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2020

The Master Plan for Ambient Air Quality Improvement in Mongolia

KEITI

Establishment of Master Plans for Improving The Environment in Developing Countries in 2020

Mongolia

The Master Plan for Ambient Air Quality Improvement in Ulaanbaatar, Mongolia

Ministry of Environment

KEITI
Korea Environmental Industry & Technology Institute

FINAL REPORT

The Master Plan for Ambient Air Quality Improvement in Ulaanbaatar, Mongolia

2021. 7

Korea Environmental Industry & Technology Institute

Executive Summary

1. Overview of the Project

The project for supporting the establishment of the master plan for environmental improvement in Ulaanbaatar, Mongolia

1.1 Purpose and Necessity of the Project

(1) Background of the project

Status of severe air pollution of Mongolia

Mongolia has been facing environmental problems, such as air pollution, because of its high industrialization and rapid economic growth over the past decade. In particular, the Ulaanbaatar City is densely populated, and the concentration of ultrafine dust (PM2.5) is an average of 128 $\mu g/m^3$ per year (IQAir, 2020) as of 2020, which is a serious urban environmental problem, consequently listing the city as one with the third highest level of fine dust in the world.

Policy efforts of the Mongolian government for improving the air pollution problem

As the number of people dying of lung cancer and asthma attributable to air pollution increases, the Mongolian government has made efforts to remove low-pressure steam boilers, expand energy sources, and increase the number of ambient air quality monitoring centers. In 2016, as the Mongolian government introduced a night power discount policy for the households in the Ger region, electric heaters were encouraged to be used to heat households instead of coal.

As part of such efforts, in March 2017, the Mongolian government approved the National Program on Reduction of Air and Environmental Pollution (NPRAEP). This program is expected to reduce air pollutants by 80%, prohibit the use of untreated coal at all locations other than the thermal power plants in Ulaanbaatar, and reduce the air and environmental pollution by 50% or more by 2025.

Further, the Mongolian government has been making policy efforts to reduce air pollution, such as prohibiting the use of the raw coal in the households in six areas of Ulaanbaatar since May 15, 2019, by announcing Resolution No. 62 “Prohibition of the use of the raw coal” on February 28, 2018.

The Mongolian government includes environment as one of the major sectors of “VISION 2050, the long-term development policy of Mongolia” that is one of the national development strategies, and, suggests policies, as specific tasks, to reduce and prevent environmental pollution and introduce eco-friendly technologies.

Limitations and problems of the policy efforts of the Mongolian government

As the main reasons for halving these efforts to improve the ambient air quality in Mongolia, the lack of policy implementation by the Mongolian government, lack of consistency and coordination between policies, insufficient capabilities of public officials, and low level of participation have been highlighted (UN, 2019). To appropriately enforce the existing air pollution management laws and regulations, effective supervision of implementation is essential. To achieve this, it is necessary to increase the level of understanding and knowledge the officials in the air pollution management agency and supervision agency have about related technologies. Considering it, the proposed suggestion is an improvement plan to strengthen related capabilities through this project that supports the establishment of the master plan.

(2) Purpose of the project

The goal of this project is to establish a master plan for improving the ambient air quality in Ulaanbaatar, Mongolia, and the project is expected to improve the ambient air quality in Ulaanbaatar, Mongolia and to provide opportunities for Korean environmental companies to enter the Mongolian market based on the bilateral cooperation projects identified through this project.

(3) Performance indicators of the project

In the early phase of the project, the main performance goal was to identify 12 cooperation projects, including policy proposals, write 2 Project Concept Papers (PCP) on the priority cooperation projects, and 1 master plan for improving the ambient air quality in Ulaanbaatar.

As a result of implementing the project, totally 19 cooperation projects, which consist of 7 policy proposals and 12 cooperation projects, were identified and 1 PCP on the project of introducing the ambient air quality monitoring system, which integrated the cooperation project for monitoring the ambient air quality and the cooperation project for monitoring the pollutants discharged from the workplaces, was created. In addition, the environmental technology capacity building event, which was scheduled to be held in Ulaanbaatar to strengthen the ambient air quality management capabilities of the officials of the Mongolian government and the invitational trainings for the officials of the Mongolian government in a visit to Korea were combined into an online session to strengthen the capabilities. However, the session was held once because of the COVID-19 situation.

<Table> Performance indicators of the project

<table>
<tr><th>Item</th><th>Original plan</th><th>Final performance</th></tr>
<tr><td rowspan="2">Identified project</td><td>Identified cooperation project: 12 cases</td><td>Identified cooperation project: 19 cases
(7 cases of the policy proposals included)</td></tr>
<tr><td>PCP on the priority cooperation projects: 2 cases</td><td>PCP on the priority cooperation projects: 1 case
(Written as one case by integrating 5 projects)</td></tr>
<tr><td rowspan="2">Results</td><td>One concept design diagram of
the ambient air quality monitoring system</td><td>One concept design diagram of
the ambient air quality monitoring system</td></tr>
<tr><td>One master plan for
improving the ambient air quality in Ulaanbaatar</td><td>One master plan for
improving the ambient air quality in Ulaanbaatar</td></tr>
<tr><td rowspan="2">Events</td><td>Invitational training for
Mongolian government officials: 1 case</td><td rowspan="2">Online air quality management capacity building:
1 case</td></tr>
<tr><td>Excellent environmental technology
local outbound education: 1 case</td></tr>
</table>

1.2 Scope of the Project

(1) Target area of the project

The target area of the project in Mongolia is Ulaanbaatar, the capital of Mongolia, and the master plan was established for the sectors of stationary sources, mobile sources, and monitoring to improve the ambient air quality in Ulaanbaatar.

[Figure] Map of Mongolia

(2) Details of each project implementation goal

This project was carried out by being classified into a total of five sectors, including identification of the cooperation projects in the sectors of stationary sources, mobile sources and monitoring, establishment of the master plan, and implementation of capability strengthening of the Mongolian government.

[Figure] Implementation contents and performance of the project

Goal of the project	Promotion contents of the project	Promotion performance
① Identification of cooperation projects for stationary source fuel and the prevention equipment sector	• Diagnosis for facility of power plant • Survey on operation systems of HOBs and heaters • Identification of improvement method and identification of (key) cooperation projects • Preparation of PCPs on key projects	• Identification of cooperation project related to installation of prevention equipment of power plant ('20.6~'20.12) • Performing survey on local power plants and HOBs ('21.3) • Survey on the status of gas boilers in the UB City and identification of cooperation project related to the introduction of HOBs **('21.7)**
② Identification of cooperation projects for analysis of mobile source fuel and management system cooperation projects	• Survey on status of transport system management system • Identification of improvement method and identification of (key) cooperation projects • Preparation of PCPs on key projects	• Identification of cooperation project related to the introduction of DPFs for public buses in Mongolia • Proposal of policy in the area of mobile source
③ Identification of basic design of the monitoring system and additional cooperation projects	• Identification of air modeling-based measuring points • Basic design of ICT-based measuring monitoring system and preparation of PCPs • Identification of additional cooperation projects in the measuring monitoring sector	• One basic design of air pollution measurement data collection-management system • Evaluation of the current location of the ambient air pollution automatic monitoring station and proposal of six additional installation regions • Proposal to introduce a real-time management system for stack emissions from coal power plant
④ Establishment of the master plan	• Survey on policies, statistics, markets, and technology level • Establishment of policy proposals and master plan	• One copy of master plan report in Korean • One copy of master plan report in Mongolian and English, respectively
⑤ Strengthening capabilities of local governments	• Invitation training for officials in recipient country	• Conducting online capacity building program ('21.7.21-22)
	• Excellent environmental technology Outbound training	• Unable to proceed due to "COVID-19"

(3) Project Implementation Entities

This project was carried out by constituting the consortium between ECO&PARTNERS Inc. and the Korea Environment Corporation. Further, the works were carried out by selecting the outsourced service agencies with expertise in individual sector.

