitability		**Table 5.66**

Table 5.66 Evaluation Criteria (ClC01)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will improve from the current situation

(i) Development Impact

Residents' life

Since the surplus of hot water supply will arise through energy conservation improvement, it is expected that there will be an expansion of supply service area related to hot water for heating. In addition, if the heating tariff system is changed to the one based on the heat consumption, there will be an incentive for energy conservation, and it is expected that by reducing the energy cost the burden on residents will be reduced. Therefore, it is expected that through the aforementioned items the living condition of residents will improve.

Since a new hot water supply to public facilities will be implemented, the effect of increased activities in public facilities can be expected and the effect of increased opportunities for welfare services can also be expected. Since the reduction of breakdown in the hot water supply services is the same as in the current situation, and it hardly contributes to the improvement of dwelling and indoor environment, the enhancement of amenity is expected to remain in the current situation.

Environmental improvement

The energy conservation effect reduces the amount of coal used, the amount of air pollutants emitted and the amount of coal ash generated. There is little possibility for water quality problems to occur and little possibility to have an effect on the change of natural environment. As energy conservation progresses, the coal consumption will be reduced and GHG emissions will also be reduced. On the other hand, since it is not directly related to climate change adaptation measures and there is almost no effect such as in reducing the emissions of ozone-depleting compounds, these remain in the current situation.

Local economy

Since it depends on the intentions of Japanese and Mongolian companies, the current situation is neutral, and since it is a substitute for the existing employment, this remains in the current situation. The existing technicians will acquire the ability, but this remains in the current situation because it is a limited technology. In short, there is no large direct impact on the local economy.

(ii) Investment Impact

Cost-effectiveness

While there are benefits in reducing emissions of air pollutants and GHGs, cost reductions cannot be expected if the heating tariffs are determined by the building area and/or volume. Therefore, the current situation is neutral.

Profitability

Since general hot water radiators are widely used in Mongolia, it is assumed that the competitive price of energy conservation type hot water radiators is not so high, thus the profitability is not high.

(iii) Application of Japanese Technology

Possibility of future business development

Radiators are widespread and the business environment is in place, but the business market is fiercely competitive and business development is not easy.

Uniqueness and superiority of the technology

The superiority of Japanese technology for heating equipment, such as the insulation material that enhances the airtightness of buildings and the heat equipment using hot water, is not high in comparison to European countries and the USA.

Operation and maintenance by the local agency

Since the agency of the German manufacturer is located in UB City, it is assumed that the local O&M system is in place to some extent.

Degree of interest by Japanese firms

Although the survey by JICA has been carried out, the market size of Mongolia is not big, and it cannot be said that the degree of interest is very high.

(iv) Implementation Condition

Relevance with upper plans

It can be one of the measures based on the Energy Conservation Act.

Relevance with other plans

Since the energy conservation projects are being implemented, the level of relevance is high.

Capacity of implementing agency

In general, the financial situation is not good since the financial situation in Mongolia is not good. Mongolia itself has the capacity of radiator technology.

Situation of development of institutional frameworks

For energy conservation radiators and construction of buildings with high heat insulation performance to become popular, the heat tariff systems will have to be changed from the tariff per building area/volume to the tariff based on the amount of heat actually used. It is necessary to increase the incentive for energy conservation, but the heat tariff institution is inadequate. In addition, since the introduction of energy conservation radiators in old apartment buildings may require changes to the piping system of the entire building, it is not easy to become popular.

Request from the Mongolian Government

Although various energy conservation measures are being implemented under the Energy Conservation Act, there is not much interest by the Mongolian Government in energy conservation radiator technology.

c. Overall Evaluation

Although the building insulation project is being implemented through the support of GGGI, and various comments were received from the Mongolian Government, there was no mention of energy conservation technology related to the hot water valve control system for heating, which is a heating supply for facilities, and it was judged that this priority is not high. In order to carry out such an energy conservation project, it is necessary to change the heating tariff system from the tariff per building area and/or the tariff per building volume to an energy tariff system based on the amount of heat actually used. In order to build an appropriate tariff structure, it is considered necessary to support the government agencies through technical cooperation projects.

d. Remarks

German companies sell heating equipment through agencies in Mongolia, and various equipment including those made in China are already being sold in Mongolia, so it is difficult to find an advantage for Japanese companies in the energy conservation equipment business.

e. Comments by the Mongolian Government

Comments were received on energy conservation projects such as building insulation project, improvements in thermal power plants, electricity transmission and distribution networks, and hot water supply network, but there was no mention of hot water valve control system for heating. Therefore, it was concluded that the priority is not high.

f. Consideration of Technical Assistance Related to Yen-Loan

Since these needs are not very high, they have not been considered. However, it is beneficial to carry out projects such as the support for development of the heating tariff system through the technical cooperation project as a part of energy conservation project.

Table 5.67 Evaluation Result Summary (CIC01)

No.	**CIC02**
Project Name	The effective utilization of renewable energy by installation of storage batteries
Implementing Agency	Public corporation for electricity transmission and distribution; Relating Agency:
Project Cost	Business of Approximately 12 billion Yen

Outline and Objective of the Project

The introduction of storage batteries for large-scale electricity systems will solve the problem of the electrical grid system becoming unstable as the renewable energy is affected by climate conditions and other factors. By connecting the renewable energy power plant to an electrical grid system, it is possible to stabilize the electric power system by storing electricity when the electric power is in surplus and supplying the electricity when the electricity is defficit. As a result, the introduction of renewable

Evaluation Item: Large	Medium	Small		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development impact	Resident's Life	Improvement of Public Services	Expansion of supply service area related to electricity	Status quo	There is no direct impact on the improvement of the electrical grid.	3.0	0.48	1.44	2.40
			Reduction of burden on citizen	Status quo	There is a possibility that the electricity tariff will increase as a result of the storage battery facilities installation cost and operating cost, but this is expected only to have a minor impact.	3.0	0.48	1.44	2.40
		Enlargement of Activity Range	Increased activities in public facilities	Status quo	As there is no direct impact on the increase in activities, this remains in the status quo.	3.0	0.36	1.08	1.80
			Increased opportunities gained for welfare services	Status quo	Since there is no direct impact of the increase in service opportunities, this remains in status quo.	3.0	0.36	1.08	1.80
		Enhancement of Amenity	Reduction of breakdown in electricity supply services	Little improvement	In the event of problems at the thermal power plant, etc., the support to the electricity supply is expected from the storage batteries.	4.0	0.36	1.44	1.80
			Improvement of dwelling environment / indoor environment	Status quo	It hardly contributes to the improvement of dwelling condition and indoor environment.	3.0	0.36	1.08	1.80
	Sub-total							7.56	12.00
	Environment Improvement	Living Environment Conservation	Improvement of the air pollution problem	Little improvement	As the electricity generated by the renewable energy will increase and electricity supply from the coal-fired thermal power plants will decrease, the coal consumption and the air pollutant emissions will be reduced.	4.0	0.36	1.44	1.80
			Improvement of waste problem	Little improvement	As the electricity generated by the renewable energy will be increase and electricity supply from the coal-fired thermal power plants will decrease, the coal consumption and the generation of coal ash will be reduced.	4.0	0.36	1.44	1.80
		Natural Environment Conservation	Improvement of water pollution problem	Status quo	There is little possibility for the water quality problems to occur.	3.0	0.48	1.44	2.40
			Impact for natural environment conservation	Status quo	A certain site surface area is required for the installation of storage batteries, but it does not significantly change the natural environment.	3.0	0.48	1.44	2.40
		Global Environment Conservation	Climate change mitigation measurement	Significantly improvement	As the electricity generated by renewable energy will increase and electricity supply from the coal-fired thermal power plants will decrease, the coal consumption and GHG emissions will be reduced.	5.0	0.36	1.80	1.80
			Climate change adaptation measurement	Status quo	As it is not directly related to climate change adaptation measures, this remains in the status quo.	3.0	0.36	1.08	1.80
	Sub-total							8.64	12.00
	Local Economy	Expansion of Production	Direct effect by JICA project	Status quo	There is no large direct impact on the local economy.	3.0	0.30	0.90	1.50
			Introduction of production technology	Status quo	As the possibility for local production is very small, this remains in the status quo.	3.0	0.30	0.90	1.50
		Increase of Employment	Creation of new employment	Little improvement	It is a new technology for Mongolia and it has some potential to create new jobs.	4.0	0.30	1.20	1.50
			Acquisition of operation technology	Little improvement	It is a new operation technology for Mongolia.	4.0	0.30	1.20	1.50
	Sub-total							4.20	6.00
Sub-total								20.40	30.00
Investment Impact	Cost-Effectiveness			High	This project leads to the reduction of air pollutants and GHG emissions and is a cost-effective project.	5.0	1.60	8.00	8.00
	Profitability			Medium	It is unclear whether the system is designed to be established as a private-sector business. There is information that a private company is aiming to enter the market.	3.0	0.40	1.20	2.00
Sub-total								9.20	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Significantly small	There are no high needs until 2030.	1.0	0.80	0.80	4.00
		Uniqueness and Superiority of the Technology		High	Itt has the technological capabilities of storage batteries, and the technological and production capacities of Chinese companies are increasing greatly.	4.0	1.60	6.40	8.00
		Operation and Maintenance by the Local Agency		Significantly small	The local O&M system is not sufficient. The ADB project also includes the activity for the capacity enhancement of operators.	1.0	1.20	1.20	6.00
		Degree of Interest by the Japanese Firms		Significantly small	Due to the small market size of Mongolia, it is difficult to find business development as a storage battery business.	1.0	0.40	0.40	2.00
Sub-total								8.80	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	The introduction and dissemination of renewable energy is planned, and this is an indispensable project for its promotion.	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	The project by ADB is in progress.	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Significantly low	As the state-owned company is in charge of the electricity transmisison and distribution business, it is assumed that its financial situation is directly linked to the financial situation of Mongolia.	1.0	1.00	1.00	5.00
		Situation of Development of Institutional Frameworks		High	Since the project by ADB is progressing, it is assumed that the legal systems and technical studies are being developed.	4.0	1.00	4.00	5.00
	Sub-total							13.00	20.00
	Requests from the Mongolian Government			Significantly small	The needs for assistance in the period up to 2030 are fairly low, but there are needs for further assistance in a long term.	1.0	4.00	4.00	20.00
	Sub-total							4.00	20.00
Sub-total								17.00	40.00
					Ground Total			**55.40**	**100**

No.	CIC02
Project Name	The effective utilization of renewable energy by installation of storage batteries

Overall Evaluation

As the introduction of renewable energy is planned to be promoted in the future in Mongolia, the business of storage batteries connected to the electrical grid is important. However, the ADB project is scheduled to be implemented and the need for the JICA support will not be that high until 2030.

Remarks

Japanese companies also have technological capacities, but the technological and production capacities of Chinese companies is increasing significantly. As a Japanese company, it is difficult to find a business opportunity of storage batteries for electrical grid system as the demand in Mongolia is limited.

Comments by the Mongolian Government

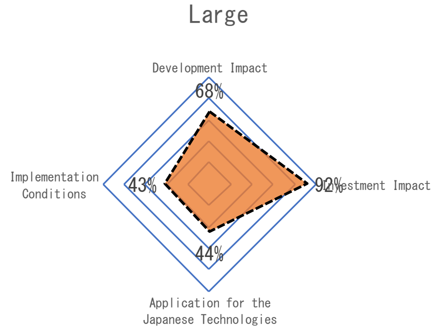
Mr. Ts.Atarjargal Director, Energy Bureau, Energy Regulation Committee
As a result of the Project by ADB, etc., the priority of the project for introduction of storage batteries will not be high until 2030.

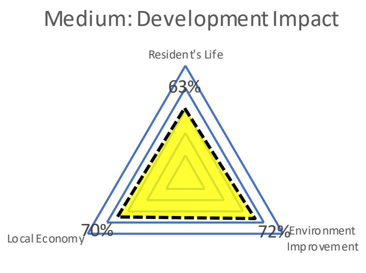
Ms. B.Tumendelger, Director of Research Analysis Bureau, National Development Agency
As a result of the Project by ADB, etc., the needs for new projects until 2030 are small.

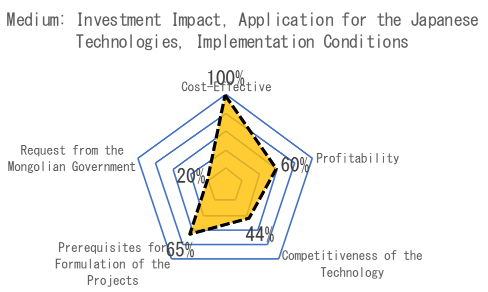
Consideration of Technical Assistance related to Yen Loan

As the needs of Mongolian side are not high, it has not been studied.

Charts







(2) CIC02: Effective Utilization of Renewable Energy by Introducing Storage Batteries

a. Outline and Purpose of the Project

The photovoltaic power generation and wind power generation, which are being introduced in Mongolia, face the problems where the amount of electricity generation depends on the weather conditions and it is difficult to control this issue. Therefore, if a large amount of power from these renewable power plants is connected to the electrical grid, there is a problem that the electrical grid system will become unstable. The introduction of storage batteries for large-scale electricity systems will solve the problems such as the electricity grid system becoming unstable due to renewable energy being affected by the climate conditions and other factors. By connecting a renewable energy power plant to an electrical grid system, it is possible to stabilize the electric power system by storing electricity when the electric power is in surplus and supplying the electricity when the electricity is in deficit. As a result, the introduction of renewable energy will be promoted.

There is a 100 MW storage battery project by ADB and around 50 MW class storage battery project by private companies. On the other hand, under the situation of COVID-19 pandemic, it is expected that various difficulties will occur in the implementation of the project by private companies, and there might be a possibility of need for support by JICA. In addition, in JICA project promoted by the Japanese Government, the introduction of many photovoltaic power plants is progressing, and in order to stabilize the electrical grid, it is assumed that there will be a need for the business of storage batteries connected to the electrical grid.

The 100 MW storage battery project by ADB will enable electricity supply of 610 GWh/year of renewable energy. The GHG emission reductions are calculated as 0.65 million tons CO_2/year by multiplying it with the electricity emission factor in Mongolia of 1.061 tons CO_2/MWh. On the other hand, since 22.7% reduction of NDC target is equivalent to GHG emission reductions of 16.9 million tons CO_2/year, additional use of renewable energy is necessary.

The amount of electricity generated by renewable energy in 2019 was 109 GWh/year from photovoltaic power plants, 85.4 GWh/year from hydroelectric power plants, and 459.3 GWh from wind power generation, or a total of 653.7 GWh/year from renewable energy power plants. It is assumed that the photovoltaic power generation business is progressing due to the JCM project, and there may be a further need for the storage battery business based on the growing global need for renewable energy.

The outline of the Yen Loan Project on storage batteries is shown in **Table 5.68** by referring to the ADB project.

Table 5.68 Outline of Proposed Yen-Loan Project on Storage Batteries

Items	Contents
Outline of Project	Introduction of storage batteries connected to the electrical grid
Outline of Facilities	Capacity of storage batteries: 100 MW
Approximate Cost	Around 115 million USD, 12 billion Yen
Construction Period	Around 2 years

Note: These are edited from ‘https://www.adb.org/projects/53249-001/main#project-pds’.