<Table> Status of the project implementation entities

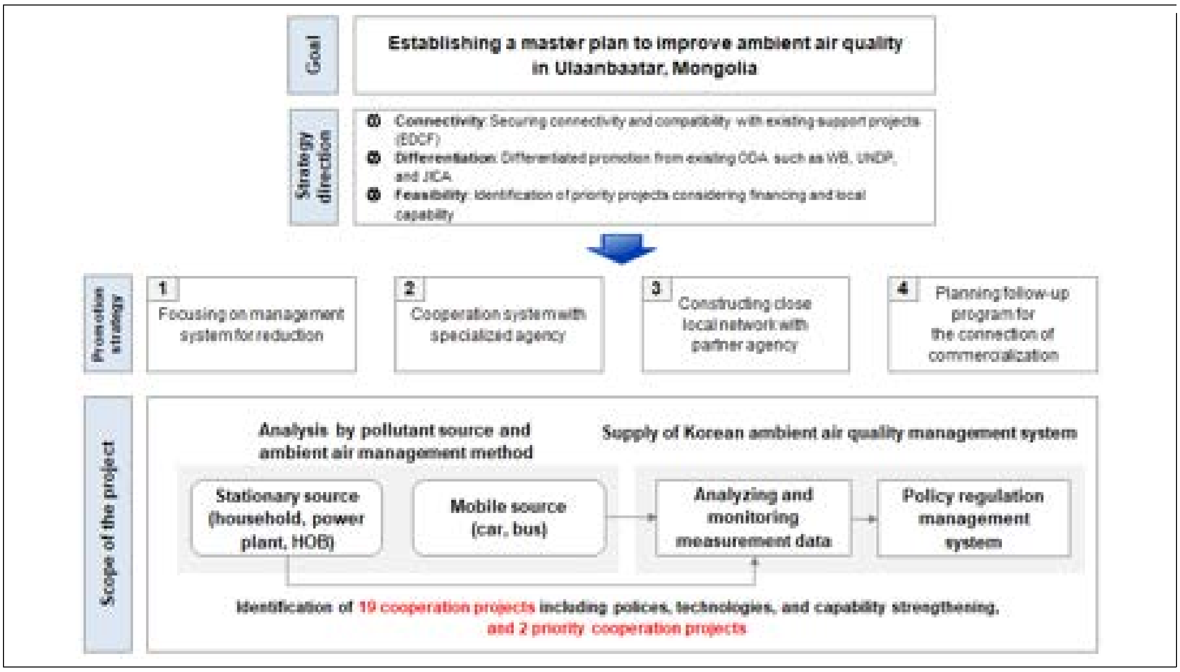
Item	Name of agency	Contents of work
Host agency	ECO&PARTNERS Inc.	• Overall project management such as progress management, quality management, and report, etc. • Identification of the cooperation projects through consultation with each agency, consultation for selecting key cooperation projects, writing and supplementing the PCP, promoting the entry of environmental companies into the domestic ambient air quality sector, etc. • Literature research and master plan establishment, strengthening the capabilities and planning for post-program activities
Consortium	Korea Environment Corporation	• Preparation for the methods of standardization of the monitoring project-related system and the data collection system, and identification of the priority cooperation projects • Identification of the cooperation projects for the mobile sources (transport) management system • Planning and implementation of the invitational training for government officials of the recipient country
Outsourced service agencies	Incheon National University	• Investigating the air pollution influence factors and characteristics analysis through the ambient air quality modeling across Ulaanbaatar and designing the expansion (plan) of the air pollution monitoring stations
	KC Green Holdings	• Investigation of the status of stationary sources, and identification of improvement methods and cooperation projects
	CE TECH Inc.	• Concept design diagram (plan) of the ambient air quality monitoring system in Ulaanbaatar
	Soil&Habitat	• On-site investigation of the existing air pollution monitoring stations in Ulaanbaatar (operation status and peripheral environment)
	Mongolian office of MIRECO	• Interview with the local ambient air quality management staff and collection of local data by visiting the relevant sites

[Figure] Organizational chart for the project execution

1.3 Implementation Direction and Strategy of the Project

The most important thing of this project is to accurately identify the demands of the Mongolian government, and to this end, this task was carried out in consideration of three strategic directions.

[Figure] Goals and scope of the project



1.4 Process of the Project Implementation

This project has been implemented through video conferences between Koreans and Mongolians, literature research, site visits through a local consulting firm, etc. since it was launched on May 19, 2020. In particular, the work meetings were carried out through online video conferences using a video conference system in response to the difficulty of visiting the site because of COVID-19. The original project period was about 12 months—from May 2020 to May 2021, but the project was carried out for about 14 months as the project end date was extended to July 2021 because it was difficult to search for the local data and to have meetings with the local agencies because of COVID-19.

(1) Status of main meetings

The issues and necessary improvements for individual sectors were identified through video conferences with the Ministry of Environment and Tourism of Mongolia, which is in charge of the project, and four relevant authories (UB Mayor’s Office, the Ministry of Road and Transport Development, NAMEM, and APRD), and the literature research was performed by requesting the information, such as data, laws and regulations necessary for understanding the status of Mongolia. In addition, the response actions for the matters (PCP, LOI, etc.) necessary for implementing the key cooperation projects in Mogolia were taken through continuous work meetings with the Ministry of Environment and Tourism in charge of this project.

[Figure] Main implementation status by month

This task was carried out through a close cooperation system through the official and working meetings with Mongolia. The work status was shared through the interim report meetings, final report meetings, etc., and further, the works were implemented through capacity building programs, workshops, and work meetings between domestic project agencies, etc.

(2) Online event for capacity building program

At the beginning of the project, the invitation visits to Korea and local seminar programs were planned to strengthen the ambient air quality management capabilities for environmental policy managers in Mongolia, but because of COVID-19, they were replaced with online education using Zoom.

<Table>Schedule for the capacity building program

Date (based on Korean time)		Name of curriculum	Educational agency
Jul.21.2021 (Wednesday) **Policy-level section**	10:00	Orientation	Korea Environment Corporation
	11:00	① Ambient air quality management system in Korea	Korea Environment Corporation
	13:00	Lunch break	
	14:00	② Eco-friendly automobile management policy	Korea Environment Corporation
	16:00	③ Total air pollutant amount management system	Korea Environment Corporation
Jul.22.2021 (Thursday) **Working-level section**	11:00	④ Understanding the prevention equipment of the thermal power plant	KC Green Holdings
	13:00	Lunch break	
	14:00	⑤ Fuel quality monitoring method	Korea Petroleum Quality & Distribution Authority
	16:00	⑥ Practice with the ambient air quality monitoring system	Korea Environment Corporation

To enhance the educational effects, the training materials were translated into Mongolian, and the education was conducted based on the simultaneous interpretation of Korean-Mongolian. The online session for capacity building program was conducted for 2 days, in which on the first day, major environmental management policies in Korea were introduced with the educational contents centered on policies. On the second day, as practical contents were planned, it was possible to introduce expertise in operating the prevention equipment of the thermal power plant, know-how in fuel quality management, and the main ambient air quality monitoring systems in Korea. After the sessions were completed, a session for questions and answers was held to allow the officials from Mongolia were able to freely discuss questions, local issues, etc. related to ambient air quality management.

[Figure] Status of capacity building program

This capacity building program was attended by a total of 15 people from 12 agencies, including the Ministry of Energy, the Ministry of Road and Transport Development, the Ministry of Mining and Heavy Industry, the National Agency of Meteorology and the Environmental Monitoring of Mongolia (NAMEM), the Air Pollution Reduction Department in Ulaanbaatar (APRD), the National Environmental Pollution Reduction Committee, the Energy Regulation Committee, TES-4 (combined heat and power plant), and the National University of Mongolia in addition to the Ministry of Environment and Tourism that is Mongolia's agency in charge of the project for supporting the establishment of the master plan in Mongolia.

(3) Performance sharing method

The webpage for introducing the contents, such as the main contents of the establishment of the master plan and the identified cooperation projects, was created to continuously monitor the performance of this project and to share the performance thereof. This webpage included the project implementation system and policy proposal status, the details of the key cooperation projects, etc. as well as the introduction of the master plan in the developing countries. Further, this project was intended to spread the performance of the master plan project by translating it into three languages: Korean, Mongolian, and English.

The address of the webpage is www.cleanairmongolia.com, and the webpage will work as an online medium for sharing the usable information with visitors through continuous maintenance such as updating of the activities related to improvements in ambient air quality in Mongolia even after the project is completed.

[Figure] Status of webpage construction

2. Investigation on the Status of the Project Target Countries

2.1 General Status

Mongolia is an inland country located in the northern part of the Central Asian Plateau. Mongolia's area is about 1.564 million ㎢ that is about 7.1 times that of the Korean Peninsula. The total length of the border is 8,253 km, bordering Russia and China. (The Export-Import Bank of Korea, 2019, the National Statistical Office of Mongolia)

<Table> General status of Mongolia

Item	Contents
Name of country	Mongolia
Area	1,564,116㎢ (source: the National Statistical Office of Mongolia, as of June 2020)
Capital	Ulaanbaatar
Population	3,349,077 people (source: the National Statistical Office of Mongolia, as of November 2020)
Ethnic group (race)	Khalkha (90%), Kazak (5.9%), Buriad (2%), etc.
Language	Mongolian
Religion	Lama Buddhism
Climate	Cold dry climate, long, cold winters, and short summers
Head of country (As of August 2021)	• President: Ukhnaa Khurelsukh • Prime Minister: Luvsannamsrai Oyun-Erdene • Speaker of the National Assembly: Gombojav Zandanshatar
Major political parties	• The People’s Party (62 seats), the Democratic Party (11 seats), the People’s Revolutionary Party (1 seat), the National Labor Party (1 seat), and the Independent Party (1 seat)
Political system	Dual government system (personality of a semi-presidential system)
Congress	Unicameral system (76 seats)

Source: KOTRA, KOTRA country information (Mongolia) (2020); the Export-Import Bank of Korea, 2020 World National Handbook (2019); KOTRA, Mongolia· local information (https://news.kotra.or.kr), Mongolian news site (http://ikon.mn)

2.2 Market Survey

(1) General economic status

<Table> General economic status of Mongolia.

GDP	USD 13.6 billion (2019)
GDP per capita	USD 4,133 (2019)
Monetary unit	Tugrik (Tug)
Fiscal year	2019.1.1 – 2019.12.31
Industrial structure	Service industry 50%, manufacturing 38%, and agriculture 12% (2017)
Main exports	Copper, clothing, livestock, livestock products, cashmere, wool, leather, fluorspar, non-ferrous metal, and coal
Main imports	Machinery, fuel, automobiles, groceries, industrial consumer goods, chemicals, construction materials, cigarettes, household equipment, soap, and detergent
Main natural resources	Petroleum, coal, copper, molybdenum, tungsten, phosphate, tin, nickel, zinc, and fluorspar
Sovereign credit rating	OECD 6th grade, Moody's B3, and Fitch B

Source: the Export-Import Bank of Kore, 2020 World National Handbook (2019)

(2) Status of energy

The energy generation volume of Mongolia has been steadily increasing every year, and thermal power generation using coal was found to be the main source of energy. As of 2018, thermal power generation accounted for 88% of the total power generation, and the petroleum power generation accounted for 5%. As for renewable energy sources, it was surveyed that photovoltaic power generation accounted for 5%, and wind power generation and hydroelectric power generation accounted for 1% and 1%, respectively.

<Table> Power generation for each energy source of Mongolia (2011 to 2018) (unit: GWh)

	2011	2012	2013	2014	2015	2016	2017	2018
Coal	4,238	4,502	4,629	4,934	5,062	5,227	5,331	5,782
Petroleum	236	253	269	242	230	193	279	295
Wind power	53	52	60	66	59	85	85	85
Hydroelectric power	8	8	8	8	8	8	25	33
Photovoltaic	1	1	54	126	154	154	307	340
Sum	4,536	4,816	5,020	5,376	5,513	5,667	6,027	6,535

Electrical power generation in Mongolia steadily increased to reach 6,900 GWh in 2019, and power generation per capita is also increasing. Electricity imports have accounted for 20% of total usage since 2013. In terms of electricity consumption by sector, it was surveyed that the electricity consumption in the industrial and construction sectors was the highest with a steady increase, and the household and apartment sector's electricity consumption was also high.

2.3 Status of National Development Plan

2.3.1 Status of National Development Plan Related to the Ambient Air Quality

It was surveyed that there have been national development plans, such as VISION 2050, the Five-Year General Guidelines for the Development of Mongolia 2021-2025, the Action Program of the Government of Mongolia 2020-2024, the Green Development Policy, and the Energy Policy of Mongolia 2015-2030. The Long-Term Development Policy of Mongolia 2015-2040 established in 2015 was replaced with VISION 2050 that was the first long-term development policy of Mongolia and therefore was excluded from this survey.

(1) VISION 2050, the long-term development policy of Mongolia

In May 2020, the "VISION 2050", which is the long-term development policy of Mongolia, was finally approved by the congress. This policy is Mongolia's first long-term development plan to be implemented in the unit of 30 years and emphasizes sustainable growth, macroeconomic stability, human development, and fostering of middle class and, to achieve them, consists of 9 sectors, and 50 development goals and 187 projects under each sector. This policy will be carried out in three phases: 2021–2030, 2031–2040, and 2041–2050.

(2) Five-Year General Guidelines for the Development of Mongolia 2021-2025

The five-year general guidelines for the development of Mongolia took effect on August 28, 2020. For the development of the nation, the guidelines established individual goals, as well as detailed goals under each of them, in nine categories—national value, population development, quality of life and middle class, economy, governance, green development, social security, infrastructure, Ulaanbaatar and satellite cities. Concerning the contents related to air pollution, “9.2.1 Reduction of the air pollution in Ulaanbaatar by 80%,” and “2.5.3 Reduction of air, water, and soil pollution and also reduction of noise for expanding clean green areas” are specified.

(3) Action Program of the Government of Mongolia 2020-2024

The “Action Program of the Government of Mongolia 2020–2024” specifies 6 categories and 23 priority and sub-priority goals for successfully overcoming social and economic difficulties caused by the COVID-19 pandemic, and achieving human, social, and economic development, environmental balance, governance improvement, zone and regional development, and rural development support. (Mongolian national assembly government site (vip76), 2020)

(4) Green Development Policy

To escape the threats to survival, such as global climate change, rapid population growth, and resource depletion, the policy is intended not only to switch to eco-friendly “green,” encompassing the meanings about green energy, green city, green purchase, green money, and green tax in addition to green economy and green growth, and also intended to change the trend and pattern of economic and social developments. (Korea Environment Industry Association, 2019) Six strategic goals have been set for the purpose of a prosperous nation that maintains environmental stability and provides opportunities for future generations to enjoy the benefits of economic growth based on the concept of green development. (Korea Environment Industry Association, 2019)

(5) Energy Policy of Mongolia 2015-2030

This policy suggested detailed goals that should be achieved in the use of energy in Mongolia and classified them into two phases: the first one for 2015–2023 and the second for 2023–2030. Specified in the policy, the goal of the first phase is to construct combined heat and power plants, thermal power plant and hydroelectric power plants with an aim to expand the capacity of energy installations and lay down a foundation for renewable energy power generation, and the goal of the second phase is to build infrastructures and expand the capacities of the photovoltaic, wind, and hydroelectric power plants with an aim to make the proportion of the renewable energy power generation reach 30% of the energy mix.

2.3.2 Management Status in the Environmental Sector

<Table> Status of relevant laws and policies in the environmental sector

Item	Laws	Main contents
Overall environment	Law on Environmental Protection (1995)	• The resource development and economic development of Mongolia aim to guarantee human rights to live eco-friendly, healthily, and safely. • This law is prescribed to protect natural resources (land and soil, land resources, water, plants, animals, and air) and to prevent environmental imbalance.
Overall environment	Law of Mongolia on Environmental Impact Assessments (2012)	• This law is prescribed to protect the environment, prevent environmental imbalance caused by human activities, and protect the environment while using natural resources and to assess policies, development projects, and programs that affect the environment. • The environmental impact assessments include the following evaluations: Environmental strategy assessment, status assessment, impact assessment, and cumulative impact assessment
Air	Law on Air (2012)	• This law is prescribed to protect the environment by preventing air pollution, reducing, and controlling the discharge of air pollutants, and monitoring ambient air quality.
	Law on Air Pollution Tax (2010)	• This law imposes a tax in the event of air pollution (coal combustion, automobile, organic matter, and other resources).
Water	Law of Mongolia on Water (2012)	• This law is prescribed to protect, reasonably use, and reproduce water resources.
	Law on Water Pollution Tax (2012)	• This law imposes a tax on individuals and businesses responsible for polluting Mongolia's water resources.
Forest	Law of Mongolia on Forest (2012)	• This law is prescribed to protect, restore, reproduce, own, and use the forest, and to prevent fires in the forest and grassland.
Waste	Law of Mongolia on Waste (2017)	• This law is prescribed to reduce and prevent the negative impact of waste on human health and the environment, to put waste into economic circulation, and to save natural resources. • This law is prescribed to conserve the environment by suppressing the generation of the waste as much as possible and treating the generated waste in an eco-friendly manner.

Source: Legal site of Mongolia (https://www.legalinfo.mn/)

2.3.3 Status of Issues in the Environment Sector

(1) Status of the ambient air quality management

Air pollution is serious due to the population concentration in Ulaanbaatar and the use of coal stoves in the Ger region. In January 2019, the concentration of ultrafine dust in the UB City was about 24 times that of the recommended standard of the World Health Organization (WHO), and as one of the countermeasures therefor, in May of the same year, a policy was passed to prohibit the use of raw coal to reduce air pollution in the Ger region and to attach filters for reducing emissions discharged from vehicles. (Korea Environment Industry Association, 2019)

Compared to the average annual concentration of air pollutants in Ulaanbaatar in 2017, the figures in 2018 were as low as PM2.5 (12 $\mu g/m^3$) 14%, and nitrogen dioxide (5 $\mu g/m^3$) 13% but the concentrations of PM10 and sulfur dioxide were shown to maintain the same level as in the previous year. In 2018, the major sources of winter air pollution in Ulaanbaatar were shown to be, when put in order, the Ger region and HOBs (80%), vehicles (10%), combined heat & power plants (6%), and waste and soil contamination (4%). (Ministry of Environment and Tourism of Mongolia, 2019)

(2) Status of water quality management

Water resource pollution is intensifying because of problems such as rapid urbanization, wastewater from the mining industry, chemicals from livestock processing, and manure from grazing livestock. The National Index Water Quality Monitoring Network of Mongolia measures and evaluates the chemical compositions and water quality standards, and water pollution indices at 127 points and 191 points in 94 rivers and 18 lakes. The water pollution indices follow the MNS4586-98 water quality standard, and the average annual concentration is measured based on the oxygen dissolved in water (dissolved oxygen), easily oxidized organic materials, minerals, phosphorus, chromium, and copper. (Ministry of Environment and Tourism of Mongolia, 2019)

(3) Status of waste management

There is a surge in waste generation due to the population concentration and industrialization, and the absence of a hazardous and medical waste treatment system. About 50% of all waste appears to be recyclable, but the actual recycling rate was only 0.31%. (Korea Environment Industry Association, 2019) Based on the amount of waste treated in the central waste disposal plant, it is steadily increasing from 2,102,721.8 tons in 2016, to 2,480,745.54 tons in 2017, and 3,353,548.73 tons in 2018. (Ministry of Environment and Tourism of Mongolia, 2019)

As of 2018, there were 390 approved waste treatment sites in Mongolia. Of total waste treatment volume in 2018, 8.2% were for industrial waste and 91.8% were for household waste. The recyclable waste accounts for 50% of the total waste, but the currently recycled waste is less than 10%, and improvement in the waste separation system is a top priority. As of 2018, about 40% of all waste in Ulaanbaatar came from apartment complexes, and about 30% came from the Ger regions. (Ministry of Environment and Tourism of Mongolia, 2019)

2.3.4 Status of the Project Related to the Ambient Air Quality Management

(1) Status of other aid agencies entering the ambient air quality management of Mongolia

World Bank (WB), Asia Development Bank (ADB), United Nations Development Programme (UNDP), and countries such as Japan and USA carried out or are carrying out projects in various areas for improving the ambient air quality of Mongolia.

(2) Status of other domestic ministries entering the ambient air quality management of Mongolia

The main projects that are in progress and carried out by other domestic ministries for managing the ambient air quality of Mongolia were reviewed.