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.69**, and the evaluation criteria are shown in **Table 5.70**.

Table 5.69 Individual Evaluation Items and Evaluation Criteria (ClC02)

Evaluation Items				Evaluation Criteria
Large	**Medium**	**Small**		
Development Impact	Residents' Life	Improvement of Public Services	Expansion of supply service area related to hot water for heating	**Table 5.70**
			Reduction of burden on citizen	**Table 5.70**
		Enlargement of Activity Range	Increased activities in public facilities	**Table 5.70**
			Increased opportunities gained for welfare services	**Table 5.70**
		Enhancement of Amenity	Reduction of breakdown in hot water supply services	**Table 5.70**
			Improvement of dwelling environment / indoor environment	**Table 5.70**
	Environmental Improvement	Living Environment Conservation	Improvement of air pollution problem	**Table 5.70**
			Improvement of waste problem	**Table 5.70**
		Natural Environment Conservation	Improvement of water pollution problem	**Table 5.70**
			Impact on natural environment conservation	**Table 5.70**
		Global Environment Conservation	Climate Change Mitigation	**Table 5.70**
			Climate Change Adaptation	**Table 5.70**
	Local Economy	Expansion of Production	Direct effect by the JICA project	**Table 5.70**
			Introduction of production technology	**Table 5.70**
		Increase of Employment	Creation of new employment	**Table 5.70**
			Acquisition of operation technology	**Table 5.70**
Investment Impact		Cost-Effectiveness		**Table 5.70**
		Profitability		**Table 5.70**

Table 5.70 Evaluation Criteria (ClC02)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will improve from the current situation

(i) Development Impact

Residents' life

In connection with expansion of electricity supply service area, there is no direct impact on the improvement of the electricity grid. Regarding the reduction of burden on residents, there is a possibility that the electricity tariff will increase as a result of the storage battery facilities installation cost and operating cost, but this is expected to have only a minor impact.

Since there is no direct impact on the increased activities in public facilities and the increased opportunities gained for welfare services, this remains in the current situation.

Regarding the enhancement of amenity, in the event of a problem at the thermal power plant, etc., support for the electricity supply will be expected from the storage batteries, but this hardly contributes to the improvement of dwelling condition and indoor environment.

Environmental improvement

Since the electricity generated by renewable energy will increase and electricity supply from the coal-fired thermal power plants will decrease, coal consumption will be less. This leads to the reduction of air pollutant emissions and coal ash generation.

There is little possibility for the water quality problems to occur. A certain amount of surface is required for the installation of storage batteries, but it does not significantly change the natural environment.

As the electricity generated through renewable energy will increase and electricity supply from the coal-fired thermal power plants will decrease, the coal consumption and GHG emissions will decrease. Therefore, from the viewpoint of climate change mitigation, this is a significant improvement. However, since it is not directly related to climate change adaptation measures, this remains in the current situation.

Local economy

The JICA project has no large direct impact on the local economy. Since the possibility of local production is very small, this remains in the current situation. Since it is a new technology for Mongolia, it has some potential to create new employment, and Mongolia will acquire the new operation technology. Therefore, a good impact is expected.

(ii) Investment Impact

Cost-effectiveness

Since it is a technology supporting the introduction and popularization of renewable energy, and this project will lead to the reduction of air pollutants and GHG emissions, it is a cost-effective project.

Profitability

Although it is unclear whether the system is designed to be a profitable private-sector business at present, there is information that a private company is aiming to enter the market. Therefore, it is judged to be medium.

(iii) Application of Japanese Technology

Possibility of future business development

Although the needs for the storage battery business connected to the electrical grid will not be so high until 2030, there is a possibility that storage batteries will be gradually introduced to renewable energy power plants. If the Mongolia's NDC target will be set at a higher level under the Paris Agreement, the demand for renewable energy may increase and the needs for the storage battery business connected to the electrical grid may also increase.

Uniqueness and superiority of the technology

Japan has technological capabilities on storage batteries, and the capacity of Chinese technology and production are in increase. It is also a technical field where competition in the world is currently very fierce.

Operation and maintenance by the local agency

The local O&M system related to the large-scale storage battery business connected to the electrical grid is not sufficient, since there are no such projects in Mongolia. For this reason, the storage battery project by ADB includes the activity to support the establishment of O&M system for the purpose of capacity enhancement for operators.

Degree of interest by Japanese firms

Due to the small market size of Mongolia, it is difficult to find businesses that are interested to develop as storage battery business. It is considered that there is a possibility of a storage battery business connected to renewable energy power plants such as photovoltaic power generation.

(iv) Implementation Condition

Relevance with upper plans

The introduction and dissemination of renewable energy is planned, and this is an indispensable project for its promotion.

Relevance with other plans

The project by ADB is in progress.

Capacity of implementing agency

Since a state-owned company is in charge of the electricity transmission and distribution business, it is assumed that its financial situation is directly linked to the financial situation of Mongolia. It is also assumed that the capacity of operation for the storage battery business connected to the electrical grid is low.

Situation of development of institutional frameworks

Since the project by ADB is progressing, it is assumed that the legal systems and technical studies are being developed.

Request from the Mongolian Government

Since it has been decided that the project by ADB will be implemented, the needs for assistance from foreign donors such as JICA will be quite low until 2030, but the needs for further assistance in the introduction of renewable energy are expected to be higher in the longer term.

c. Overall Evaluation

Since the introduction of renewable energy is planned to be promoted in the future in Mongolia, the business of storage batteries connected to the electrical grid is important. The ADB project is scheduled to be implemented and the need for JICA's support will not be that high until 2030. However, due to the fact that private companies are considering the storage battery business and the introduction of renewable energy is progressing further, it can be expected that the Mongolian Government will request the support of JICA in the future.

d. Remarks

Japanese companies have technological capacities, but the technological and production capacities of Chinese companies are increasing significantly. As a Japanese company, it is difficult to find a business opportunity related to storage batteries for electrical grid system because the demand in Mongolia is limited.

e. Comments by the Mongolian Government

The comments by the Mongolian Government are shown in **Table 5.71**.

Table 5.71 Comments by the Mongolian Government on Storage Batteries

Person	Comments
Mr. Ts. Atarjargal Director, Energy Bureau, Energy Regulation Committee	As a result of the Project by ADB, etc., the priority of the project for introduction of storage batteries will not be so high until 2030.
Ms. B. Tumendelger, Director of Research Analysis Bureau, National Development Agency	As a result of the Project by ADB, etc., the needs for new projects until 2030 will be low.

f. Consideration of Technical Assistance Related to Yen-Loan

Since the needs of the Mongolian side are not high, it has not been studied.

Table 5.72 Evaluation Result Summary (CIC02)

No.	**CIC02**
Project Name	The effective utilization of renewable energy by installation of storage batteries
Implementing Agency	Public corporation for electricity transmission and distribution / Relating Agency:
Project Cost	Business of Approximately 12 billion Yen

Outline and Objective of the Project

The introduction of storage batteries for large-scale electricity systems will solve the problem of the electrical grid system becoming unstable as the renewable energy is affected by climate conditions and other factors. By connecting the renewable energy power plant to an electrical grid system, it is possible to stabilize the electric power system by storing electricity when the electric power is in surplus and supplying the electricity when the electricity is defficit. As a result, the introduction of renewable energy will be promoted.

Evaluation Item (Large)	Evaluation Item (Medium)	Evaluation Item (Small)		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development inpact	Resident's Life	Improvement of Public Services	Expansion of supply service area related to electricity	Status quo	There is no direct impact on the improvement of the electrical grid.	3.0	0.48	1.44	2.40
			Reduction of burden on citizen	Status quo	There is a possibility that the electricity tariff will increase as a result of the storage battery facilities installation cost and operating cost, but this is expected only to have a minor impact.	3.0	0.48	1.44	2.40
		Enlargement of Activity Range	Increased activities in public facilities	Status quo	As there is no direct impact on the increase in activities, this remains in the status quo.	3.0	0.36	1.08	1.80
			Increased opportunities gained for welfare services	Status quo	Since there is no direct impact of the increase in service opportunities, this remains in status quo.	3.0	0.36	1.08	1.80
		Enhancement of Amenity	Reduction of breakdown in electricity supply services	Little improvement	In the event of problems at the thermal power plant, etc., the support to the electricity supply is expected from the storage batteries.	4.0	0.36	1.44	1.80
			Improvement of dwelling environment / indoor environment	Status quo	It hardly contributes to the improvement of dwelling condition and indoor environment.	3.0	0.36	1.08	1.80
	Sub-total							7.56	12.00
	Environment Improvement	Living Environment Conservation	Improvement of the air pollution problem	Little improvement	As the electricity generated by the renewable energy will increase and electricity supply from the coal-fired thermal power plants will decrease, the coal consumption and the air pollutant emissions will be reduced.	4.0	0.36	1.44	1.80
			Improvement of waste problem	Little improvement	As the electricity generated by the renewable energy will be increase and electricity supply from the coal-fired thermal power plants will decrease, the coal consumption and the generation of coal ash will be reduced.	4.0	0.36	1.44	1.80
		Natural Environment Conservation	Improvement of water pollution problem	Status quo	There is little possibility for the water quality problems to occur.	3.0	0.48	1.44	2.40
			Impact for natural environment conservation	Status quo	A certain site surface area is required for the installation of storage batteries, but it does not significantly change the natural environment.	3.0	0.48	1.44	2.40
		Global Environment Conservation	Climate change mitigation measurement	Significantly improvement	As the electricity generated by renewable energy will increase and electricity supply from the coal-fired thermal power plants will decrease, the coal consumption and GHG emissions will be reduced.	5.0	0.36	1.80	1.80
			Climate change adaptation measurement	Status quo	As it is not directly related to climate change adaptation measures, this remains in the status quo.	3.0	0.36	1.08	1.80
	Sub-total							8.64	12.00
	Local Economy	Expansion of Production	Direct effect by JICA project	Status quo	There is no large direct impact on the local economy.	3.0	0.30	0.90	1.50
			Introduction of production technology	Status quo	As the possibility for local production is very small, this remains in the status quo.	3.0	0.30	0.90	1.50
		Increase of Employment	Creation of new employment	Little improvement	It is a new technology for Mongolia and it has some potential to create new jobs.	4.0	0.30	1.20	1.50
			Acquisition of operation technology	Little improvement	It is a new operation technology for Mongolia.	4.0	0.30	1.20	1.50
	Sub-total							4.20	6.00
Sub-total								20.40	30.00
Investment Impact	Cost-Effectiveness			High	This project leads to the reduction of air pollutants and GHG emissions and is a cost-effective project.	5.0	1.60	8.00	8.00
	Profitability			Medium	It is unclear whether the system is designed to be established as a private-sector business. There is information that a private company is aiming to enter the market.	3.0	0.40	1.20	2.00
Sub-total								9.20	10.00
Application for the Japanese technology	Competitiveness of the Tecnology	Possibility of the Future Business Development		Significantly small	There are no high needs until 2030.	1.0	0.80	0.80	4.00
		Uniqueness and Superiority of the Technology		High	Itt has the technological capabilities of storage batteries, and the technological and production capacities of Chinese companies are increasing greatly.	4.0	1.60	6.40	8.00
		Operation and Maintenance by the Local Agency		Significantly small	The local O&M system is not sufficient. The ADB project also includes the activity for the capacity enhancement of operators.	1.0	1.20	1.20	6.00
		Degree of Interest by the Japanese Firms		Significantly small	Due to the small market size of Mongolia, it is difficult to find business development as a storage battery business.	1.0	0.40	0.40	2.00
Sub-total								8.80	20.00
Implementation Condition	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	The introduction and dissemination of renewable energy is planned, and this is an indispensable project for its promotion.	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	The project by ADB is in progress.	4.0	1.00	4.00	5.00
		Capacity of Implementing Agency		Significantly low	As the state-owned company is in charge of the electricity transmisison and distribution business, it is assumed that its financial situation is directly linked to the financial situation of Mongolia.	1.0	1.00	1.00	5.00
		Situation of Development of Institutional Frameworks		High	Since the project by ADB is progressing, it is assumed that the legal systems and technical studies are being developed.	4.0	1.00	4.00	5.00
	Sub-total							13.00	20.00
	Requests from the Mongolian Government			Significantly small	The needs for assistance in the period up to 2030 are fairly low, but there are needs for further assistance in a long term.	1.0	4.00	4.00	20.00
	Sub-total							4.00	20.00
Sub-total								17.00	40.00
					Ground Total			**55.40**	**100**

No.	**CIC02**
Project Name	The effective utilization of renewable energy by installation of storage batteries

Overall Evaluation

As the introduction of renewable energy is planned to be promoted in the future in Mongolia, the business of storage batteries connected to the electrical grid is important. However, the ADB project is scheduled to be implemented and the need for the JICA support will not be that high until 2030.

Remarks

Japanese companies also have technological capacities, but the technological and production capacities of Chinese companies is increasing significantly. As a Japanese company, it is difficult to find a business opportunity of storage batteries for electrical grid system as the demand in Mongolia is limited.

Comments by the Mongolian Government

Mr. Ts.Atarjargal Director, Energy Bureau, Energy Regulation Committee
As a result of the Project by ADB, etc., the priority of the project for introduction of storage batteries will not be high until 2030.

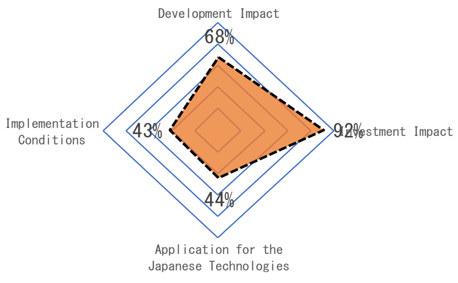
Ms. B.Tumendelger, Director of Research Analysis Bureau, National Development Agency
As a result of the Project by ADB, etc., the needs for new projects until 2030 are small.

Consideration of Technical Assistance related to Yen Loan

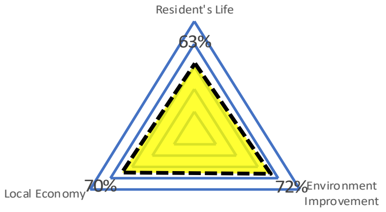
As the needs of Mongolian side are not high, it has not been studied.