All aid projects carried out by other domestic ministries for managing the ambient air quality of Mongolia were investigated as projects, such as supplying and installing devices locally or creating forests, etc. By target, two projects for supporting heaters in the Ger region in the household sector and two projects for supporting renewable energy in the power generation sector were investigated, and the weather monitoring facilities installation and afforestation were investigated one each.

3. Status of Environment System·Policy and Suggestion of Improvement Proposal

3.1. Status of Mongolia

3.1.1 Status of the Ambient Air quality management Governance of Mongolia

(1) Ministry of Environment and Tourism of Mongolia (MET)

The Ministry of Environment and Tourism is a national central administrative agency in charge of nature and environment. It provides opportunities for green development and tourism development, ensures environmental balance, and guarantees the right to live in a healthy and safe environment through cooperation and efforts of individuals, industries, and organizations.

(2) Ministry of Energy (MOE)

The Ministry of Energy is a national administrative agency with the main goal of executing energy policies for ensuring the socio-economic development of Mongolia and providing productions and services for the healthy and safe environment.

(3) National Agency for Meteorology and Environmental Monitoring of Mongolia (NAMEM)

Starting with the climate test of the Institute of the Scripture in 1924, the NAMEM continuously, accurately monitors water, weather, and environment and provides preventive information in a timely manner to inform natural disasters and potential risks.

(4) Ministry of Road and Transport Development of Mongolia

The Ministry of Road and Transport Development of Mongolia is a national central administrative agency in charge of roads, transportation networks, and transportation services in Mongolia, and is responsible for expanding road transport networks by ensuring economic growth and expanding exports. Further, it aims to expand the road fund investment and convert it into an independent operation by constructing the toll collection and the monitoring mechanism based on the transportation smart system. It is responsible for developing environmental, continuous, efficient, and safe transportation services, maintaining air transportation liberalization, creating a competitive environment, expanding the number of flights and routes, and improving and expanding local airport use.

(5) National Center for Road Transportation

The National Center for Road Transportation is operated nationwide in accordance with the Road Traffic Act, and government resolutions and regulations as follows, and serve to provide services such as technical inspections of vehicles, registration of vehicles that are being operated in Mongolia, license plate issuance, transfer registration, registration cancellation, vehicle certificates and license plate reissuance, and construction and information provision of the vehicle database and registration networks.

(6) Ministry of Mining and Heavy Industry

The Ministry of Mining and Heavy Industry provides laws, policies, mid- to long-term strategies, programs and projects development, policy analysis implementation, and policy guidelines related to geological, mining, fuel, and heavy industry. It is also responsible for administrative and human resource management, legal counsel, expansion of overseas cooperation projects, and supports for developing financial, economic, and investment policies. It executes and coordinates laws, policies, programs, and projects, and serves to carry out the internal monitoring of legal and policy execution, financing budget, financial audits and internal audits of programs, projects, and investments, and crisis management.

(7) Mineral Resources and Petroleum Authority

Mineral Resources and Petroleum Authority supports development policies in geology, mining, and petroleum sectors, and provides rapid and fair services to investors and consumers.

3.1.2 Ambient Air quality management Laws of Mongolia

The laws in the ambient air quality management sector include the Law on Air, which is the basic law and the Law on Air Pollution Tax, which was enacted to levy a tax on air pollution activities to control air pollution.

The Law on Air is composed of five Chapters, and subdivided into areas such as air quality monitoring, air protection measures, and others. The Law on Air Pollution Tax is a law aimed at regulating the relationship related to the imposition and payment of air pollution charges to those who caused the air pollution. The payers of air pollution charges presented in this law include coal miners, importers of organic solvents, vehicle drivers, possessors of large air pollutants licenses, and citizens, businesses, and organizations that emit air pollutants.

<Table> Law of the ambient air quality management of Mongolia

Enacted year	Name of law	Main contents
2012	Law on Air	• To provide the environment for the current and future generations, it is prescribed to restrict emissions on air pollution, harmful effects, and small changes in air components such as ozone and hydrogen (revised in January 2018). • It is prescribed to give the responsibility for organizing and implementing measures to mitigate air pollution in the region to leaders of Aimags and capital city. • It has been enforced again since 2019 by reestablishing the Anti-Air Pollution Fund. * However, as of 2021, it was surveyed as being not enforced.
2010	Law on Air Pollution Tax	• This law imposes a tax in the event of air pollution (coal combustion, automobile, organic matter, and other resources). • As it was revised in January 2018, taxes have been paid to the Anti-Air Pollution Fund since January 2019. * However, as of 2021, it was surveyed as being not enforced.

3.1.3 Ambient Air quality management Policies of Mongolia

Mongolia’s ambient air quality management policies include the NPRAEP, which defines the activities of executing policies such as reducing pollution sources to reduce the air and environmental pollution problems in Mongolia, the Zero Night-Time Electricity Payment Policy, and the Banning (Raw) Coal Policy..

<Table> Policies of the ambient air quality management of Mongolia

Year	Name of the policy	Main contents
2017	The National Program on Reduction of Air and Environmental Pollution (NPRAEP)	• Period: First phase (2017-2019) / second phase (2020-2025) • Goal: To ensure a healthy and safe living environment for citizens and create a clean environment for future generations in response to the increasing environmental pollution problem in Mongolia. • Specific goal: Compared to in 2016, an 80% reduction in air and environmental pollution in 2025 (expenditure is expected to be around $370M.) • Project contents: It includes the announcement of the Zero Night-Time Electricity Payment Policy, distribution of clean coal technologies such as semi-coke briquettes and low-carbon emission fuels, and expansion of the district heating networks for stopping steam boilers in small cities.
2017	Zero Night-Time Electricity Payment Policy	• It was established by Articles 6.1.5, 6.1.6, 6.1.7, and 13.1.3 of the Law on Air. • During the winter, the Mongolian government announced its zero night-time electricity payment policy only for some Ger regions, which is to encourage the replacement of fossil fuels in the Ger region with electricity.
2019	Banning (Raw) Coal	• It was established by Article 16.1.5 of the Law on Air. • There is a movement to reduce coal dependence and change energy use to clean and sustainable energy sources. • In May 2019, the Mongolian government decided to prohibit the use of the raw coal only for households (excluding the combined heat and power plant, CHPs).

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

3.1.4 Standards of the Ambient Air quality management of Mongolia

As a result of surveying the ambient air quality management standard, the standard can be largely divided into ① the allowable standard used to manage indoor and outdoor ambient air quality overall, ② the permissible emission standard applied to the stationary source management such as the combined heat and power plants, and the heat generation plants and boilers, ③ the air pollutant allowable standard emitted from mobile sources such as buses and automobiles, and ④ the fuel standard such as coal, gasoline, or diesel.

<Table> Standard in the ambient air quality management

Items	Target	Standard
Air general	• Outdoor ambient air quality management • Indoor air quality management	• MNS 4585:2016 Air quality. General technical requirements • MNS 5885:2008 Acceptable concentration of air pollutant elements. General technical requirements • MNS 6063:2010 Air Quality-permissible concentration of pollutant elements for atmospheric air in public area • MNS 6342:2012 Air quality. Maximum permissible level of some air pollutants in flue gas from the hazardous waste incinerator • MNS ISO 4227:2002 Ambient air quality control plan
Stationary source	• Thermal combined heat and power plant • Thermal heat generation plant • Boiler for collective building • Heater for households • Coal fuel	• MNS5919:2008 Maximum acceptable level and measuring method of air pollutants in the exhaust gases from the steam and hot water boilers of TPP and Thermal Stations • MNS6298:2011 Maximum acceptable level and measuring method of air pollutants in flue gas of New thermal power plant and thermal plant • MNS5043:2016 Hot-water boilers with heating capacity up to 4.2MW. General technical requirements • MNS5216:2016 Stove for household. General technical requirements
Mobile source	• Bus • Diesel/gasoline automobiles	• MNS5013:2009 Petrol engine vehicle-Maximum acceptable level and measuring method of exhaust emission • MNS5014:2009 Diesel engine vehicles-Maximum acceptable level and measuring methods of opacity • MNS6757:2019 Installation and use of DPF for diesel engines of road vehicles. General technical requirements
Fuel	• Coal • Gasoline for vehicle • Diesel for vehicle • LPG	• MNS5679:2019 Upgraded solid fuel. Technical requirement • MNS0217:2017 Automotive fuels. Unleaded petrol. Technical requirements • MNS6861:2020 Diesel fuel. Specifications • MNS 5083:2001 Liquefied petroleum gases-Fuel for domestic use-Specifications

Source: Standard and measurement department webpage (https://estandard.gov.mn/) (reviewed and written by the research team)

3.2 Status of Ambient Air quality management in Korea

3.2.1 Air quality management Laws and Policies in Korea

The regulations of the ambient air quality in Korea are diversified through the Special Act on the Improvement of Air Quality in Seoul Metropolitan Area for the management of Seoul and the metropolitan area, and the recently enacted Special Act on the Reduction and Management of Fine Dust and the Special Act on the Improvement of Air Control in Air Control Zones based on the Clean Air Conservation Act for meeting the high level of demand in the ambient air quality of the public and solving the fine dust problem that is a recent issue.