Charts

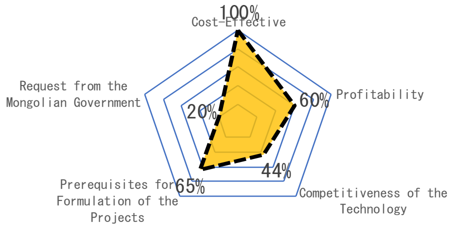
Large



Medium: Development Impact



Medium: Investment Impact, Application for the Japanese Technologies, Implementation Conditions

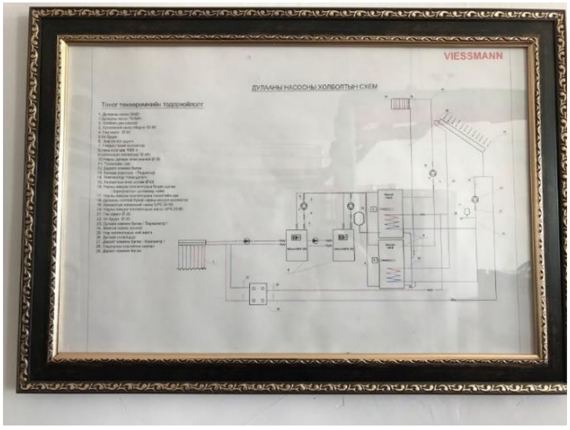


(3) CIC03: Introduction of Heat Pump and Heat Storage Heater

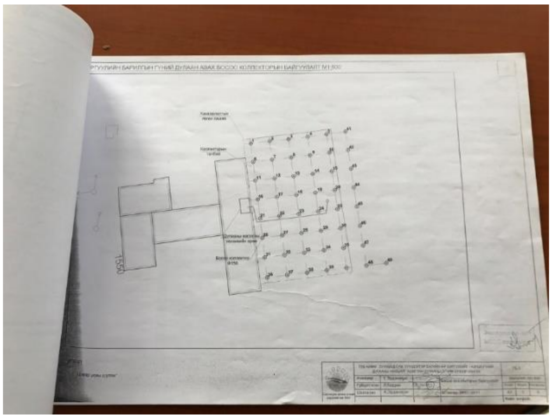
a. Outline and Purpose of the Project

In UB City, where air pollution has become more serious, it is the heating system that is one of the measures considered for the air pollution problem, by switching from the heating system using coal to the heating system using electricity. The heating system using a geothermal heat pump is a heating device that circulates antifreeze in a geothermal heat exchanger up to around 100 m underground, and exchanges heat with a heat pump. It is assumed that it is compatible with extremely cold environments and it can be used even when the outside temperature is -30 degrees Celsius.

The following is an overview of the geothermal heat pumps installed at kindergartens, schools and hospitals in Zuunmod of Töv Aimag, as an example of actual introduction in Mongolia.



Overview of geothermal heat pump facility



Plan view of design on geothermal heat pump

Main body for geothermal heat pump

Installation site of geothermal exchanger (next to the school building)

Source: These photos are taken in the field survey in the MUGCUP2 Project.

Figure 5.10 Geothermal Heat Pump Facilities Operating in Mongolia

This assumed project was examined based on the “Feasibility Survey for Environment-Friendly Ground Source Heat Pump System” (JICA FS) shown in **Table 5.73** and the “New Mechanism Feasibility Study for Replacement of Coal-Fired Boiler by Geo-Thermal Heat Pump for Heating” (JCM FS) shown in **Table 5.74**.

Table 5.73 Example of Geothermal Heat Pump Project (1)

Items	Contents
Outline of Project	Since the heat supply by only geothermal heat pumps is not sufficient during midwinter, the solar thermal hot water supply system is installed in parallel. In addition, a coal-fired HOB is set as spare equipment.
Outline of Facilities	Manufacturer: NATURE LLC (Swiss) Capacity of heat pump: 90 kW of BWH280 and 78.8 kW of BWH268.1
Number of underground heat exchanger	49 drilled wells, which are 100 meters in depth and 150 mm in diameter, using Mongolian technology.
Approximate Cost	1,850 million MNT (Around 117 million Yen, exchange rate in 2013 was 1MNT = 0.06325 Yen)
Construction Period	School: Gross floor area (2,120 m^2), Volume of the Building (7,630 m^3)

Source: These are edited from the JICA FS and the interview research in the MUGCUP2 Project.

Table 5.74 Example of Geothermal Heat Pump Project (2)

Items	Contents
Gross Floor Area	657 m^2
Heating Capacity	52.5 kW
Consumed Power	17.8 kW
Annual COP	2.6 (COP: Coefficient of Performance, COP is determined by the ratio between energy usage and useful heat extracted from equipment (cooling or heating))
Annual Electricity Consumption	55,909 kWh: excluding Pump for heating source 56,840 kWh: including Pump for heating source
Number of Underground Heat Exchanger	100 meters and 14 drilled wells

Source: These are edited from the JCM FS.

As shown in **Table 5.75** below, the introduction of a geothermal heat pump will cost around 100 million Yen for one site. As of 2018, there are around 330 HOBs registered in the HOB registration system of UB City, and around 60 HOBs are installed in schools and kindergartens. Therefore, a project was thought of where the heating for public buildings such as 20 schools and/or government offices will switch from using coal-fired HOBs to using geothermal heat pumps.

Table 5.75 Development Impact Example of Yen-Loan-Financed Project for Geothermal Heat Pumps

Items	Contents	Note
Outline of Project	Heating for public buildings such as 20 schools and/or government offices will shift from using coal-fired HOBs to using geothermal heat pumps. Total Project scale is around 2 billion Yen	Set from the potential of UB City and the neighboring region
Information on buildings receiving heating	Total 20 sites; Average building size: Gross floor area (2,000 m^2), Volume of Building (7,600 m^3)	Set from Source 1)
Outline of Facilities	Total Capacity: 3.6 MW Capacity of one site: 2 sets of 90 kW	Set from Source 1)
Number of Underground Heat Exchanger	50 drilled wells, which are 100 meters in depth and 150 mm in diameter	Set from Source 1)
Approximate Cost	One site: Around 100 million Yen Total (20 sites): Around 2 billion Yen	Set from Source 1) Including facilities, excavation, and the attached equipment and fixtures
Construction Period	2 years	10 sites per year

Items	Contents	Note
Maintenance Cost	One Site Annual electricity consumption cost: around 30 million MNT = around 1.2 million Yen, by using the following calculation condition: Annual electricity consumption: around 170 MWh/year Unit price of electricity for business facilities in 2019: 164.38 MNT/kW (around 170 MNT/kW). Cost of labor: around 1 million Yen/year (one staff 30 thousand Yen/month, 9 months, 4 staff per one site). Other maintenance cost is set as 300 thousand Yen/year. Total Cost for one site: 3 million Yen/year, and Total Cost for 20 sites: 60 million Yen/year	Approximate calculation by using information from Source 2) Cost of labor is set from Source 3)
Income Source	Monthly Tariff for heating: Around 500 MNT/m^3 (Tariff of district heating for business facilities in UB City is 472 MNT/m^3 in 2019.) 500 (MNT/m^3) × 7600 (m^3) × 9 months / 25 (MNT/Yen) = around 1.4 million Yen. Income per one site: 1.4 million Yen Total income from 20 sites: 28 million Yen	The business cannot be established unless the heating tariff is more than twice the price of the district heating.

Source 1): JICA FS
Source 2): JCM FS
Source 3): MUGCUP2

b. Project Evaluation Results

Project evaluation has been conducted. The individual evaluation items are shown in **Table 5.76**, and the evaluation criteria are shown in **Table 5.77**.

Table 5.76 Individual Evaluation Items and Evaluation Criteria (ClC03)

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
Development Impact	Residents' Life	Improvement of Public Services	Expansion of supply service area related to hot water for heating	**Table 5.77**
			Reduction of burden on residents	**Table 5.77**
		Enlargement of Activity Range	Increased activities in public facilities	**Table 5.77**
			Increased opportunities gained for welfare services	**Table 5.77**
		Enhancement of Amenity	Reduction of breakdown in hot water supply services	**Table 5.77**
			Improvement of dwelling environment / indoor environment	**Table 5.77**
	Environmental Improvement	Living Environment Conservation	Improvement of air pollution problem	**Table 5.77**
			Improvement of waste problem	**Table 5.77**
		Natural Environment Conservation	Improvement of water pollution problem	**Table 5.77**
			Impact on natural environment conservation	**Table 5.77**
			Climate Change Mitigation	**Table 5.77**

Evaluation Items				Evaluation Criteria
Large	Medium	Small		
		Global Environment Conservation	Climate Change Adaptation	**Table 5.77**
	Local Economy	Expansion of Production	Direct effect by the JICA project	**Table 5.77**
			Introduction of production technology	**Table 5.77**
		Increase of Employment	Creation of new employment	**Table 5.77**
			Acquisition of operation technology	**Table 5.77**
Investment Impact		Cost-Effectiveness		**Table 5.77**
		Profitability		**Table 5.77**

Table 5.77 Evaluation Criteria (ClC03)

Score	Evaluation Criteria
+4～5	By implementing the project, the situation will improve from the current situation
+3	Status quo (benchmark)
+1～2	By implementing the project, the situation will worsen from the current situation

(i) Development Impact

<u>Residents' life</u>

Since the expansion of the hot water supply service area is not expected as a result of the geothermal heat pump capacity when compared to the existing HOBs, this remains in the current situation. In addition, since it cannot be assumed that high initial cost will be covered by the burden on residents, and it is also not expected that the burden on residents will be directly reduced by introducing these facilities, this remains in the current situation.

Compared to the alternative technology coal-fired boilers (HOBs), it does not directly lead to the expansion of activities in the life of residents. Therefore, since there is no direct impact on the increase of activities in public facilities and on the increase of opportunities gained for welfare services, this remains in the current situation.

Regarding the dwelling environment and the indoor environment, as the alternative technology, coal-fired boilers (HOBs) will be replaced by geothermal heat pumps using electricity, coal combustion near the equipment will be eliminated and the indoor air environment will greatly improve. Since the occurrence of heating service outage during the midwinter is expected to be almost the same for both existing systems and geothermal heat pumps, this remains in the current situation.

<u>Environmental improvement</u>

Since the HOBs will be replaced with geothermal heat pumps using electricity, coal combustion will be eliminated, there will be almost no air pollutants that are emitted from the facilities, and there will be almost no waste generated by operation of the facilities.

There is no change in the amount of hot water used for heating. There is a possibility of the influence of groundwater from the underground tube for heat exchange, but this is limited. The underground burial work of heat exchange tubes and impact on groundwater during the operation can be factors that deteriorate the natural environment, but they are also limited. Therefore, this remains in the current situation.

Regarding global environment conservation, this is a technology that replaces the use of coal with the use of electricity. However, in Mongolia, where there many coal-fired power plants exist, it may not lead to the reduction of GHG emissions. On the other hand, since the introduction of renewable energy power generation projects progresses, it may become a climate change mitigation measure in the future. It is not directly related to climate change adaptation measures, and its direct impact on other global environmental conservation such as reduction of ozone depleting substances is minor.

Local economy

The expansion of production by local companies in Mongolia depends on the intention of Japanese companies, etc., but the positive impact on the local economy is limited because improvement of the current situation cannot be expected. Although new employment is not expected due to the relocation of coal-fired HOB operators, which is an alternative technology, there is a positive effect on the acquisition of geothermal heat pump operation technology by local operators.

(ii) Investment Impact

Cost-effectiveness

Since the effect of reducing the emission of air pollutants is expected, the benefit of reducing the health damages is expected.

Profitability

Since the initial cost is quite high in comparison to coal-fired HOBs, the profitability is low.

(iii) Application of Japanese Technology

Possibility of future business development

The initial cost is relatively high as the cost of coal since a fuel is low. As a result, although there is a possibility of business development by Japanese companies, it is difficult to predict if the businesses will be widely developed only by the private business without the support of the government and foreign donors. Therefore, this is set as medium.

Uniqueness and superiority of the technology

Compared to European countries and the USA, it is not easy to find uniqueness and advantage of Japanese companies. According to the “Development of Renewable Energy Heat Utilization Technology” (NEDO, R&D project for 5 years from 2014 to 2018) (URL: https://www.nedo.go.jp/content/100800231.pdf), the utilization of geothermal heat is lagging behind compared to Europe and the United States. The main cause is that the cost of excavation work for collecting geothermal heat is generally high because of the hard and soft multi-layered land of Japan, which can easily collapse. In addition, the following has been described: At present, it is hard to say that the use of renewable energy as heat in Japan is sufficiently advanced compared to the potential in Europe and the United States. However, it is hoped that Japanese drilling cost will be reduced to half in comparison to the US drilling cost, and that international competitiveness can be secured by promoting standardization and packaging for the technology.

At present, this industry sector is at the stage of aiming to secure technological capacity with international competitiveness in the future, and the uniqueness and advantages of Japanese technology cannot be exactly found.

Operation and maintenance by the local agency

According to the reports of the “Feasibility Survey for Environment-Friendly Ground Source Heat Pump System”, technical O&M guidance for local staff is necessary, and according to this report, the following problems have occurred in local heat pump equipment, and the heating for school is not sufficient.

- It seems that the antifreeze that circulates in the drilling for use of the geothermal heat is leaking underground. It is possible that the underground piping has been poorly constructed.
- Since some errors may occur in the geothermal system and the operation may stop, coal-fired HOB is used as a backup.
- Since there are no experts in Mongolia, if errors occur, operators make adjustments by communicating with Swiss manufacturers in every case.

Degree of interest by Japanese firms

Since ZENERAL HEATPUMP INDUSTRY CO., LTD. applied for a JICA project, SDGs Business Model Formulation Survey with the Private Sector, and conducted a field survey in Mongolia, it is expected that the degree of interest will be high. In addition, SHIMIZU CORPORATION conducted a feasibility study for the JCM project.

(iv) Implementation Condition

Relevance with upper plans

Since it is one of the electrical technologies, which contributes to the air pollutant emission reductions, it is related to a higher-level plan. In addition, since the use of electricity is being promoted to meet the demand for heating as a measure for air pollution, it is consistent with this measure.

Relevance with other plans

The project by ADB is being considered.

Capacity of implementing agency

Since the financial situation of Mongolia is not very good, it is assumed that there are financial problems. It is difficult to predict the domestic production of equipment because the domestic market is currently insufficient. As maintenance has to rely on foreign countries, the capacity for O&M of the relevant organization is significantly low.

Situation of development of institutional frameworks

Since there is no particular institutional issue for implementation, this is medium. The EIA (Environmental Impact Assessment) should be conducted in a robust manner.

Request from the Mongolian Government

Since it is one of the air pollution control measures that has a very high priority, the interest of the Mongolian Government is high. However, since it is a new technology for Mongolia and has almost no record of introduction, it is not a high priority project at present.

c. Overall Evaluation

Since there is no process to burn the fossil fuel directly, and it is a heating system that uses electricity, this is a promising project for air pollution control measures. On the other hand, since the electricity generated mainly by coal-fired thermal power plants will be used in Mongolia, there are issues such as GHG emission reductions will become small or GHG emissions can increase. In comparison to the alternative technology such as the heating system using coal-fired boilers (HOB), the very high initial cost is a problem. There are currently many issues regarding the domestic production of equipment and the independent implementation of O&M in Mongolia, and this technology should be introduced with the support of foreign donors.

d. Remarks

Since geothermal heat pumps have been widely used in Western countries since the 1980s, it is not easy to find a uniqueness and advantage of the Japanese technology.

e. Comments by the Mongolian Government

The comments by the Mongolian Government are shown in **Table 5.78**.

Table 5.78 Comments by the Mongolian Government on Geothermal Heat Pumps

Person	Comments
Mr. J. Erdenechimeg, Senior Expert, Development Policy Planning Department, Governor's Office of UB City	Since this is a new technology in Mongolia, there is almost no track record. The introduction was tried at the 81st kindergarten in the Songinokhairkhan district with the support of GIZ more than 10 years ago, but it did not work very well. There was application to JICA for support of the introduction to the Bayazurkh District, but it was not adopted.
Ms. B.Tumendelger, Director of Research Analysis Bureau, National Development Agency	It is one of the options for promoting the introduction of renewable energy in Mongolian national strategy. However, the ones with high priority are photovoltaic power generation, wind power generation, and hydroelectric power generation, and the priority is not so high. A high initial cost is the bottleneck, and its introduction in Mongolia has not progressed.

f. Consideration of Technical Assistance Related to Yen-Loan

The technical support with a yen-loan-financed project has not been considered, since the local needs are not so high, the scale of the project is not so large, the uniqueness and advantage of Japanese technology is not so high, and there is a possibility of support by two step loans, etc.