<Table> Ambient air-related laws and plans·policies in Korea

Laws	Plans/Policies
Clean Air Conservation Act (1991-)	• First Comprehensive Plan on Air Quality Improvement (2006 - 2015) • Second Comprehensive Plan on Air Quality Improvement (2016-2025)
Special Act on the Improvement of Air Quality in Seoul Metropolitan Area (2003)	• First Basic Plan on Air Quality Management in Seoul Metropolitan Area (2005 - 2014) • Second Basic Plan on Air Quality Management in Seoul Metropolitan Area (2015 - 2025)
Special Act on the Reduction and Management of Fine Dust (2019)	• Comprehensive Plan on Fine Dust Management (2020 - 2024) • Special Measure on Fine Dust Management (2016) • Comprehensive Measure on Fine Dust Management (2017)
The Special Act on the Improvement of Air Control in Air Control Zones (2020)	• Master Plan on Air Quality Management for Each Air Control Zone (2020 - 2024)

Source: Ministry of Environment, 2020 Environmental White Paper (2020), Ministry of Environment webpage (http://me.go.kr/), etc. (reviewed and written by the research team)

(1) Clean Air Conservation Act (1991)

The Clean Air Conservation Act was enacted in 1990 and went into effect in 1991. This law was enacted to prevent public health or environmental hazards caused by air pollution, and properly manage or conserve the ambient air quality such that all people can live in a healthy and comfortable environment.

(2) Special Act on the Improvement of Air Quality in Seoul Metropolitan Area (2005)

The Special Act on Improvement of Air Quality in Seoul Metropolitan Area, enacted in 2005, aims to protect the health of local residents and create a comfortable living environment by promoting comprehensive policies and systematically managing the air pollutant source in order to improve the severe air pollution environment in the metropolitan area, and as the main contents thereof, there are the management of total pollutants at workplaces, the suppression of emissions of vehicles such as low-pollution vehicles and specific diesel vehicles, and the suppression of emissions of volatile organic compounds.

(3) Special Act on the Reduction and Management of Fine Dust (2019)

The Special Act on the Reduction and Management of Fine Dust, which went into effect on February 15, 2019, aims to prevent harm to public health and properly manage and conserve the ambient air quality to create a comfortable living environment by reducing the emissions of fine dust and fine dust-generating substances and continuously managing their generation.

(4) The Special Act on the Improvement of Air Control in Air Control Zones (Air quality management Area Act) (2020)

The Special Act on the Improvement of Air Control in Air Control Zoneswas enacted to protect the health of local residents and create a comfortable living environment by promoting comprehensive policies and systematically broadly managing the air pollutant source in order to improve the ambient air quality of the region with severe air pollution.

3.2.2 Status of Governance Related to Ambient Air quality management Area

The Ministry of Environment is in charge of ambient air quality management areas in Korea. The Ministry of Environment in Korea was established on December 23, 1994 and is the central administrative agency of Korea in charge of work on conservation of the natural and living environment, prevention of environmental pollution, and conservation, use, and development of water resources.

(1) Agencies of the Ministry of Environment

Under the Ministry of Environment, there are agencies such as the Korea Meteorological Administration, the National Institute of Environmental Research, the National Institute of Environmental Human Resources Development, the Greenhouse Gas Inventory and Research Center, the National Environmental Dispute Resolution Commission, the Metropolitan Air Environment Agency, and the National Institute of Biological Resources. The overview and main tasks of the agencies are as follows.

<Table> Overviews and main works of agencies of the Ministry of Environment

Name of agency	Overview	Main work
Meteorological Administration	It is a central administrative agency that oversees and supports national weather matters and is a weather expert agency that not only produces and studies weather and climate information through observation and forecasts, but also protects the lives and property of people from weather disasters and develops the weather and climate industry.	- Three-dimensional observation of the state of the air and the ocean in the sky, earth, sea, and space - Production of forecasts by adding the forecaster's professional knowledge and experience to various observational data collected at home and abroad, current weather conditions, and the results of the numerical forecast model - Real-time collection, processing, and distribution of the weather data produced at home and abroad - Production of numerical forecast data by analyzing vast observational data quickly and accurately using the supercomputer - Provision of weather information through various media such as broadcasting, newspapers, and the Internet - Creation of a new value of weather and climate information by opening and sharing weather and climate big data to government agencies, public agencies, research institutes, universities, etc. - Provision of various weather and climate services that have increased usability in public health, life, and industry
National Institute of Environmental Research	It is a specialized research institute in the environmental sector separated from the National Institute of Health in July 1978 to be in charge of the works on the investigation research test and evaluation for environmental conservation and environmental pollution prevention.	- Research on risk reduction methods for protecting public health - Support the green growth by advancing the climate and air research - Research on securing the safety of drinking water and the health of aquatic ecosystems - Research on the creation of foundation for ecosystem management - Strengthen support for the technology of managing and reducing the transportation environment pollutant source - Research on the construction of scientific foundations for the expansion of the resource circulation use of waste and the safe disposal of the waste - Research on water environment of the Four Rivers for systematically managing the basin environment - Environmental quality monitoring and quality management
National Institute of Environmental Human Resources Development	It is a specialized educational agency in the environmental sector separated from the National Institute of Environmental Research in December 2006 to be in charge of the matters on the education and training of public officials and civilians engaged in work in the environmental sector.	- Expansion of the education and training infrastructure - Planning and operation of educational programs - Enhancement of educational results, performance evaluation, and self-capacity
Greenhouse Gas Inventory and Research Center	It is an agency that is in charge of matters on the establishment and coordination of the mid- to long-term greenhouse gas comprehensive information management plan, the establishment and coordination of the comprehensive management plan for greenhouse gas statistics, and the establishment and support of the greenhouse gas reduction goals by country and	- Support for setting greenhouse gas reduction goals by country and sector - Operation of the national greenhouse gas comprehensive information management system in accordance with international standards - Support for business cooperation related to greenhouse gas and energy target management and provision of information on related central administrative agencies - Investigation and research for supporting the reduction in domestic and international greenhouse gases - Investigation and research for establishing the master plan for emission rights trading system and the plan for allocation of national emission rights

	sector pursuant to the enforcement of the Framework Act on Low Carbon, Green Growth in July 2010.	- Matters on the calculation and reporting of greenhouse gas emissions, such as verification and management of the national greenhouse gas emission coefficient, improvement in the emission calculation method, etc. - Review of statements related to the emission rights trading system and implementation plans related to greenhouse gas and energy target management in the waste sector - Management of the statements related to the emission rights trading system and the construction and operation of the emission rights registration system - Management of the management company's implementation plan and specifications pursuant to Article 42, Paragraph 9 of the Framework Act on Low Carbon, Green Growth
National Environmental Dispute Resolution Commission	It is an agency established for dispute mediation due to environmental pollution damage pursuant to Article 4 of the Environmental Dispute Mediation Act.	- In charge of matters on environmental disputes - Operation of the environmental dispute mediation procedure
Metropolitan Air Environment Agency	It establishes a master plan for the ambient air quality in the metropolitan area to improve the ambient air quality in Seoul, Incheon, and Gyeonggi-do, and implements policies such as total air pollutant management, emission reduction of in-use vehicles, and the season management system.	- Establishment and execution of detailed implementation plans for the ambient air quality management in the metropolitan area - Basic investigation related to the air such as population automobile industry and ambient air emissions in the metropolitan area - Operation of the total emission permission management system for each emission source by region - Supply of low-pollution vehicles and management of specific diesel vehicles
National Institute of Biological Resources	It was established in March 2007 as a specialized research institute that is in charge of investigation and research matters for the efficient conservation and use of national biological resources and public relations and exhibitions of biological resources.	- Securing, keeping, and managing national biological resources - Investigation of and research on biological resources - Construction of and support for the foundation materials of the biological industry (BT) - Construction of the national biological resource information system and support for policies - Exhibition and education of biological resources and training of professionals
Regional Environmental Management Offices	It is an organization dedicated to improving the ambient air quality in the metropolitan area and includes the Metropolitan Air Environment Agency, and special regional administrative agencies for managing the drainage system of the Four Major Rivers basin (such as Four Major Rivers Environment Department and the Regional Environment Departments in Wonju, Daegu, and Jeonju).	

(2) Agencies under the Ministry of Environment

Agencies under the Ministry of Environment include the Korea Environment Corporation, the Korea Environmental Industry & Technology Institute, the Korea National Park Service, and the SUDOKWON Landfill Site Management Corp. The overviews and main work of the agencies are as follows.

<Table> Overviews and main works of agencies under the Ministry of Environment

Name of agency	Overview	Main work
Korea Environment Corporation	It is an agency established for contributing to the eco-friendly national development, such as establishing the environmental conservation and circular resource management system by efficiently promoting projects for preventing environmental pollution, improving the environment, and promoting resource circulation.	- Response to climate change and reduction of greenhouse gases - Improvement in the water environment - Construction of the circular resource management system - Operation of the environmental monitoring network and health service - Policy support and environmental industry support
Korea Environmental Industry & Technology Institute	It is an institute established in 2009 pursuant to the Act on the Environmental Technology Development and Support and is a specialized institute for supporting the development of environmental technology, training and export of the environmental industry, and promoting the distribution of eco-friendly products.	- Planning, evaluation, and management of environmental technology development projects - Support for the training and export of the environmental industry - Training of environmental industry and technology professionals and creation of jobs - Collection and distribution of information on environmental industries and technologies - Environmental new technology certification and technology verification - Operation of the environmental sign system and distribution of eco-friendly products
International Environmental Cooperation Center	It is an agency that works to strengthen Korea's international environmental cooperation capabilities and enhance environmental leadership capabilities in the international society.	- Research, investigation, and strategy establishment of international environmental trends (including agreements and regulations) - Discovery of topics related to bilateral-multilateral environmental cooperation, policy exchange, and project linkage - Construction and operation of the international environmental cooperation information system - Operation of the International Environmental Cooperation Council - Planning and operation of environmental diagnosis consulting projects in developing countries, and operation and management of master's degree courses for public officials in the Environmental Cooperation Bureau - Planning and operation of the public relations center of the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) - Cooperation of UNEP sustainable consumption production - OECD environmental information working group response

Korea National Park Service	It is an agency established for businesses such as conservation of the national parks, investigation of and research on park resources, installation and maintenance of park facilities, and guidance and promotion of park use pursuant to the provisions of the Natural Park Act for the conservation of park resources, such as the natural ecology, historical culture, and landscape of the national park, and the sustainable use by future generations.	- Investigation, research, and conservation of the natural ecosystem and natural and cultural landscape - Restoration and proliferation of wild animals and plants for promoting biological diversity - Observation of ecological changes in natural resources - Establishment of a sound exploration culture, such as the development and operation of exploration programs - Prevention of damage to park resources, crackdown on illegal activities, etc.
SUDOKWON Landfill Site Management Corp.	It is an agency established to promote proper disposal and resourceization of waste generated in the metropolitan area, and to contribute to the creation of a comfortable living environment for residents in the surrounding area.	- Disposal of wastes brought into landfills in the metropolitan area - Installation and management of waste disposal facilities and facilities attached thereto - Installation and management of facilities for resourceizing wastes - Creation of the resident support fund and support for the surrounding affected areas

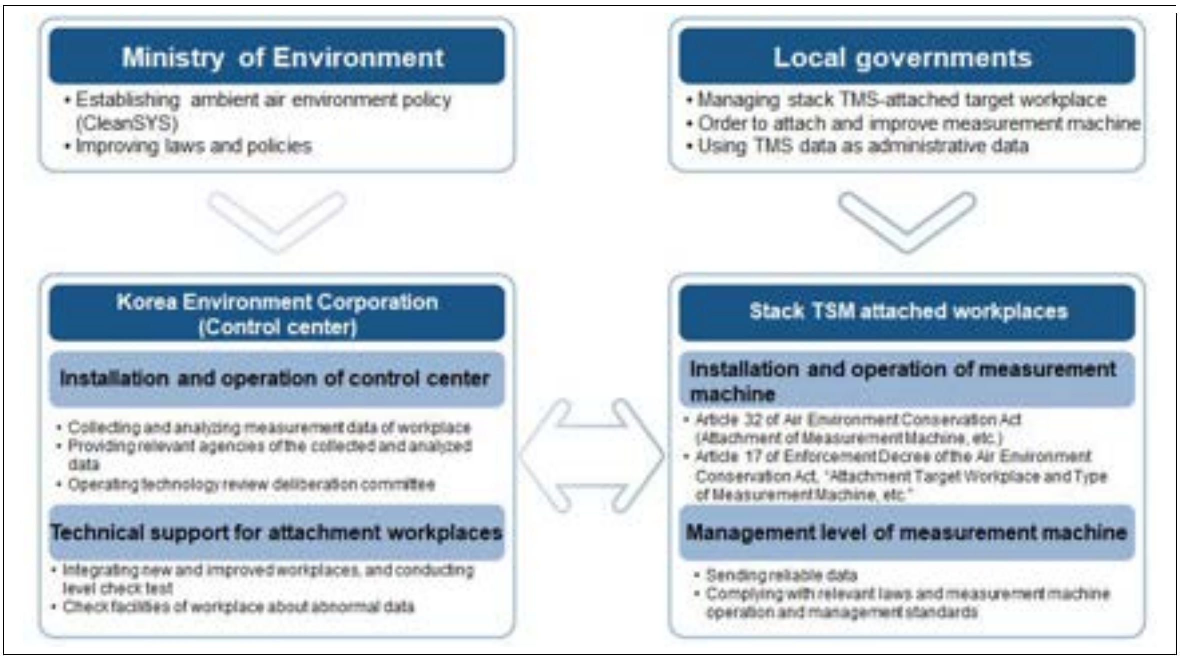
(3) Status of domestic air pollution monitoring governance

Since 2001, the operation and management of the air pollution monitoring network has been divided in Korea and the roles have been shared between the Ministry of Environment and regional governments. Easy to manage monitoring stations for checking ambient air quality reference substances are managed by the regional governments, but measurements of low-concentration background areas or special items that are relatively difficult to evaluate are managed by the Ministry of Environment.

(4) Status of stack emission pollutant monitoring governance

Agencies related to stack emission monitoring are the Ministry of Environment, the Korea Environment Corporation, regional governments, and the stack TMS attached workplaces. The work system for each agency is as follows.

[Figure] Stack emission monitoring governance



3.2.3 Status of Ambient Air quality management in Seoul

In 1978, the Seoul Metropolitan Government planned to expansively supply LPG, from about 40,000 homes to 500,000 homes among the 800,000 homes that used briquettes at the time. By reducing the use of briquettes, air pollution was greatly reduced. With the government's expansion of policies such as the supply of low sulfur oil in 1981, restrictions on the use of the solid fuel in 1985, the supply of anthracite gasoline in 1987, and the mandatory use of LNG in 1988, the levels of primary air pollutants such as SO_2, total fine dust, and CO have been improved noticeably and maintained below environmental standards.

To fundamentally solve the emission of air pollutants, the Seoul Metropolitan Government has supplied green cars and has been constructing a charging infrastructure since 2009. This led to the launch of green car demonstration projects such as low-speed electric vehicles, modified electric vehicles, high-speed electric vehicles, electric buses, hydrogen fuel cell vehicles, and online electric vehicles. Charging stations have been constructed in public facilities such as city hall, autonomous district offices, and parks since 2009, and in particular, a “smart charging system” has been developed that enables payment of fees in preparation for general charging demand.

Further, the Seoul Metropolitan Government is operating ambient air quality monitoring stations throughout Seoul to systematically implement ambient air quality management, and introduced the ozone warning system in 1995, followed by the fine dust forecast warning system in 2005 so that citizens can prepare. The Seoul Metropolitan Government set “Seoul, a healthy breathing city,” as one of four major municipal goals, and suggested a goal to reduce ultrafine dust directly related to civic health by 20% by 2018. To this end, the Seoul Metropolitan Government is actively promoting policies to fundamentally block vehicle emissions, such as lowering pollution of old diesel vehicles, reducing nitrogen oxides for large vehicles, and expanding the introduction of electric vehicles and CNG hybrid buses.

3.3 Proposal of Policies in the Ambient Air quality management Sector

The early causes of air pollution in most of the world's cities, including in Korea, are population growth, industrialization, urban concentration, an increase in the number of vehicles, and poor pollution prevention technologies and facilities.

More than 60% of the total population of Mongolia also lives in cities, and since 1990, the industrial structure has changed from agricultural and livestock-oriented industries to manufacturing industries, and in particular, the capital Ulaanbaatar suffers from severe air pollution due to short-term high urbanization rate, coal-fired power plants, factories with insufficient prevention facilities, and an increase in vehicles due to population density, which has many similarities to Korea's past.

Looking at the ambient air quality management and air pollution improvement process, and the efforts that it has made in Korea, air pollution was seriously accelerated by an increase in the use of fossil fuels without consideration of the environment and the expansion of industrial facilities that neglected environmental pollution prevention measures according to the growth-oriented development logic of the 1960s to 1970s, and the increase in vehicles further accelerated this situation. The management of these environments began to establish a legal basis with the enactment of the Air Pollution Prevention Act in 1963, which was developed into the Environmental Conservation Act and the Clean Air Conservation Act and provided as the legal basis for ambient air quality management.

Various policy and institutional systems have been devised and executed to effectively implement these statutes, and some policies have been successfully implemented to contribute greatly to improving the ambient air quality in Korea. Therefore, based on the status data of Mongolia, Korean policies that can help solve the ambient air quality problems of Mongolia and other pending issues were introduced.

3.3.1 List of Proposed Policies in the Ambient Air quality management Sector

No.	Sector	Proposal of policies	Details
1	Stationary source	Strengthening the implementation of installing air pollution prevention facilities	To achieve and meet the environmental standards for emissions, it is necessary to introduce methods for defining major emission sources and restricting pollutants, and gradually expanding restrictions of emission sources and pollutants to strengthen management. To this end, it is mandatory to install emission facilities for meeting the relevant restricted pollutant standards for each emission source, and in the long term, it is necessary to manage the restriction more strictly on emissions by introducing restrictions on total air pollutants.
2	Stationary source	HOBs fuel replacement for reducing air pollution	For effective fuel replacement, it is necessary to establish policies step by step, such as ① restrictions on existing fuel use, ② establishment of new fuel introduction standards, and ③expansion of new fuel supply, and it is necessary to establish policy measures in stages to ensure their smooth introduction in the market.

3	Mobile source	Introduction of an old vehicle management system	Old diesel vehicles are managed in accordance with the specific diesel vehicle emission standards that are more stringent than the driving vehicle emission standards. Therefore, owners of specific diesel vehicles will be subject to such measures as ① attachment of an emission reduction device, ② modification to low-pollution engine, and ③ early scrapping of vehicles to meet the permissible emission standards of the specific diesel vehicles. At this time, consideration can be given for government subsidies to offset related expenses.
4	Mobile source	Introduction of a vehicle fuel quality management system	In the short term, there is a need to identify the status of petroleum providers, introduce a quality inspection system for each fuel distribution stage, and construct a specialized laboratory that can test and analyze fuel for vehicles. In mid- and long-term, it is necessary to actively manage the distribution of vehicle fuels, identify fake petroleum products, strengthen the ability to analyze vehicle fuels, and improve the quality of vehicle fuels.
5	Monitoring	Establishment of MP in the air pollution monitoring network area	① To improve the efficiency of the air monitoring management, the proposal is to establish a plan to classify the operators of the monitoring network and to expand the air pollution monitoring network for areas that are not being measured, and ② It is also necessary to introduce a degree management system for increasing the reliability of the measured ambient air quality data and to introduce a method for managing risky substances in the ambient air by introducing an analysis system for hazardous air pollutants.
6	Monitoring	Establishment of an air pollutant inventory system	The proposed method for managing air pollutant emissions calls for constructing a real-time monitoring system in large-scale emission facilities, and recording and managing the air pollutant inventory.
7	Monitoring	Establishment of a hazardous air pollutant analysis system	Proposed is a system for analyzing and managing specific hazardous air pollutants more strictly than general air pollutants.