Table 5.79 Evaluation Result Summary (CIC03)

No.	**CIC03**		
Project Name	Introduction of geothermal heat pumps		
Implementing Agency	UB city (if school, the education bureau)	Relating Agency	
Project Cost	Approximately 2 billion Yen		
Outline and Objective of the Project			

A heating system using the geothermal heat pump is a heating device that circulates antifreeze in a geothermal heat exchanger up to around 100 m underground and exchanges heat with a heat pump. In the UB City, where air pollution is becoming more serious, the heating system is one of the measures for the air pollution problem by switching from a heating system using coal to a heating system using electricity.

Evaluation Item: Large	Medium	Small		Evaluation Result	Evaluation Ground	Rating	Weight	Rating * Weight	Full Scale
Development impact	Resident's Life	Improvement of Public Services	Expansion of supply service area related to hot water for heating	Status quo	As the expansion of the hot water supply service area is not expected, this remains in the status quo.	3.0	0.48	1.44	2.40
			Reduction of burden on citizen	Status quo	As it is not expected that the burden on citizens will be directly reduced by introducing facilities, this remains in the status quo.	3.0	0.48	1.44	2.40
		Enlargement of Activity Range	Increased activities in public facilities	Status quo	As there is no direct impact on the increase of activities in public facilities, this is held in the status quo.	3.0	0.36	1.08	1.80
			Increased opportunities obtaining for welfare services	Status quo	As there is no direct impact on the increase of opportunities gained for welfare services, this remains in the status quo.	3.0	0.36	1.08	1.80
		Enhancement of Amenity	Reduction of breakdown in hot water supply services	Status quo	As the occurrence of the heating service outage in the midwinter is expected to be the almost same for both existing systems and geothermal heat pumps, this remains in the status quo.	3.0	0.36	1.08	1.80
			Improvement of dwelling environment / indoor environment	Significantly improvement	Since there are reductions of air pollutant emissions and amount of waste such as coal ash, the dwelling environment and indoor environment will be improved.	5.0	0.36	1.80	1.80
	Sub-total							7.92	12.00
	Environment Improvement	Living Environment Conservation	Improvement of air pollution problem	Significantly improvement	There is almost no air pollutants emitted from the facilities.	5.0	0.36	1.80	1.80
			Improvement of waste problem	Significantly improvement	There is almost no waste generated by operating the facilities.	5.0	0.36	1.80	1.80
		Natural Environment Conservation	Improvement of water pollution problem	Status quo	There is no change in the amount of hot water used for heating. There is a possibility of the influence of groundwater by the underground tube for heat exchange.	3.0	0.48	1.44	2.40
			Impact for natural environment conservation	Status quo	As the underground burial work of heat exchange tubes and impact on groundwater during operation can be factors that deteriorate the natural environment but they are limited, this is held in the status quo.	3.0	0.48	1.44	2.40
		Global Environment Conservation	Climate change mitigation measurement	Status quo	If renewable energy power generation increases in the future, the effect of reducing GHG emissions is expected but it is not easy to predict it at present, so this remains in the status quo.	3.0	0.36	1.08	1.80
			Climate change adaptation measurement	Status quo	As it is not directly related to climate change adaptation measures, this remains in the status quo.	3.0	0.36	1.08	1.80
	Sub-total							8.64	12.00
	Local Economy	Expansion of Production	Direct effect by JICA project	Status quo	There is not large direct impact on the local economy.	3.0	0.30	0.90	1.50
			Introduction of production technology	Status quo	As it depends on the intentions of Japanese companies and Mongolian companies, the current situation is neutral.	3.0	0.30	0.90	1.50
		Increase of Employment	Creation of new employment	Status quo	Since new employment can not be expected due to the reassignment of operators at existing facilities, this remains in the status quo.	3.0	0.30	0.90	1.50
			Acquisition of operation technology	Little improvement	Regarding the improvement of the capacity of operation companies in Mongolia, once the facilities are introduced, the operation will be essential and it is expected that the technology will be acquired.	4.0	0.30	1.20	1.50
	Sub-total							3.90	6.00
Sub-total								20.46	30.00
Investment Impact	Cost-Effectiveness			Little large	The effect of reducing the emission of air pollutants is expected, and the benefit of reducing health damage is expected.	4.0	1.60	6.40	8.00
	Profitability			Significantly small	As the initial cost is quite high, the profitability is low.	1.0	0.40	0.40	2.00
Sub-total								6.80	10.00
Application for the Japanese technologies	Competitiveness of the Tecnology	Possibility of the Future Business Development		Medium	As the support for initial cost by government and foreign donors is essential, this is set as medium.	3.0	0.80	2.40	4.00
		Uniqueness and Superiority of the Technology		Significantly small	Comparing to European countries and USA, it is not easy to find uniqueness and advantage.	1.0	1.60	1.60	8.00
		Operation and Maintenance by the Local Agency		Small	AS some issues occur at the local operating facilities, the local O&M system is not sufficient.	2.0	1.20	2.40	6.00
		Degree of Interest by the Japanese Firms		Significantly large	As some Japanese companies conducted researches, etc., the interest is high.	5.0	0.40	2.00	2.00
Sub-total								8.40	20.00
Implementation Conditions	Prerequisites for Formulation of the Projects	Relevance with Upper Plans		High	It is one of the electrical technologies, which contributes to the air pollutants emission reductions, and it is related to the higher-level plan.	4.0	1.00	4.00	5.00
		Relevance with Other Plans		High	The project by ADB is being considered.	5.0	1.00	5.00	5.00
		Capacity of Implementing Agency		Significantly low	As the financial situation of Mongolia and local O&M systems is not sufficient, the capacity of the relevant organizations is significantly low.	1.0	1.00	1.00	5.00
		Situation of Development of Institutional Frameworks		Medium	As there are no particular institutional issues for implementation, this is medium.	3.0	1.00	3.00	5.00
	Sub-total							13.00	20.00
	Requests from the Mongolian Government			High	Interest is high, but the priority of project implementation is not so high.	4.0	4.00	16.00	20.00
	Sub-total							16.00	20.00
Sub-total								29.00	40.00
					Ground Total			**64.66**	**100**

No.	**CIC03**
Project Name	Introduction of geothermal heat pumps

Overall Evaluation

As there is no process to burn fossil fuel directly and it is a heating system that uses electricity, this is a promising project for air pollution control measures. On the other hand, since the electricity generated mainly from the coal-fired thermal power plants will be used in Mongolia, there are issues such as GHG emission reductions becoming small or GHG emissions can increase.
Compared to the alternative technology such as heating system using coal-fired boilers (HOB), the very high initial cost is problem.
There are currently many issues regarding the domestic production of equipment and the independent implementation of O&M in Mongolia, and this technology should be introduced with the support of foreign donors.

Remarks

AS the geothermal heat pumps have been widely used in Western countries since the 1980s, it is not easy to find the uniqueness and advantage of Japanese technology.

Comments by the Mongolian Government

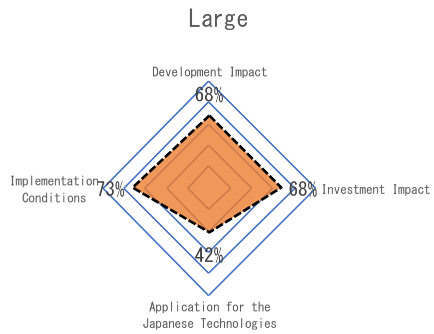
Mr. J. Erdenechimeg, Senior Expert, Development Policy Planning Department, Governor's Office of the UB City
AS this is new technology in Mongolia, there is almost no track record. The introduction was tried at the 81th kindergarten in the Songinokhairkhan district with the support of GIZ more than 10 years ago, but it did not work very well. There was application to JICA regarding the support on introduction to the Bayazurkh district, but it was not adopted.

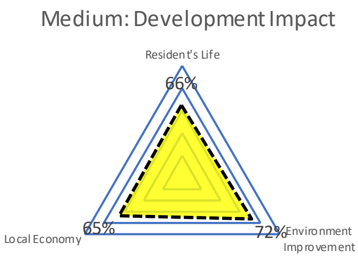
Ms. B. Tumendelger, Director of Research Analysis Bureau, National Development Agency
It is one of the options for promoting the introduction of renewable energy in Mongolian national strategy. However, the ones with high priority are photovoltaic power generation, wind power generation, and hydroelectric power generation, and the priority is not so high. The

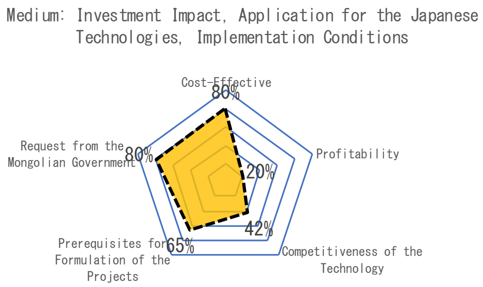
Consideration of Technical Assistance related to Yen Loan

The technical support with yen-loan-financed project is not considered, because the local needs are not so high, the scale of the project is not so large, the uniqueness and advantage of Japanese technology are not so high, and there is a possibility of support by two step loans, etc.

Charts







5.3 Short List of Candidate Projects for Yen-Loan Fund

Table 5.80 shows the evaluation results in **Section 5.2**. For the top six (6) projects, the candidate projects for the yen-loan fund enumerated in **Table 5.81** will comprise the short list.

Table 5.80 Evaluation Results of Yen-Loan Fund Projects

No.	Projects	Development Impact	Investment Impact	Japanese Technology	Implementation Environment	Total	Ranking
		30	10	20	40	100	
Air01	Introduction of improved coal-fired hot water supply boiler	20.70	6.00	7.20	10.00	43.90	20
Air02	Central heating using renewable energy, incineration equipment, etc.	18.48	2.00	10.80	24.00	55.28	18
Air03	LNG/CNG introduction infrastructure development	25.80	6.00	12.00	21.00	64.80	10
Air04	Construction of improved fuel manufacturing plant	22.56	7.20	14.00	34.00	77.76	3
Air05	Improvement of intersections and road networks for the mitigation of traffic congestion	27.24	8.00	17.60	29.00	81.84	1
Air06	Introduction of DPF for public buses	20.28	7.20	15.20	20.00	62.68	12
Wat01	Main line pipe maintenance in the central treatment area	23.28	6.00	13.60	24.00	66.88	8
Wat02	Reconstruction of aged sewer pipes in the central treatment area	22.92	8.00	17.20	33.00	81.12	2
Wat03	Installation of wastewater pre-treatment facility at factories	28.68	2.00	5.60	32.00	68.28	6
Wat04	Sewage sludge utilization digestion gas power generation project	18.60	2.00	5.60	22.00	48.20	19
Wat05	Urban rainwater drainage plan / facility improvement management	23.28	2.00	8.80	27.00	61.08	15
WM01	Construction of WtE facility (waste power generation / heat supply facility)	20.76	6.80	11.60	27.00	66.16	9
WM02	Construction of intermediate treatment facility (recycling facility) for solid waste	23.52	6.80	6.40	25.00	61.72	13
WM03	Construction of recycling facility for automobile parts	22.32	5.20	8.00	26.00	61.52	14
WM04	Hazardous waste final disposal site (managed final disposal site)	21.12	5.20	9.60	31.00	66.92	7
WM05	Introduction of hazardous waste treatment facility	21.60	6.40	8.00	33.00	69.00	5
WM06	Construction of a comprehensive waste treatment facility (EPC + SV dispatch)	21.60	6.40	13.60	33.00	74.60	4
ClC01	Introduction of energy saving technology (hot water valve control system for heating)	20.76	5.60	8.80	24.00	59.16	16
ClC02	Effective utilization of renewable energy by introducing storage batteries	20.40	9.20	8.80	17.00	55.40	17
ClC03	Introduction of heat pump and heat storage heater	20.46	6.80	8.40	29.00	64.66	11

Table 5.81 Short List of Candidate Projects for the Yen-Loan Fund

No.	Projects	Development Impact	Investment Impact	Japanese Technology	Implementation Environment	Total	Ranking
		30	10	20	40	100	
Air05	Improvement of intersections and road networks for the mitigation of traffic congestion	27.24	8.00	17.60	29.00	81.84	1
Wat02	Reconstruction of aged sewer pipes in the central treatment area	22.92	8.00	17.20	33.00	81.12	2
Air04	Construction of improved fuel manufacturing plant	22.56	7.20	14.80	34.00	77.76	3
WM06	Construction of a comprehensive waste treatment facility (EPC + SV dispatch)	21.60	6.40	13.60	33.00	74.60	4
WM05	Introduction of hazardous waste treatment facility	21.60	6.40	8.00	33.00	69.00	5
Wat03	Installation of wastewater pre-treatment facility at factories	28.68	2.00	5.60	32.00	68.28	6

5.4 Summary of Candidate Projects

5.4.1 Candidate Project for Yen-Loan Fund No.1: Improvement of Intersections and Road Networks for the Mitigation of Traffic Congestion

(1) Project Title

Project for Improvement of Intersection and Road Networks for the Mitigation of Traffic Congestion (Ajilchin Flyover Project and Green Avenue Construction Project)

(2) Background and Necessity of the Project

With the significant increase in traffic volume in UB City, the situation of traffic congestion at the main arterial road has become worse. The chronic traffic congestion at Peace Avenue, which passes through the center of the city, as well as the railway crossing in the center of the city, has been worsening the air pollution due to the increasing vehicle emissions. Especially near the intersections heavily congested by traffic, hazardous vehicle emissions such as NOx, SOx and PM are creating much higher air pollution exceeding the upper limit of the environmental regulation, having a serious impact on the health of residents along the road. It is predicted that the traffic volume at major arterial roads will be more than twice their capacity in 2030, which will make the travel speed slow and, consequently, air pollution rise escalated by vehicle emission.

To improve such a situation, UB City formulated its Medium-Term Road Development Plan to develop an effective road network connecting the city ring road with the East-West and North-South main corridors, and to mitigate the expected traffic congestion by distributing the concentrated traffic flow.

(3) Project Summary

a. Objective of the Project

Based on the Medium-Term Road Network Development Plan formulated by UB City, the Project aims to mitigate the traffic congestion in the City by expanding the road network and by eliminating traffic bottlenecks. Subsequently, this will reduce air pollution near the arterial roads and intersections.

b. Project Site/Target Area

Ajilchin Flyover Project: Bayangol District, Khan Uul District

Green Avenue Project: Khan Uul District, Bayangol District, Songinokhairkhan District

c. Application of Japanese Technology

The Project include the construction of flyovers crossing the railway, and hence it is important to select a construction method that will not disturb railway operation. To fulfil such a condition, the Launching Method, which is widely used in flyover projects in Japan, is highly recommended. In addition, in order to construct pile foundations in the limited construction space at the premises of the railway, the Rotary Penetration Steel Pipe Pile Method is recommended, to avoid any effect to the railway and to prevent the contamination of underground water near the environmental preservation area along the Tuul River. In addition, by applying the steel concrete composite deck slab and the minimized girder bridge developed in Japan, it will be possible to construct a bridge with high durability and minimum lifecycle cost.

d. Operation and Maintenance System

During construction, the Project Implementation Unit (PIU), consisting of personnel of the Ministry of Roads and Transport Development (MRTD) and the Ulaanbaartar Road Department (UBRD), will be organized to take charge of construction quality control and the monitoring of schedules. In addition, after the project is completed, the constructed structures will be turned over to UB City and be maintained by the UBRD.

e. Project Time Schedule

Ajilchin Flyover Construction Project: 48 months

Green Avenue Construction Project: 36 months

f. Project Implementation Structure

(i) Japanese Side

Japanese firm and local partner as needed.