4. Status of the Project Target Area

4.1 General Status of Ulaanbaatar City

4.1.1 General Status

Ulaanbaatar City is the capital of Mongolia, and its area is 4704.1km^2, and located at 47 degrees 55 minutes north latitude and 106 degrees 53 minutes east longitude. The topography is a meadow plateau with an average height of 1,350m and has a continental climate with a large annual temperature difference between summer and winter.

<Table> Status of Ulaanbaatar

Items	Details
Area	• 4,704.1㎢ (about 4.7 times that of Incheon), located 47 degrees 55 minutes north latitude and 106 degrees 53 minutes east longitude • A border with Russia at 3,485km to the north and a border with China at 4,676.9km to the south are formed
Altitude	• 1,350m (the meadow plateau, TsetseeGun Mountain 2,257m)
Climate	• Continental climate with a wide annual temperature range of 35℃ in summer and -39.5℃ in winter
Monthly average temperature	• -24.3℃ (recorded minimum temperature -48℃) in January and 16.6℃ (recorded maximum temperature 39℃) in July, and the coldest area among the world's capital cities • Severe changes in weather in May and June and sometimes, severe gusts • Summer is short and hot, and the temperature rises to 36℃, but the humidity is not high, and therefore, the sensory temperature is low and ultraviolet rays are very strong. 257 days of the year without clouds
Annual precipitation	• Very small at 350mm

Source: Blog of the Meteorological Administration in Korea, Incheon Metropolitan City webpage (https://www.incheon.go.kr/IC040513) (reviewed and written by the research team)

4.1.2 Status of Infrastructure Construction

(1) Power plant

In the UB City, it was investigated that there are six locations—three combined heat and power plants (CHPs) and three thermal heat generation plants, and the power generation capacity of the TES-4 power plant is the largest at 700 MW.

<Table> Status of the combined heat and power plants and the heat generation plant of Mongolia

No.	Item	Power plant	Established year	Location	Capacity (MW)
1	**Thermal combined heat and power plant (CHP)**	**UB TES-2 (Second power plant)**	**1961**	**Ulaanbaatar**	**21.5**
2	**Thermal combined heat and power plant (CHP)**	**UB TES-3 (Third power plant)**	**1968**	**Ulaanbaatar**	**198**
3	**Thermal combined heat and power plant (CHP)**	**UB TES-4 (Fourth power plant)**	**1983**	**Ulaanbaatar**	**700**

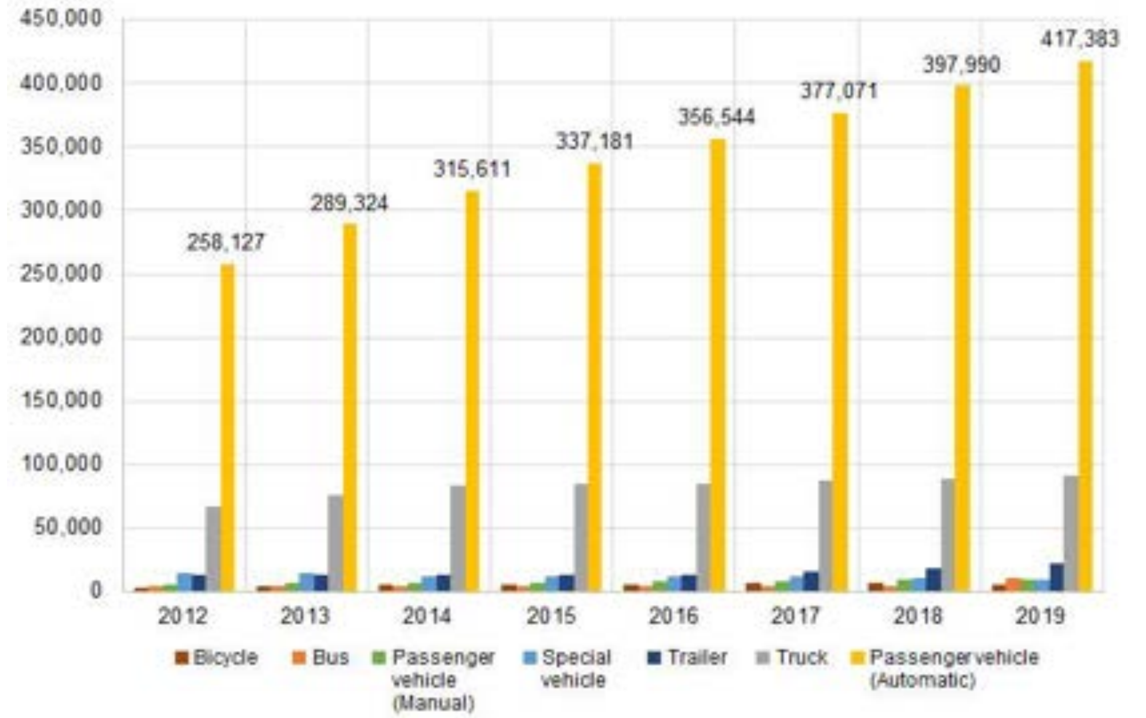
4	Thermal combined heat and power plant (CHP)	DARKHAN (Darkhan Power Plant)	1965	Darkhan	48
5	Thermal combined heat and power plant (CHP)	ERDENET (Erdenet Power Plant)	1987	Erdenet	28,8
6	Thermal combined heat and power plant (CHP)	DORNOD TPP (CHOIBALSAN) (Dornod Power Plant)	1970	Dornod	36
7	Thermal combined heat and power plant (CHP)	DALANZADGAD (Dalanzadgad Power Plant)	2000	Umnugovi, Dalanzadgad	6
8	Thermal combined heat and power plant (CHP)	ERDENET MINING CORPORATION (Erdenet Power Plant)	1976	Erdenet	53
9	Power plant (PP)	UKHAA KHUDAG (MCS-Coal Mine) (Power Plant)	2011	Umnugovi, Tsogttsetsii	18
10	**Thermal heat generation plant**	**BAGANUUR**	**1980**	**Ulaanbaatar, Baganuurduureg**	**-**
11	**Thermal heat generation plant**	**AMGALAN**	**2016**	**Ulaanbaatar, Bayanzurkhduureg**	**348**
12	**Thermal heat generation plant**	**NALAIKH**	**1976**	**Ulaanbaatar, Nalaikhduureg**	**-**
13	Thermal heat generation plant	DULAAN SHARIINGOL	1964	Darkhan, Shariingol	-
14	Thermal heat generation plant	Khuvsgul	-	-	-
15	Thermal heat generation plant	Khovd	-	-	-

Source: Ministry of Energy of Mongolia (https://energy.gov.mn) (as of November 2020, reviewed and written by the Research team)

(2) Status of vehicles

The number of registered vehicles in Ulaanbaatar continues to increase from about 360,000 in 2012 to about 570,000 in 2019 (Compound Annual Growth Rate (CAGR): 5.6%), and the number of passenger cars is the highest.

[Figure] Registration status by vehicle type in Ulaanbaatar from 2012 to 2019 (unit: ea)



<Table> Registration status by vehicle type in Ulaanbaatar from 2012 to 2019 (unit: ea)

Type	2012	2013	2014	2015	2016	2017	2018	2019
Bus	4,297	4,570	4,784	4,928	5,055	4,942	4,482	11,021
Truck	66,792	76,319	84,388	85,208	85,481	87,098	88,710	91,670
Passenger vehicle (Automatic)	258,127	289,324	315,611	337,181	356,544	377,071	397,990	417,383
Special vehicle	15,295	14,877	12,084	11,812	11,952	11,903	10,752	9,984
Passenger vehicle (Manual)	6,007	6,878	7,418	7,748	8,200	8,599	9,410	10,120
Trailer	13,374	13,783	14,093	13,835	13,947	15,459	18,734	22,959
Motorcycle	3,922	4,765	5,415	5,971	6,349	6,935	7,594	5,729
Sum	367,814	410,516	443,793	466,683	487,528	512,007	537,672	568,866

Source: The National Statistical Office of Mongolia (http://www.1212.mn/) (reviewed and written by the research team)

Among registered vehicles, it was found that vehicles more than 10 years old accounted for 74.4% and vehicles between 7 to 9 years old accounted for 19.8%. Therefore, most of the vehicles operating in Ulaanbaatar are more than 7 years old.

(3) Status of industry

The market volume of Ulaanbaatar City steadily increased at a rate of 10.5% over the past five years (from 2015 to 2019). As of 2019, the agricultural sector accounted for 0.3% of the gross domestic product (GDP) in Ulaanbaatar City, the industrial sector accounted for 41%, and the service sector accounted for 58%. Mining accounts for more than half of the industrial sector with manufacturing also accounting for a large proportion.