(ii) Mongolian Side

Ministry of Road and Transport Development / Ulaanbaatar Road Department

(4) Estimated Project Cost

It is assumed that the construction work will be carried out by a Japanese contractor under the STEP Loan scheme. The amount in the following **Table 5.82** were estimated as construction costs, which are not inclusive of the feasibility study, detailed design, and construction supervision costs.

Table 5.82 Outline and Estimated Project Cost of the Project for Improvement of Intersections and Road Networks for the Mitigation of Traffic Congestion

Project Name	Construction Outline	Approximate Project Cost
Ajilchin Flyover Project	Viaducts and Flyover: L=828m (4 lanes / ON-OFF lamp)	6.91 billion yen
	East Side Access Road: L=515m, Street maintenance: L=1210 m	450 million yen
	West Side Access Road: L=1000m, Dund River Embankment: L=915m	550 million yen
	West Industrial Road Improvement Work: L=1370m	110 million yen
	Total	8.02 billion yen
Green Avenue Project	6 lane street: L=2.16 km	450 million yen
	4 lane street: L=2.94 km	410 million yen
	Plane Intersection Construction: 5 sites	200 million yen
	Railroad Flyover: L=250m (4 lanes)	3.0 billion yen

Project Name	Construction Outline	Approximate Project Cost
	Tuul River Crossing Bridge: L=380m (6 lanes)→(Assumed as L=800m)	4.3 billion yen
	Tuul River Branch Line Crossing Bridge: L=80m (6 lanes)	260 million yen
	Dund River Crossing Bridge: L=20m (6 lanes)	60 million yen
	Total	8.68 billion yen
Grand Total of Estimated Project Cost		**16.70 billion yen**

(5) Assumed Climate Change Mitigation Potential

Air pollution levels near construction roads are reduced by up to 7%.

5.4.2 Candidate Project for Yen-Loan Fund No.2: Reconstruction of Aged Sewer Pipes in Central Sewer District

(1) Project Title

Project for Aged Sewer Pipes Reconstruction in the Central Sewer District

(2) Project Background and Necessity

In UB City, there are aged pipes that were laid in the 1960s and are now more than 50 years old. According to the survey conducted by USUG, cracks, breakage and blockages were found in the pipes. In addition, asbestos-cement pipes remain, and these pipes need to be replaced as soon as possible because they deteriorate quickly with age and their strength is easily reduced.

Furthermore, if the aged pipes are not reconstructed, the possibility of road cave-ins due to broken pipes, etc., will increase, interfering with traffic functions. This will have a great impact on the socio economy of UB City, where cars and buses are the main means of transportation.

In addition, there are concerns about contamination of the surrounding soil and groundwater by sewage leaking from the aged pipes. Particularly, it takes a long time for groundwater to recover once it is contaminated, so the need for countermeasures is extremely urgent for UB City, which depends on groundwater as its source of drinking water. To improve the above situation, it is necessary to reconstruct aged pipes as soon as possible.

(3) Project Summary

a. Objective of the Project

Reconstruction of aged pipes will lead to the continuation of sewerage services and the prevention of damage from road cave-ins, etc., thus maintaining urban functions.

b. Project Site/Target Area

Ulaanbaatar City (Bayangol, Songino Khairkhan, Bayanzurkh, Chingeltei, Sukhbaatar, and Khan Uul Districts)

c. Application of Japanese Technology

The SPR method is expected to be adopted in UB City, where the water supply to apartment buildings has been shut down for about two weeks to reconstruct sewer pipes using the open-cut method, causing complaints from residents.

d. Operation and Maintenance System

Since USUG has adopted the non open-cut rehabilitation method for the renewal of water supply pipes, it was considered that there is no problem with the implementation capacity. However, since the SPR method has not yet been adopted in Mongolia, it is necessary to provide design and construction guidance from Japan, as well as related materials and equipment during the design and construction work. There is no problem with the current maintenance and management system because USUG has been conducting maintenance and management of sewers.

e. Project Time Schedule

Of the 50 km of aged pipes to be reconstructed, the section to be reconstructed by open-cut is about 14 km (refer to **Table 5.29** and **Figure 5.4**), and that by non-open-cut is about 36 km. In consideration of work efficiency and safety, the project period will be four (4) years, with no construction during the winter months, i.e., October to March, depending on the local conditions.

f. Project Implementation Structure

(i) Japanese Side

Japanese company and partner companies

(ii) Mongolian Side

Ulaanbaatar City, USUG

(4) Estimated Project Cost

The estimated project cost for the reconstruction of aged pipes is 7.5 billion yen (0.4 billion yen for open-cut and 7.1 billion yen for non-open-cut).

(5) Assumed Climate Change Mitigation Potential

The reconstruction of aged pipes will lessen the leakage of sewage from cracks and damaged parts of aged sewer pipes and reduce soil contamination around the sewers. In addition, the reduction of excavated residual soil minimizes the need for large transportation vehicles and equipment and reduces greenhouse gas emissions during construction. Furthermore, since the construction is done without excavation, the impact on the living environment such as noise will be minimized.

5.4.3 Candidate Project for Yen-Loan Fund No.3: Improvement of Improved Fuel Manufacturing Plant

(1) Project Title

Project for Improvement of Facilities at the Production Plant for Upgrading Improved Fuel

(2) Background and Necessity of the Project

In UB City, air pollution is serious during the severe winter season, and there is a great need on the Mongolian side to improve fuel quality and reduce production costs. Various projects for air pollution control had led to the reduction of concentration and emission of PM, and the projects are highly effective in reducing PM. On the other hand, the Mongolian side is taking the lead in air pollution countermeasures, and two factories to produce improved fuel are already in operation. To support the Mongolian side's efforts, the renovation of factory facilities to improve the quality of improved fuel will support for the air pollution countermeasures.

(3) Project Summary

a. Objective of the Project

In UB City, two improved fuel production plants owned by Tawang Tolgoi Tulsh (TTT), a state-owned company established under Government Decree No. 387, are currently in operation. The improved fuels currently being produced still have some issues to be addressed in order to reduce air pollution. Therefore, to improve the quality of the improved fuel currently being produced, equipment will be added to the existing plant facilities and some equipment will be replaced. The improvement of the improved fuel will significantly reduce air pollution compared to the existing improved fuel.

b. Project Site/Target Area

The project covers two factories, one built in Songinohailkhan District in 2019 and the other in Tuv Province adjacent to Naraiha District in 2020. However, according to recent information, the plant in Songinokhairkhan district will be moved to a new plant in Tuv Province.

c. Application of Japanese Technology

Molding technology and high-pressure molding machines are among the Japanese technologies that are expected to be utilized. In Japan, molding technology in various fields including molding coke is advanced, and molding machine manufacturers have test facilities to determine the molding conditions, and also have the know-how to determine the optimal conditions including costs. The high-pressure molding machine that is planned to be introduced at this time is capable of molding at high pressures of 3 tons/cm or more, and has the ability to reduce or eliminate the need for expensive binders. Mixing semi-coke or biomass with the existing improved fuels will improve combustion and contribute to the reduction of air pollution, and this technology has also been proven in Japan.

d. Operation and Maintenance System

This project is related to the improvement of the existing plant through a yen loan, and Japan will provide equipment and operational support (dispatch of personnel in charge of SV) for improved briquette production with guidance on molding technology. In addition, Mongolia will install the equipment. Operation and maintenance of the plant will not be a problem since the existing plant is already in operation.

e. Project Time Schedule

A total of approximately three (3) years will be required for sample testing, manufacturing of equipment, removal of existing equipment, installation of equipment, and commissioning. However, since the status of the existing factory facilities is unknown, it will be necessary to conduct a field survey before considering the project.

f. Project Implementation Structure

(i) Japanese Side

An engineering company in Japan will be in charge of the project, and each equipment manufacturer will provide technical support.

(ii) Mongolian Side

Ministry of Energy and TTT Company

(4) Estimated Project Cost

Assuming that the annual production capacity of the improved fuel is 600,000 tons and the actual operation time is 5,000 hours per year, the hourly production volume will be 120 tons per hour. The estimated project cost based on this capacity is shown in **Table 5.83**. Semi-coke and biomass are considered as the improved materials for the fuel, and if one of them is used, the equipment configuration will partially change, but the specifications and number of high-pressure molding machines will not change.

Table 5.83 Estimated Project Cost of the Project for Improvement of Facilities at the Production Plant for Upgrading Improved Fuel

Item	Specifications	Unit Price (100 million yen)	Amount	Total Amount (100 million yen)
[Component Equipment]				
High pressure molding machine	Molding capacity: 15 t/hr, Molding pressure: 3 t/cm	4	8	32
Hammer type crusher	Crushing capacity: 10 t/hr	0.5	2	1
Pin type crusher	Crushing capacity: 3 t/hr	0.25	6	1.5
Conveyor, hopper, spare parts			One set	1
[Construction Cost]				
Engineering cost			One set	0.6
On-site construction cost			One set	0.5
Technical guidance			One set	0.2
Transportation cost			One set	0.2
Total				**37**

(5) Assumed Climate Change Mitigation Potential

When biomass is used as a renewable energy source, the amount of coal, which is fossil fuel used as raw material, can be reduced depending on the amount of biomass mixed in, resulting in the reduction in CO_2 emissions. Details will be calculated from the results of combustion tests.

5.4.4 Candidate Project for Yen-Loan Fund No.4: Introduction of Comprehensive Waste Treatment Facility

(1) Project Title

Ulaanbaatar City Comprehensive Waste Treatment Facility Project (WtE Incineration Facility)

(2) Background and Necessity of the Project

UB City is highly concentrated with nearly half of Mongolia's population. In the course of the development of cities, SWM issues will expand and become more complicated. For general waste, the policy is to list the WtE waste incineration power generation and heat supply project on the national concession list and proceed as a national project to reduce the volume and modernize the waste treatment. Additionally, there is no facility that properly disposes hazardous waste (medical waste, waste automobiles, waste home appliances, livestock waste, etc.). To improve the above situation, as an environmental infrastructure facility that will be the basis for modernization of SWM and treatment of hazardous waste in Ulaanbaatar, A WtE incineration power generation and heat supply facility that reduces the volume of general waste and detoxifies hazardous waste is required.

(3) Project Summary

a. Objectives of the Project

The ultimate goal of this project is to modernize SWM in Mongolia. As the project goal, it will carry out EPC construction and dispatch of supervisors for general waste, hazardous waste incineration, power generation and heat supply facilities, and teach the Mongolian side the know-how on facility construction and facility operation management.

b. Project Site/Target Area

Next Moringiin Davaa final disposal site site (Khan-Uul District)

c. Application of Japanese Technology

This project consists of the introduction of an incineration facility for reducing the volume of general waste and detoxifying hazardous waste and is also a project to construct a power generation and heat supply facility using the incineration heat as well. Japan has a track record of more than 60 years in waste incineration and has accumulated advanced equipment technology and operating know-how.

d. Operation and Maintenance System

This project consists of an EPC project and operation support (SV dispatch) for a comprehensive waste treatment facility with a yen-loan fund. **Figure 5.11** illustrates the project implementation structure. This project will be a publicly owned system, and the EPC project (design, procurement, construction) will be carried out by a Japanese company. The operator of the facility will be UB City; however, Japanese companies will provide driving support by OJT for five (5) years and transfer driving know-how to UB City. The city of Ulaanbaatar will earn income from facility operations (waste disposal fee, hazardous waste disposal fee, electricity sales fee, etc.).

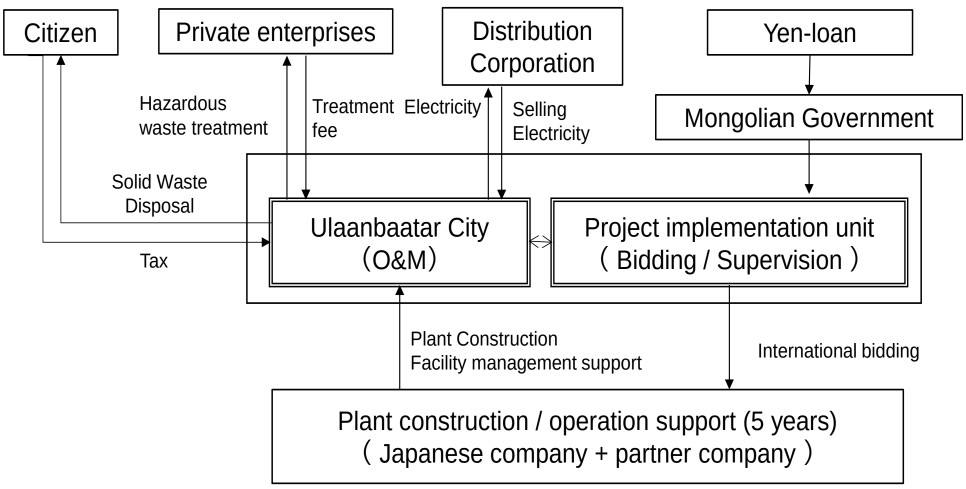


Figure 5.11 Ulaanbaatar City Comprehensive Waste Treatment Facility Project System Plan (Public Management)

e. Project Time Schedule

It will take three (3) years to construct the facility, but since it is a construction work in a frigid region and the ground condition of the construction site is unknown, it is necessary to conduct a field survey before considering it.

f. Project Implementation Structure

(i) Japanese Side

Japanese company and partner companies

(ii) Mongolian Side

Ulaanbaatar City

(4) Estimated Project Cost

The EPC project and SV dispatch supervision of the comprehensive waste treatment facility are as follows. However, since the local situation is unknown, land preparation is not included.

Table 5.84 Outline of Comprehensive Waste Treatment Facility Project

Item	Contents	Remarks
General waste + hazardous waste incineration power generation and heat supply facility		
Waste disposal amount	Solid waste 200,000 t/year, Hazardous waste 40,000 t/year	General waste + hazardous waste
Reactor type / Reactor scale	Stalker kiln type incinerator 800 t/day (400t × 2 furnaces)	300 working days
Pretreatment equipment	Consultation required (depending on the sorting situation)	Needs investigation
Power generation output	Steam turbine: 12.4 MW Annual power generation: 93,000 MWh	Back pressure turbine
Heat supply	Heat supply: 37.2 MW Annual heat supply: 223,200 MWh	Hot water supply Effective heat utilization rate 80%
Exhaust gas treatment	Dry type (activated carbon / slaked lime spray), non-catalytic denitration	
Ash treatment	Landfill	To the final disposal site for hazardous waste
Required site area	About 3ha	
Construction period	3 years (however, depending on local conditions)	
Approximate construction cost	About 13 billion yen	
Maintenance fee	Approximately 13 billion yen (20 years)	Driver's staff fee, service fee, maintenance fee
Driving support costs	Approximately 500 million yen (5 years)	

(5) Assumed Climate Change Mitigation

As the climate change mitigation potential by waste incineration power generation and heat supply facilities envisioned in this project, it is possible to: (1) avoid methane emissions (suppress the generation of methane by organic matter that was directly landfilled at the final disposal site without proper intermediate treatment) and (2) reduce the amount of electricity supplied to the grid.

Similar examples include the integrated waste power generation (600 t/day scale) in Ho Chi Minh City and the waste power generation project (60 t/ day scale) in Yangon City, which were examined under the JCM scheme, the former shows the amount of global warming gas reduction of 2,052-46,921 tCO_2/year, and the latter shows the amount of global warming gas reduction of 4,663 tCO_2/year.

5.4.5 Candidate Project for Yen-Loan Fund No.5: Introduction of Hazardous Waste Treatment Facility

(1) Project Title

Project for Introduction of Hazardous Waste Treatment Facility

(2) Background and Necessity of the Project

Disposal of hazardous waste has become an important issue for UB City due to changes in social conditions and diversifying industries. For industrial modernization in Mongolia, it is necessary to establish not only a municipal waste treatment facility but also a hazardous waste treatment system.

(3) Project Summary

a. Objective of the Project

This proposed project proposes an EPC project and an operation support project for incineration facilities for the purpose of intermediate treatment (detoxification) of hazardous waste. However, since there is a lack of basic information on hazardous waste treatment, it is necessary to grasp the basic information to carry out a project plan.

b. Project Site/Target Area

Next Moringiin Davaa final disposal site (Khan-Uul District)

However, MET is requesting the mayor of UB City to secure a candidate site for the construction of a hazardous waste treatment facility, and it is necessary to pay close attention to the decision.

c. Application of Japanese Technology

Although Japan has various treatment technologies for hazardous wastes, the technologies that can be expanded overseas are limited because the target items are diversified and specialized. At this stage, mainly proposed are items that can be processed by incineration. In the future, it will be necessary to conduct a matching survey of Japanese technologies that can be introduced based on local basic information.

d. Operation and Maintenance System

This project is an EPC project and operation support (SV dispatch) for hazardous waste treatment facilities with a yen-loan fund. **Figure 5.12** illustrates the project implementation structure. By making the facility construction publicly owned, it will be possible to reduce the project risk to Japanese companies. Hazardous waste will be under the jurisdiction of MET, but it is unclear whether it can be operated, so UB City and MET are listed together as the main body of project operation and O&M in this figure. It is profitable to undertake the treatment of hazardous waste from the public and private companies, but it is necessary to develop a legal system including penal provisions for its implementation.

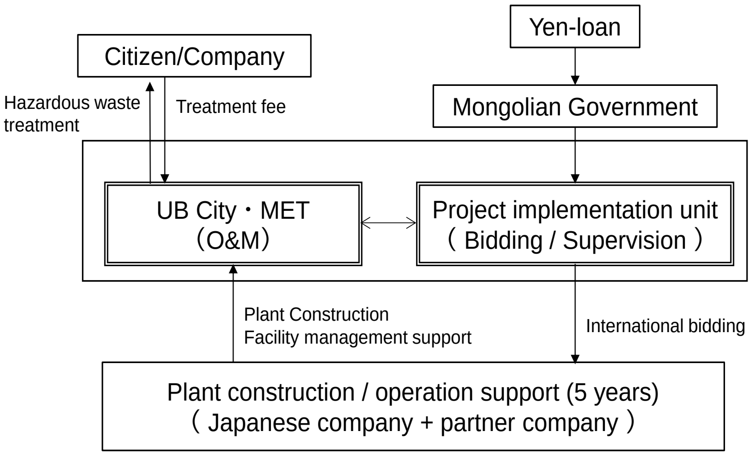


Figure 5.12 Hazardous Waste Treatment Facility Project System Plan (Publicly Owned)

e. Project Time Schedule

It will take three (3) years to construct the facility, but since it is a construction work in a frigid region and the ground condition of the construction site is unknown, it is necessary to conduct a field survey before considering it.

f. Project Implementation Structure

(i) Japanese Side

Japanese company and partner companies

(ii) Mongolian Side

MET

(4) Estimated Project Cost

The following are assumed for the EPC project and SV dispatch of hazardous waste treatment facilities. However, since the local situation is unknown, land preparation is not included.

Table 5.85 Outline of Hazardous Waste Treatment Facility Project

Item	Contents	Remarks
Waste disposal amount	62,000 t/year	
Reactor type / Reactor scale	Kiln stalker type incinerator (200 t/day × 1 furnace)	312.5 working days
Pretreatment equipment	Consultation required (depending on the sorting situation)	Needs investigation
Exhaust gas treatment	Dry type (activated carbon / slaked lime spray), non-catalytic denitration	
Ash treatment	Landfill	A managed final disposal site is required
Required site area	About 2ha	
Construction period	3 years (however, depending on local conditions)	
Approximate construction cost	About 6.5 billion yen	Does not include construction and pile construction
Maintenance fee (Not covered by project)	Approximately 6.5 billion yen (total for 20 years)	Driver's staff fee, service fee, maintenance fee (Excluding SPC operating costs)

(5) Assumed Climate Change Mitigation Potential

Hazardous waste treatment projects are not considered to have effective climate change mitigation potential. However, it is a facility that plays an important role in preserving the surrounding environment.

5.4.6 Candidate Project for Yen-Loan Fund No.6: Installation of Wastewater Pre-Treatment Facility at Factories

(1) Project Title

Project for Installation of Factory Wastewater Pre-treatment Facility

(2) Background and Necessity of the Project

UB City has established water quality standards (MNS 6561) for receiving industrial wastewater and accepts it into sewer. However, factories are discharging wastewater that exceeds these acceptable water quality standards. As a result, the sewage treatment process at the central sewage treatment plant has become highly loaded, and the treated water quality greatly exceeds the discharge water quality standards, which in turn causes water pollution in the Tuul River. To improve the above situation, it is necessary to install pre-treatment facilities in each factory to properly treat wastewater and comply with the effluent quality standards to sewer.

(3) Project Summary

a. Objectives of the Project

The Project aims to install pre-treatment facilities at each factory to properly treat industrial wastewater and comply with water quality standards for discharging wastewater into sewer.

b. Project Site/Target Ara

Ulaanbaatar City (Bayangol, Songino Khairkhan, Bayanzurkh, Chingeltei, Sukhbaatar, and Khan Uul Districts)

c. Application of Japanese Technology

Japan's factory wastewater treatment technology has been successful in improving water pollution caused by factory wastewater in Japan and has also been used overseas. On the other hand, price competition with overseas companies is severe. Pre-treatment facilities have been installed at 10 factories in UB City, but these facilities are all made in China.

d. Operation and Maintenance System

This project involves the installation of abatement facilities at each factory using two-step loans. Agencies involved in water pollution control include MCUD, MOFALI, GASI, etc. In addition, Ulaanbaatar City and USUG are responsible for factory wastewater regulation and monitoring.

As a yen loan project, it is necessary to install and properly operate and maintain the pre-treatment facilities in a short period of time. Therefore, a specialized organization is needed to provide guidance, advice, and support to each company in the installation and operation of the detoxification facilities. For this purpose, USUG, based on its past achievements, or a new specialized organization could be established. In addition, to implement more effective industrial wastewater treatment, it is necessary to consider the implementation of projects that combine Technical Support via the Finance and Investment Account.

e. Project Time Schedule

The project for the installation of approximately 200 pre-treatment facilities will be divided into two phases, as follows:

Phase 1 is a three-year period from 2022 to 2024, before the new CWWTP is put into service. In this phase, pre-treatment facilities will be installed mainly at large and medium-sized factories, as well as at factories that can be expected to benefit from the project, such as factories with bad wastewater (project scale: 15-billion-yen, total of 100 pre-treatment facilities, 40 sets in 2022, 30 sets in 2023, and 30 sets in 2024).

Phase 2 is a three-year period from 2025 to 2027, after the new CWWTP is put into service. In this phase, pre-treatment facilities will be installed mainly for small- and medium-scale factories (project scale: 15 billion yen, total of 100 pre-treatment facilities (40 sets in 2025, 30 sets in 2026, and 30 sets in 2027).

f. Project Implementation Structure

(i) Japanese Side

Japanese company and partner companies

(ii) Mongolian Side

Ulaanbaatar City, USUG, construction companies

(4) Estimated Project Cost

The estimated project cost for the installation of the pre-treatment facilities for about 150 factories (200 pre-treatment facilities to be installed) is about 30.9 billion yen.

(5) Assumed Climate Change Mitigation Potential

The installation of pre-treatment facilities at factories will ensure compliance with effluent quality standards for discharging into sewer. CWWTP will be able to properly treat sewage and meet the water quality standards for discharging into the Tuul River. As a result, the water pollution of the Tuul River will improve.

5.5 Examination of Technical Assistance under the Yen-Loan Fund

5.5.1 Technical Cooperation Project for Capacity Strengthening of Monitoring and Management System for Factory Wastewater

(1) Necessity of the Technical Cooperation Project

To implement efficiently and effectively the aforementioned “5.4.6 Candidate Project for Yen-Loan Fund No.6: Installation of Wastewater Pre-Treatment Facility at Factories”, it is necessary to strengthen the monitoring system of USUG and GASI, which is currently lacking, and to establish a management system on the factory side.

(2) Objective of the Technical Cooperation Project

The objective of the project is to strengthen the factory wastewater monitoring system and capacity in Ulaanbaatar City.

(3) Project Site/Target Area

Factories and offices in the entire Ulaanbaatar city area

(4) Assumed Counterpart Organizations

In addition to GASI and USUG, which are directly involved in factory effluent monitoring, MCUD, MOFALI, SME Agency, Ulaanbaatar City, etc., are involved in factory effluent regulation, SME development, and installation of pre-treatment facilities.

(5) Assumed Project Contents

In this technical cooperation project, the following factory wastewater monitoring system will be introduced and established, referring to the case of Tokyo Metropolitan Government, to enhance the monitoring capacity of the relevant government agencies and factories.

- Establishment of an integrated monitoring system by combining wide-area (narrowed-down) monitoring and individual monitoring of factory wastewater
- Establishment of a water quality self-control system at factories (water quality control manager system)
- Building an emergency response system for disasters and inflow of harmful substances, and improvement of the operation and management capabilities of wastewater treatment plants to maintain the function of sewerage facilities and safety

a. PDM (Program Design Matrix) of the Technical Cooperation Project

PDM for technical supporting projects was considered targeting the introduction and establishment of a factory wastewater monitoring system, strengthening regulatory guidance capacity, and improving environmental management capacity, as follows:

(i) Overall Goal

Ulaanbaatar City's environmental management capacity will be improved, and sustainable water environment conservation will be possible.

(ii) Objective of the Project

To improve the impact on sewerage system caused by factory wastewater inflow.

(iii) Results of the Project

1. Improve USUG/GASI's ability to monitor industrial wastewater

   Indicator 1: USUG/GASI monitoring of factory wastewater to be carried out on a regular basis.

2. Improve the ability of factories to voluntarily monitor wastewater quality

   Indicator 2: Water quality discharged from each factory complies with the sewage acceptance standards.

3. CWWTP's emergency response system will function and improve its ability to manage operations.

   Indicator 3: The function and safety of CWWTP is secured and treated water quality discharged from each factory complies with the sewage acceptance standards.

(iv) Activities of the Project

1. An integrated monitoring system will be established by combining wide-area and individual monitoring of factory wastewater.

1-1 Establishment of a factory wastewater monitoring system
1-2 Strengthening of USUG/GASI monitoring system, division of roles and cooperation

2. A self-control management system will be established at factories.

2-1 Establishment of Water Quality Control Manager System
2-2 Strengthen guidance by USUG/GASI

3. An emergency response system will be established to maintain the functionality and safety of sewerage facilities.

3-1 Preparation of Business Continuity Plan (BCP) for CWWTP
3-2 Preparation of emergency response manuals and implementation of drill

5.5.2 Technical Cooperation Project for Formulation of Discarded Automobile Recycling System

(1) Necessity of the Technical Cooperation Project

From the results of hearings with MRTD, it was confirmed that Japan has a high need for support for recycling scrapped automobiles (see **Subsection 2.4.3**). On the other hand, as a result of hearings with Japanese companies, it was obvious that a discarded automobile recycling system, such as an automobile registration system and the establishment of a fund for the treatment of hazardous waste derived from discarded automobiles, should be formulated to carry out the automobile recycling project locally.

Since such a system to promote proper recycling of waste is highly developed as various recycling systems in Japan, the application of the system for Mongolia not only brings about the improvement of waste management capacity, but also provides cross-sectoral benefits as a system that is the basis of widespread industrial development. This recycling system can also be applied to the recycling of E-Waste and waste home appliances, which are expected to increase in Mongolia in the future as well.

(2) Objective of the Technical Cooperation Project

The objective of the project is to stablish an automobile recycling system in Mongolia.

(3) Project site/Target Area

The whole nation of Mongolia

(4) Assumed Counterpart Organizations

MRTD, which has jurisdiction over scrap car recycling

(5) Assumed Project Contents

In this technical cooperation project, an automobile recycling system in Mongolia will be established with reference to Japan's automobile recycling system. The contents of the project will cover the following:

- Establishment of various registration systems for automobiles, dealers and processors
- Establishment of an illegal dumping countermeasure system for scrapped vehicles
- Consideration of establishment of a system for operating the automobile recycling system and organization

a. PDM (Program Design Matrix) of the Technical Cooperation Project

PDM for technical cooperation projects was considered targeting establishment of an automobile recycling system, as follows:

(i) Overall Goal

The automobile recycling system of Mongolia will be established, and sustainable automobile recycling will therefore take place.

(ii) Objective of the Project

A project for establishment of Mongolia's automobile recycling system will start at the national level.

(iii) Results of the Project

1. Various registration systems will be established, and the capacity for implementation of the recycling system will improve.

   Indicator 1: Registration of vehicles and vendors is started.

2. Illegal dumping system for scrapped vehicles will be strengthened and illegal dumping will decrease.

   Indicator 2: Understanding the number of illegal dumping and reducing the number of illegal dumping from the start year.

3. Nationa-level talks on the operation of the automobile recycling system will be started.

   Indicator 3: National-level talks to operate the automobile recycling system begin.

(iv) Activities of the Project

1. Various registration systems (automobiles, distributors, processors) are established.

1-1 Establishment of a registration system and database
1-2 Implementation of registration activities

2. Illegal dumping countermeasure system for scrapped cars is established.

2-1 Strengthening the penal system for illegal dumping of scrapped vehicles
2-2 Strengthening the monitoring system in collaboration with UB City

3. Examination of establishment of system/organization for the automobile recycling system operation is started at the national level.

3-1 Establishment of a review committee for the automobile recycling system

CHAPTER 6. RECOMMENDATIONS FOR FUTURE SUPPORT POLICIES

6.1 Air Pollution Control

6.1.1 Improved Fuels and Coal Alternative Fuel

When considering household fuels as an air pollution control measure, it is necessary to distinguish between low-income households living in ger areas and middle- and high-income households living in apartments and houses. These two cases are as described below.

(1) Low-Income Households (Ger, etc.)

a. Current Situation

Although the use of improved fuel still has air pollution problems, the use of improved fuel is expected to continue in the future because there is no effective alternative in the ger areas. Therefore, there is a great need for the Mongolian side to improve the quality of the improved fuel and reduce the production cost in order to prevent air pollution. In addition, through the JICA Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 3 (Technical Cooperation Project) and other projects, the improvement of improved fuel as an air pollution control measure is being studied.

b. Issues and Challenges

The government is demanding cost reduction to introduce improved technology and reduce subsidies, and this needs to be addressed.

c. Items to be Considered

Since the introduction of improved technology including cost reduction requires the introduction of expensive equipment, the lifecycle cost and profitability must be considered.

However, the manufacturer of the improved fuel does not have the facilities to study the improvement technology, so it is not possible to demonstrate the effect of the improvement. It is, therefore, necessary to study a separate method to verify the effect.

d. Recommendations

Introduction of additional equipment to improve the improved fuel as a model equipment:

It is necessary to introduce or upgrade additional plant equipment to improve the quality of the improved fuel. Since the introduction of alternative equipment corresponding to the current equipment capacity is expensive, it is important to first introduce and demonstrate one high-pressure molding machine as a model equipment in order to popularize it in the future.

Support for the establishment of Improved Fuel Development Center (tentative name) that can conduct industrial analysis and combustion tests:

It is desirable to establish a center that can demonstrate the effects of improvements. The establishment of the center will further develop the evolution of combustion test measurement technology and evaluation technology for improved fuels as air pollution countermeasures through the JICA Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 3 (Technical Cooperation Project). It will be possible to link the support for soft infrastructure, such as planning of atmospheric countermeasures, to the development of hard infrastructure, such as the support for manufacturing technology.

(2) Middle- and High-Income Households (Apartments, Houses, etc.)

a. Current Situation

In the apartments, heating is by hot water and cooking is mainly by electricity. Households living in the houses use electricity, improved fuels, and centralized heating systems. In the future, the use of coal substitute fuels such as LPG, oil, and electricity, which are easier to control temperature for heating and cooking, is expected to increase. Therefore, energy-saving measures to reduce fuel costs such as the introduction of thermal storage facilities and insulation are also expected to increase. On the other hand, since the Cabinet Secretary has issued a directive to change the fuel for HOBs from coal to electricity and gas, it is expected that the shift from coal to gas will continue.

b. Issues and Challenges

Electricity consumption will increase.

c. Items to be Considered

Since there are currently only coal-fired power plants as base power sources, middle power sources that can dynamically adjust output according to power demand are needed. In addition, when there is a shortage, the country relies on power purchases from Russia, and it is necessary to examine the cost-effectiveness of the power purchase price.

d. Recommendations

Support the introduction of gas power generation as a middle power source:

Support the introduction of gas power generation as a middle power source using imported LNG, CNG and domestic LPG: The Ministry of Energy has completed the FS for 50MW × 2, and public-private partnership is expected for this feasibility.

Development of infrastructure for introduction of LNG and CNG:

Since LNG and CNG are the most economical for gas power generation, infrastructure facilities include facilities for receiving and storing LNG from Kazakhstan and Russia by wagon transport, pipelines to power plants, and vaporizer or CNG storage facilities.

6.1.2 Road/Intersection Improvement

(1) Current Situation

Two (2) priority projects, namely, the Ajilchin Flyover Construction Project and the Green Avenue Construction Project, have been selected as highly effective to mitigate traffic congestion based on the UMRP. It is highly possible that these projects can be promoted to be Yen Loan (STEP) projects using Japanese technology related to bridge construction. On the other hand, the railway underpass project at the vicinity of the above two projects is also scheduled by another donor. It is important that the Government of Mongolia, as well as Ulaanbaatar City, should coordinate the implementation of these projects, based on the priority and effects of the projects.

(2) Issues and Challenges

a. Ajilchin Flyover Construction Project

Seven (7) years have passed since the preparatory survey was conducted by JICA for this project in 2013. Therefore, it is necessary to review the traffic demand forecast, construction costs, and land acquisition plan. Particularly, there are strong requests from the MRTD to review and reduce construction costs to promote the Project. In addition, Ulaanbaatar City has prioritized the railway underpass project with Chinese-loan assistance at the same project site of which detailed design will be started from 2021. The implementation of projects shall be coordinated by the Government of Mongolia.

b. Green Avenue Construction Project

Since this Project passes through the environmental preservation area (water source area) and residential area along the Tuul River, sufficient consideration and measures are required for the mitigation of adverse effects to the environment during and after construction (noise, vibration, river water pollution, groundwater pollution, etc.). In addition, a railway underpass project with assistance from China is scheduled at the vicinity of the Green Avenue construction site, and also need to be coordinated by the Government of Mongolia.

c. Maintenance Due to Expansion of Road Infrastructure

With the rapid expansion of road infrastructure in Ulaanbaatar toward 2030 (expansion of road length and number of bridges), it is expected that budget allocation, human resources and advanced technology necessary for maintenance will be serious issues in the future.

(3) Items to be Considered

- Review of project effects based on updated traffic demand forecast in light of the latest traffic volume and road network
- Consensus building with the Government of Mongolia by reduction of construction costs for Ajilchin Flyover Construction Project
- Clear understanding of the project effects by the Government of Mongolia
- Confirmation of scope and implementation schedule of the projects assisted by other donors (China, WB, etc.)
- Confirmation of institutional and engineering issues on maintenance for the road infrastructure rapidly expanding in Ulaanbaatar City

(4) Recommendations

Review of the preparatory survey of the Ajilchin Flyover Project:

It is recommended to conduct a review survey for the construction costs based on the latest market unit price and exchange rate, to conduct a study on cost reduction measures, to review the project effect based on the updated traffic demand forecast, to investigate the current situation of land acquisition, etc., in order to confirm the validity of project implementation. Regarding the underpass project to be assisted by China, it is important to confirm the feasibility of its implementation and the concrete plan at an early stage. In addition, to visually introduce the project effect, presentation by traffic simulation model before and after the Project will be effective to facilitate the understanding of project effects by the Government of Mongolia.

Formulation of scope for Green Avenue Construction Project:

It is effective to propose the project based on the concept of Quality Infrastructure applying Japanese technology after determination of the route, and the location of railway crossing and its method such as underpass or flyover. In addition, it will be more attractive for the Government of Mongolia to introduce Japanese technology in terms of friendly environment in conformity with the restrictions and regulations to protect the environment during and after construction. It is also important to confirm, at an early stage, the actual scope of the road section supported by the WB, and particularly, the underpass project supported by China scheduled at the vicinity of the expected route of Green Avenue.

(5) Funding Schemes other than Yen-Loan

In order to achieve efficient asset management for the huge number of road and bridges by the limited personnel and budget in Mongolia, it will be effective to provide technology transfer of inspection and maintenance methods utilizing advanced IT technology such as drone, which has been introduced to maintenance work in Japan in recent years, through the Technical Cooperation Projects. It will facilitate the understanding of the effectiveness of Japanese technology together with construction technology.

In addition, there is a needs potential for the capacity development to improve the Traffic Demand Management (improvement of parking space, sophistication of road control, policy making such as road pricing, etc.) for the mitigation of traffic congestion.

6.2 Water Pollution Control

6.2.1 Reconstruction of Aged Sewer Pipes in Central Treatment District

(1) Current Situation

In UB City, there are old pipes that were laid in the 1960s and are now more than 50 years old. According to the survey conducted by USUG, cracks, breaks and blockages have been found in the pipes. In addition, asbestos-cement pipes remain, and these pipes need to be replaced as soon as possible because they deteriorate quickly with age and their strength is easily reduced.

(2) Issues and Challenges

Although water supply pipes have been reconstructed, the reconstruction of sewers have not progressed much. If the aged sewer pipes are not reconstructed, damage to sewers may cause roads to sink, interfering with traffic functions. In addition, there are concerns that sewage is leaking from cracks in aged sewer pipes, and it is necessary to reconstruct aged sewer pipes to prevent soil contamination around sewers.

(3) Items to be Considered

a. Collection of Basic Information on Existing Pipes

TV camera survey is necessary to confirm the condition of existing pipes. Depending on the condition of existing pipes (vertical sagging, etc.), it may not be possible to use the non-cutting method such as SPR, etc., and it may be necessary to replace the pipes using the open-cut method. It is important to collect basic information on the existing pipes to select the renewal method.

b. Study of Sewer Pipe Flow Capacity

The section of sewer pipes to be replaced by open-cut method includes aged pipes with insufficient flow capacity. Therefore, it is necessary to study the diameter and gradient of the new pipes to satisfy the required flow capacity.

c. Collection of Detailed Information on Water Supply Pipe Reconstruction Work

It is necessary to collect detailed information on rehabilitation methods of water supply pipes currently being implemented in UB City, including rehabilitation costs.

d. Temporary Diversion of Sewage Flow

The SPR method allows construction while allowing sewage water to flow through but depending on the water level and flow speed in the pipe, construction may be difficult and temporary diversion may be necessary. In such a case, separate costs should be considered, and requests for cooperation from local residents near the target sewers, such as cutting off the water supply, should also be considered.

e. Work Schedule

The work schedule is assumed to be about four (4) years, but it may vary depending on the work system (number of work groups on site, etc.) and local conditions. In addition, it is necessary to consider the effects of night work and winter construction when visibility on the road is poor.

(4) Recommendations

Technology demonstration project to promote the introduction of Japanese technology:

Since the SPR method has never been adopted in UB City, it is difficult to understand the technical superiority of this Japanese technology. Therefore, if the demonstration project of the SPR method can be carried out in UB City using JICA's SDGs Business Supporting Survey, the understanding of the local organizations will be deepened, and the introduction of Japanese technology will be promoted.

(5) Funding Schemes other than Yen-Loan

JICA's SDGs Business Supporting Survey can be considered as a support scheme for implementing the demonstration projects mentioned above.

6.2.2 Installation of Pre-Treatment Facility at Factories

(1) Current Situation

UB City has established water quality standards (MNS 6561) for receiving industrial wastewater and accepts it into sewer. However, factories are discharging wastewater that exceeds these acceptable water quality standards. As a result, the sewage treatment process at the central sewage treatment plant has become highly loaded, and the treated water quality greatly exceeds the discharge water quality standards, which in turn causes water pollution in the Tuul River.

(2) Issues and Challenges

It is necessary to install pre-treatment facilities in each factory to properly treat factory wastewater and comply with the effluent quality standards for sewer.

(3) Items to be Considered

a. Review of Specifications and Project Costs

In this survey, the total estimated cost of the project (total project cost framework) was calculated using the construction cost calculated from pre-treatment facilities with average wastewater quality and treatment capacity. In the next phase, the specifications of the abatement facilities and the installation cost will need to be reviewed by checking the local conditions (treatment capacity of individual pre-treatment facilities, requirements of the business owners, civil work cost in UB City, etc.). It is expected that this will lower the installation cost of pre-treatment facilities.

b. Consideration of Locations for Installation of Pre-Treatment Facilities

In this survey, the approximate cost of installing pre-treatment facilities for factories were calculated individually. As for the installation locations, it is necessary to consider installation methods that can be expected to produce project effects at an early stage, such as the installation of shared pre-treatment facilities for multiple factories.

c. Confirmation of Number of Potential Lenders

It is necessary to collect information on the number of potential lenders and their location, site area, business scale, etc., and to consider the scale of the loan.

d. Review of Loan Conditions for JICA Two-Step Loan Project

The upper and lower limits of the loan amount, interest rate, repayment period and deferment period, etc., should be considered while considering the situation of the potential lender.

e. Securement of Dominance of Japanese Companies

To make the project a yen-loan project, it is assumed that Japanese companies will implement the project. However, the technology and cost of wastewater treatment by Japanese companies are difficult to secure a competitive edge. It is important to discuss with the Mongolian side the measures to be taken by Japanese companies to implement the project in the next phase.

(4) Recommendations

Financial support by the government:

Since most of the factories are small and medium-sized enterprises and do not have the financial resources to set up pre-treatment facilities, support from public funds is essential. For example, tax reduction (corporate income tax and equipment import tariff), reduction of drinking water tariffs and introduction of subsidies could be considered. It is believed that financial support from the Mongolian government would facilitate the installation of pre-treatment facilities at factories.

Strengthen regulatory capacity and self-monitoring of wastewater treatment by factory:

The current regulatory monitoring and penalties system by GASI and USUG needs to be strengthened. In addition, it is necessary to establish a system that promotes compliance with laws and regulations by business operators, such as a self-control wastewater monitoring system by business operators (e.g., water quality control officer system). Furthermore, to implement more effective factory wastewater treatment, it is necessary to consider the implementation of projects that combine JICA's Technical Support via the Finance and Investment Account.

(5) Funding Schemes other than Yen-Loan

A technical supporting project could be considered to strengthen independent monitoring capacity and establish a factory wastewater management system (refer to **Section 5.5**).

6.3 Solid Waste Management

(1) Current Situation

The current state of SWM in UB City, where about two-thirds of Mongolia's population is concentrated, is by no means good. It has many problems: lack of waste volume reduction facilities to extend the life of the final disposal site, lack of heavy machinery such as bulldozers used for final disposal site maintenance due to lack of financial resources, aging collection and transportation equipment, lack of waste treatment facilities for home appliances waste and waste automobiles due to changes in social conditions, and improper disposal of carcasses of livestock that die from livestock infectious diseases and livestock chemicals.

(2) Issues and Challenges

To modernize SWM in UB City and solve problems, it is necessary to reduce the volume of general waste by incineration and extend the life of the disposal site. Additionally, it is necessary to carry out appropriate detoxification treatment for diversifying hazardous waste.

(3) Items to be Considered

a. Construction and Operation of a General Waste Volume Reduction Facility (WtE)

(i) Project Risk to Japanese Companies

It is a policy to prioritize the promotion of facilities for reducing the volume of general waste as a national project, and there is a great need to introduce facilities. However, from the viewpoint of lack of financial resources, the project is a concession project in which the contractor has the right to operate the project. Mongolia has a high-country risk, and according to interviews with domestic companies, there has been no project method that presupposes independent profitability, even if it is a yen-loan fund project. Moreover, a local partner is required for the construction and operation of the facility.

(ii) Acquisition of Operating Expertise for Waste Incineration Facilities

Facility management by a foreign company is an act of abandoning the acquisition of operational know-how of a waste incineration facility that should be a central facility for SWM in the country; from a long-term perspective, it is not sustainable SWM.

(iii) Lack of Basic Information on Facility Design

A basic survey of general waste was conducted in 2018, and a survey of waste composition by residential area is being conducted. However, when designing an incineration facility, it is necessary to investigate the bulk specific gravity, three components (moisture, combustibles, ash), elemental composition, and calorific value in addition to the type and composition of waste. Besides, it is necessary to grasp the state of contamination and abolition of waste carried into the final disposal site, the ratio of oversized waste, and the state of contamination of hazardous waste based on the sorting work carried out as pre-treatment.

b. Construction and Operation of Detoxification Facility for Hazardous Waste

(i) Project Risk to Japanese Companies

As with the above-mentioned facilities for reducing the volume of general waste, the project risk to Japanese companies is high, so it is necessary to thoroughly consider a project implementation system that can reduce the risk.

(ii) Clarification of Project Implementation Structure

According to the Law of Mongolia about Waste, the local government has the jurisdiction over general waste and the hazardous waste is MET's. On the other hand, since MET itself is not an organization that operates facilities, care must be taken when considering a specific implementation system.

(iii) Lack of Basic Information on Facility Design

Although there is a strong need for detoxification of hazardous waste, there is a lack of information on its type, location, and amount of waste. Besides, although there is a wide variety of hazardous waste treatment technologies, there are not many Japanese companies that can construct facilities in Mongolia. For this reason, even when a hazardous waste treatment facility is adopted as a yen-loan fund project, it is considered that incineration facilities with overseas construction experience will be the main constituents. In this way, it is necessary to thoroughly consider matching of applicable technologies of Japanese companies based on detailed local information.

(4) Recommendations

Mitigation of project risk to Japanese companies:

As mentioned above, project in the country is risky to Japanese companies, and sufficient risk reduction measures are required when formulating yen-loan fund projects. As one of these measures, an EPC + driving support project for public management is proposed instead of a concession method that assumes independent profitability. Since this method does not involve project operations, it is possible to reduce project risk to Japanese companies, and information from the questionnaire to Japanese companies indicates that some companies would like to consider participating if the basic information is clear.

However, since the project for waste incineration power generation is being promoted by the concession method as a national policy in Mongolia, for the partner country to approve public management, it is necessary to show the merits of showing a concrete facility plan and to pave the way for introduction through dialogue between nations.

Partner companies:

It is necessary to investigate candidates for local partner companies. There is a possibility that foreign companies (China, South Korea, Austria, etc.) that are currently proposing WtE projects by the concession method can become partner companies. In future surveys, it is necessary to conduct a survey on the possibility of cooperation with Japanese companies, including the above companies.

Securing the superiority of Japanese companies:

The yen-loan fund project is based on the premise that a Japanese company will implement this project. However, it is difficult to secure superiority in the technology and cost of Japanese companies regarding WtE waste incineration power generation and heat supply facilities.

On the other hand, information from interviews show that the reliability of Japanese technology is very high, and it can be said that Japan's strength lies in this "reliability". Mongolia is demanding the improvement of its own SWM capacity, and there are many voices requesting the transfer of Japan's facility construction and operation know-how. In future surveys, it is important for Japanese companies to proceed with sufficient discussions with the partner country on measures to implement the project.

Collection of basic waste information:

It is important to collect basic waste information from UB City to consider the optimum facility specifications and scale. For this reason, in future surveys, it is necessary to conduct cross-sectoral surveys on the acquisition of basic information that contributes to the design of incineration facilities and the types and amounts of hazardous waste generated.

(5) Funding Schemes other than Yen-Loan

The hazardous waste detoxification facility and the comprehensive waste treatment facility (general waste volume reduction and hazardous waste detoxification) proposed as yen-loan fund project this time are facilities that contribute to the modernization of SWM in UB City, but it is extremely important to improve collection and transportation and improve the legal system for its efficient operation. For this reason, it is thought that as a support scheme other than yen-loan fund project, collection and transportation capacity improvement support project, project to improve the ability to respond to illegal dumping, and institutional development projects for the recycling of automobiles and home appliances are efficient.

6.4 Climate Change Mitigation

(1) Current Situation

Various projects in the field of climate change mitigation are projects leading to reduction of GHG emissions, and the viewpoint of energy conservation is very important. In UB City, the demand for heating during the midwinter is very high, and the potential for energy conservation is also large. To promote activities for energy conservation, incentives to reduce electric energy and fuel consumption should be required.

(2) Issues and Challenges

In Mongolia, the heating tariff system is basically based on the building area and/or volume, and it is necessary to change the tariff system to the one based on the amount of heat consumption, and create a mechanism to generate incentives for energy conservation. These are also great needs and big issues for the Mongolian side.

(3) Items to be Considered

a. Consideration of Technical Cooperation Project

In order to resolve the issues related to the promotion of climate change mitigation measures in UB City, there is a need for soft infrastructure through technical cooperation projects such as for energy tariff system establishment and human resource development, and the contents of the projects will have to be considered.

b. Consideration of Promotion for Understanding of Japanese Strengths and Reliability

In addition, through technical cooperation projects, etc., it is very important to promote the dissemination of Japanese systems related to energy conservation, environment, and safety. In addition, it is also very important to promote the understanding of Japanese strengths such as the environmental performance, the life cycle cost, meticulous management, the risk management like business continuity plan (BCP) aiming to balance energy conservation and environment, and the superiority and reliability of operation technology. It is also necessary to consider the project formulation based on these perspectives.

(4) Recommendations

Support of business environment:

Through the aforementioned activities such as technical cooperation projects, the introduction of Japanese technology, which is generally said to have a slightly high initial cost, is promoted, and it will also lead to the acquisition of the de facto standard in the partner country, which also leads to the improvement of business environment where Japanese companies can easily operate. As a result, it is expected that the support of the soft infrastructure will lead to the development of the hard infrastructure.

(5) Funding Schemes other than Yen-Loan

Scheme for enhancing synergistic effect:

It is expected that the synergistic effect of various support projects by JICA will be enhanced by supporting the advancement of small and medium sized enterprises in Mongolia, utilizing the private sector cooperation scheme after preparing the business environment through the technical cooperation projects.

ANNEXES

1. Air 03: Cost Estimates for Installation of LNG and CNG Infrastructure

1.1 Conditions of Cost Estimation

This is a facility that imports liquefied natural gas (LNG) from abroad to Ulaanbaatar by freight car and supplies natural gas (NG) to the gas turbine of the No. 2 thermal power plant. The scope of the estimate covers from the LNG storage tank to the NG storage tank after vaporization.

1.2 Specifications

Table 1 Specifications of Installation of LNG and CNG Infrastructure

Item	Quantity	Unit	Remarks
Gas Power Generation Facilities	2	unit	50MW
Operating hours per day	10	hr/day	
Annual operating hours	3,650	hr/year	
LNG consumption per hour	17.7	t/hr	
Power plant LNG consumption per day	177	t	389 m^3
Annual LNG consumption	64,600	t	247,800 m^3
Transportation capacity of one LNG freight car	36	t	79.1m^3
LNG storage tank	1,000	kl	455t
LNG Vaporizer	20	t/hr	
NG Storage Tank	75,000	kl	

1.3 Estimated Cost

The LNG satellite plant "Kurume Plant[1]" of Chikugo Gas Pumping Co., Ltd. of the Seibu Gas Group completed in 2015 was used as a reference for this cost estimate.

Table 2 Specifications of LNG Plant Used as a Reference

Item	Specifications
LNG storage tank	100 kl × 2 units
LNG vaporizer	6 t/h × 3 units
Lorry receiving facilities	2 units
Plant Administration Building	200 m^2

The above construction cost was 1.3 billion yen in total, and 1,000 kl was considered as a reference. 6.5 billion yen was used as a base, simply because the cost increases 5 times from 200 kl to 1,000 kl. The reduction rate of construction cost in Japan and Mongolia is 65%, and the scale merit from 200kl to 1,000kl is 60%, so 65 × 0.65 × 0.60 = 2.535 billion yen in total was assumed.

1.4 Challenges

The problem is that a 1,000kl storage tank is enough for 2.6 days of power plant use, and 13 LNG wagons are needed to transport it. In order to ensure a stable supply of LNG, railroad infrastructure needs to be considered, and it is expected that even larger storage tanks will be needed. The operation rate of the power plant is also an issue to be considered.

[1] http://chikugogas.co.jp/information/rux

2. Air 06: Outline of Product and Technology Provided (MoCobee)

Name	Cassette type retrofit black smoke removal system (DPF) “MoCobee” MoCobee is composed of following (i) and (ii). (i) MoCobee CT (Cassette-type DPF) (ii) MoCobee RE (DPF filter recovery oven)  **Photo 1 Example of Cassette-Type DPF Installation in This Project**  **Photo 2 DPF Filter Recovery Oven (complete combustion through proper temperature control)**
Specification	“Nine prefectures and cities particulate matter reduction device designation number 002-D” ➢ Reduction rate of black smoke (particulate matter): 70% or more ➢ Fuel used: Diesel oil (sulfur content of about 5,000 ppm or less) ➢ Classification of vehicles: All categories (including vehicles that did not comply with the regulations in 1989 and 1990) ➢ Scope of vehicles subject to installation: Vehicles equipped with diesel engines up to 25,000 cc

<table>
<tr><td></td><td>

Figure 1 Sticker indicating Vehicle Equipped PM Reducing Equipment</td></tr>
<tr><td>Features</td><td>In addition to satisfying the conditions for designation as a "particulate matter reduction device for nine prefectures and cities" that conform to the particulate matter emission standards emitted from diesel vehicles set forth in the ordinances of Saitama, Chiba, Tokyo, Kanagawa, and other prefectures in Japan, the product has the characteristics shown in "Comparative Advantages over Competitor Products" necessary for application to UB City.</td></tr>
<tr><td>Comparative advantage over competitors' products</td><td>1) No catalyst is used (Most of the competitors' products use a catalyst, which is poisoned by the sulfur contained in a large amount of diesel oil in UB City, resulting in an immediate decline in performance. In addition, when driving at low speeds in UB City, the temperature of the catalyst is insufficient and regeneration is insufficient, resulting in a high risk of vehicle fire due to rapid combustion of accumulated black smoke).

2) It is applicable to Korean vehicles and engines that are mainly used in UB City (most of the competitors' products are only applicable to vehicles and engines with low black smoke emissions).</td></tr>
<tr><td>Domestic and international sales results</td><td>
<table>
<tr><th>Domestic</th><th>Number of sets</th><th>Major customers, etc.</th></tr>
<tr><td>Sales due to diesel vehicle regulations in nine prefectures and cities</td><td>Approximately 3,300</td><td>Nine prefectures and cities, other municipalities</td></tr>
<tr><td>Other including rental</td><td>Approximately 1,500</td><td>Construction equipment rental companies, emergency generator manufacturers, and forklift manufacturers</td></tr>
</table>
</td></tr>
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Size	Filter: diameter 6.5 inch (approximately 165mm) length 6 inch (approximately 150mm) Triple-loader included: 840×460×290 mm
Installation location	Large buses for public transportation in UB City
Quantity of equipment proposed for this project	➢ Filter recovery oven RE: 15 sets ➢ Opacity meters: 3 sets ➢ Equipment to clean engine: 3 sets ➢ CO warning equipment: 6 sets ➢ Driving recorder: 24 sets
Price	1) Cassette-type DPF MoCobee CT3 Sales price per set: 750,000 yen 2) DPF regenerator MoCobee RE Sales price per set: 500 thousand yen 3) Total cost of equipment and materials for the project (including transportation, customs, etc.) 31,250 thousand yen

3. Basis for Calculation of Estimated Project Cost of Wat01 and Wat02

3.1 Construction Cost per Meter for Open-Cut and Rehabilitation Method

The construction cost per meter of sewer was calculated as shown in Table 3.

Table 3 Unit Construction Cost for Open-Cut and Rehabilitation Method

Unit: thousand yen / m

Pipe Diameter (mm)	Open-cut*1 (Mongolia Achievements)	Rehabilitation*2
150	24	25
200	26	37
250	27	50
300	29	62
400	32	88
500	35	113
600	38	139
700	41	165
800	45	191
900	49	217
1000	53	244
1100	56	271
1200	60	298
1300	63	325
1400	67	353
1500	71	381
2000		523

*1: The open-cut method is based on the Water Supply and Sewerage Master Plan, 2013.
*2: The rehabilitation method is based on the research material of National Institute for Land and Infrastructure Management (2015), Figure 4 (p.74).
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0882pdf/ks088206.pdf (Last access: 20 March 2021)

3.2 Project Cost Calculation for Wat01

By multiplying the unit construction cost for the open-cut method in Table 3 by the pipe length, the project cost for the trunk sewers of approximately 19 km (14 km for the Туул-1 коллектор line and 5 km for the Шинэ Яармагийн салбар line) was calculated.

Since there is no information on the pipe length for each pipe diameter, the calculations were made assuming the pipe length as shown below.

(1) Туул-1 коллектор line (Total length 14,000 m, diameter: 800 mm to 1500 mm)

Assuming a pipe length of 1,750 m for each pipe diameter between 800 and 1500 (as shown in Table 1), the estimated project cost is approximately 812 million yen.

(2) Шинэ Яармагийн салбар line (total length 5,000 m, 400 mm to 500 mm)

Assuming a pipe length of 2,500 m for each of the 400 mm and 500 mm dia. pipes, the estimated project cost is approximately 168 million yen.

Therefore, the total estimated project cost for Wat01 is about 980 million yen (about 1 billion yen).

3.3 Project Cost Calculation for Wat02

Since the pipe diameter varies from line to line, a representative pipe diameter was set to calculate the estimated project cost for each line.

The estimated project cost was calculated by multiplying the construction cost per meter of the representative pipe diameter (as shown in Table 1) by the pipe length.

Table 4 Aged Sewer Pipes to Reconstruct and Estimated Project Cost for Each Sewer Line

No.	Sewer Line Name	Pipe Length (m)	Pipe Diameter (mm)	Pipe Covering (m)	Proposed Reconstruction Method	Estimated Project Cost (thousand yen)
1	12a, 12б line	1,450	200-300 (300)	3.5-4	Replacement (Open-cut)	42,050
2	Collector No. 1	1,390	200-600 (400)	3.5	Replacement (Open-cut)	44,480
3	Hospital line	730	200	3-3.5	Replacement (Open-cut)	18,980
4	3rd obstetrician line	280	200	3.5-4.5	Replacement (Open-cut)	7,280
5	16th khoroolol line	540	150	3.5-4	Replacement (Open-cut)	12,960
6	124th Military unit line	700	150	3.5-5	Replacement (Open-cut)	16,800
7	Collector No. 24	4,000	300-600 (500)	3.5-4.5	Replacement (Open-cut)	140,000
8	Collector No. 9	4,140	300-400 (400)	4.5	Replacement (Open-cut)	132,480
9	Collector No. 2	1,000	200-400 (300)	3-4.5	Replacement (Open-cut)	29,000
10	Collector No. 3	5,185	250-800 (600)	2.5-3	Rehabilitation	720,715
11	Collector No. 7	1,300	150-400 (300)	3-3.5	Rehabilitation	80,600
12	Collector No. 8a	1,535	200-300 (300)	3-3.5	Rehabilitation	95,170
13	Central Collector	5,350	600-800 (700)	3-3.5	Rehabilitation	882,750
14	Collector No. 5	2,460	400-500 (500)	2.5-3	Rehabilitation	277,980
15	Central and north collector	15,000	1000-1400 (1200)	3-4.5	Rehabilitation	4,470,000
16	Nalaikh collector	4,940	500	2.5-3.5	Rehabilitation	558,220
	Total	50,000				7,529,465

Note: Value of pipe diameter in parentheses '(   )' represents the representative pipe diameter.

Therefore, the estimated project cost of Wat02 is approximately 7.5 billion yen (approximately 0.4 billion yen for the open-cut method and 7.1 billion yen for the rehabilitation method).