<Table> Status of main industries in Ulaanbaatar (unit: MNT)

Industry sector	2015	2016	2017	2018	2019
Domestic Gross Product (Market price)	14,964,718.7	15,703,079.4	18,105,283.4	21,509,825.1	24,683,663.7
Agriculture	**96,930.4**	**82,868.6**	**56,845.1**	**78,733.4**	**66,825.04**
Crops	22,983.2	11,175.7	9,299.3	14,364	15,247.25
Livestock	40,585.7	36,567.7	29,939.5	46,510.3	48,135.97
Other agricultures	33,361.4	35,125.2	17,606.3	17,859	3,441.82
Industrial	**5,066,531.7**	**5,654,367.3**	**7,195,663.5**	**8,981,754.1**	**10,199,132.18**
Mining	2,501,823.7	3,108,830.7	3,864,855.4	5,126,566.4	5,725,040.66
Manufacturing	1,234,999.3	1,163,711.2	1,786,918.4	2,069,946.5	2,483,238.98
Electricity, gas, and water business	378,106.7	465,347.1	492,582	567,488.5	653,651.6
Construction industry	951,602	916,478.2	1,051,307.6	1,217,752.7	1,337,200.94
Service industry	**9,801,256.6**	**9,965,843.5**	**10,852,774.8**	**12,449,337.6**	**14,417,706.48**
Wholesale and retail and lodging food business	3,538,042.4	3,666,205.1	4,183,006.9	5,121,820.2	5,953,754.19
Transportation and information and communication business	1,560,866.7	1,585,291.9	1,710,676.3	1,898,169.7	2,069,783.19
Financial and business service industries	3,073,857.5	3,048,661.6	3,180,913.9	3,519,158.9	4,057,478.16
Other service industries	1,628,490	1,665,684.9	1,778,177.8	1,910,188.7	2,336,690.94

Source: The National Statistical Office of Mongolia (www.1212.mn) (reviewed and written by the research team)

(4) Status of economy

The economic status of the past five years from 2015 to 2019 in Ulaanbaatar, Mongolia, was investigated through economic indicators such as gross domestic product (GDP), GDP per capita, and average household income.

<Table> Five-year economic indicators in Ulaanbaatar

Item	2015	2016	2017	2018	2019
Domestic Gross Product (GDP) (unit: hundred million MNT)	14,965	15,703	18,105.3	21,510	24,684
GDP per capita (domestic gross product) (unit: thousand MNT)	11,252	11,520	12,940.7	15,031	16,960
Changes in the annual consumer price index (unit: %)	1.1	0.5	7.2	9.7	5.0
USD average exchange rate of MNT (unit: MNT)	1,970	2,146	2,440	2,472	2,664
Budget in Ulaanbaatar City (unit: hundred million MNT)	846.7	870.6	1,070.2	1,249.5	1,381.5
Budget usage status in Ulaanbaatar City (unit: hundred million MNT)	883.8	1,025.8	1,075.1	1,282.4	1,447.5
Average monthly household income (unit: MNT)	1,169,820	1,073,118	1,188,933	1,368,251	1,510,926
Average monthly household expenditure (unit: MNT)	1,097,901	1,034,986	1,188,837	1,377,888	1,525,282

Source: Ulaanbaatar City webpage (www.ulaanbaatar.mn) (reviewed and written by the research team)

4.2 Status of the Ambient Air quality management Governance of Mongolia

(1) Ulaanbaatar City Environmental Department

The Ulaanbaatar City Environmental Department is an agency that is in charge of management of agencies under the Ulaanbaatar City Environmental Department, environmental projects, and pollution. In 1924, it was established as the forest agency in Ulaanbaatar City and was renamed to the Ulaanbaatar City Environmental Department from 2016. Currently, it is in charge of the environment of the Ulaanbaatar City, green development policies and projects, rational use of natural resources, and management of green area summer houses.

(2) Ulaanbaatar City Air Pollution Reduction Department (APRD)

The Ulaanbaatar City Air Pollution Reduction Department was established in 2006 as the ambient air quality agency of the Ulaanbaatar City Environmental Protection Department and renamed to the Ulaanbaatar City Air Pollution Reduction Department, that is, APRD, in 2019. The APRD consists of Administrative Department, Policy Execution Department, and Ambient Air Quality Monitoring Department, and is carrying out the works such as ambient air quality measurement, monitoring, analysis, ambient air quality information provision, execution of policies approved for reducing the air pollution, and air protection-related regulations, rules, programs, and standards development.

(3) Ulaanbaatar Mayor's Office

The Ulaanbaatar Mayor's Office consists of six departments, of which the urban engineering facility department is in charge of the establishment of policies and plans in road and bridge construction, heat supply, water supply, and drainage facilities in Ulaanbaatar City. Further, it is in charge of the works such as HOBs, heaters, generators, and heat supply.

(4) Inspection Agency of the Capital City (IACC)

The Inspection Agency of the Capital City (IACC) is a specialized inspection agency for law, environment, and sustainable development in the UB City. The IACC has 10 goals, of which Goal 3 focuses on environmental pollution such as air, water, and soil.

4.3 Status of the Ambient Air quality management Strategy Goals and Implementations

(1) Status of establishment of Ulaanbaatar City’s master plan to reduce air pollution

On June 28, 2018, the Ulaanbaatar City's master plan to reduce air pollution was passed through a resolution by the Ulaanbaatar City Council. The mayor of Ulaanbaatar City is in charge of the implementation of the master plan, and the chairperson of the Ulaanbaatar City Council is in charge of implementation monitoring. The implementation phase of Ulaanbaatar City’s master plan to reduce air pollution is divided into two phases, first is from 2018 to 2019 and the second is from 2020 to 2025. The master plan specifies policy directions, specific policy content, performance, standards and implementing agencies, and joint enforcement agencies at each stage to achieve 5 goals that are identical with the NPRAEP.

(2) Status of implementation for the air pollution prevention activities in Ulaanbaatar City

The Ulaanbaatar City Air Pollution Reduction Department (APRD) organizes and discloses the implementation status of air pollution prevention activities conducted in the UB city every year. Among the air pollution prevention activity reports released in 2020, the air pollution reduction activities are reported in detail in Goals 2, 3, and 5.

5. Identifying of Environmental Cooperation Projects and Establishment of Basic Plans

5.1 Approach to the Environmental Cooperation Project

We identified the main status and problems of each pollutant source in Ulaanbaatar City by conducting video interviews with Mongolia’s government officials in the ambient air quality management sector and visiting the site through local outsourced service agencies.
12 environmental cooperation projects that will contribute to solving problems in the ambient air quality management in Mongolia were identified by reviewing related laws, policies, standards, executing and supervising implementation subjects regulating Mongolia’s air quality management.

5.2 List of the Environmental Cooperation Projects by Sector

<table>
<tr><th>No.</th><th>Improvement proposal</th><th>Sector</th><th>Details</th></tr>
<tr><td>1</td><td>Improvement and installation of electrostatic precipitators in the combined heat and power plants in Ulaanbaatar city</td><td rowspan="2">Stationary source</td><td rowspan="2">To fundamentally reduce the emission of air pollutants in Ulaanbaatar City, a project to install replacements for old electrostatic precipitators to TES-4 (supplying power to over 60% of the UB City) with the largest power generation capacity of 700 MW. After that, it is possible to sequentially consider the installation of the prevention equipment for the management of coal ash and in preparation for the strengthened regulation on sulfur oxides and nitrogen oxides.</td></tr>
<tr><td>2</td><td>Introduction of desulfurization facilities in the combined heat and power plants in Ulaanbaatar city</td></tr>
<tr><td>3</td><td>Pilot installation of the workplace air pollutant management system (CleanSYS)</td><td>Stationary source</td><td>By introducing the system that can identify real-time emission concentrations and emissions into a stack that is a large stationary source, and therefore, evidence for the Ministry of Environment and Tourism or the APRD that is the management and supervision entity, to check the status of real-time emissions and issue action orders are provided. It is almost similar to the air pollution monitoring network and management system, but since there is a need for the special management method of monitoring device/equipment to withstand the high moisture level and temperature of the workplace, more advanced and joint capacity building programs are required.</td></tr>
<tr><td>4</td><td>Introduction of gas fired heat only boilers (HOBs)</td><td>Stationary source</td><td>To improve the ambient air quality, it is necessary to introduce gas boilers that can replace coal boilers conventionally used in Mongolia. Further, there is a need for laws related to the installation of gas boilers and emission management regulations.</td></tr>
<tr><td>5</td><td>Introduction of measuring device for implementing the emission gas inspection system</td><td>Mobile source</td><td>Currently, permission standards for air pollutants discharged by vehicle type in Mongolia are provided, but there is a lack of equipment to measure these pollutants. Therefore, by introducing vehicle emission inspection measurement equipment to strengthen the vehicle exhaust gas inspection system, air pollutants generated by mobile pollutants can be managed, thereby contributing to the improvement of ambient air quality in Ulaanbaatar City.</td></tr>
<tr><td>6</td><td>Pilot installation of DPF for reducing emissions from old diesel vehicles in Mongolia</td><td>Mobile source</td><td>Many air pollutants are discharged from old diesel vehicles traveling in Ulaanbaatar City, adversely affecting ambient air quality. We propose a project to introduce a DPF device for installation into old diesel-powered vehicles that is capable of reducing the discharge of air pollutants in Ulaanbaatar City.</td></tr>
</table>

7	Expansion of LPG stations	Mobile source	To spread the use of LPG vehicles with less air pollutants than gasoline and diesel vehicles, the LPG charging infrastructure capable of supplying LPG to users is essential. Since the infrastructure project needs large-scale capital, it is possible to devise a method for expanding charging stations utilizing concessional loans, etc. In the long term, it is also necessary to consider projects to expand electric charging stations through the introduction of policies to encourage the introduction of electric vehicles at the government level.
8	Expansion of electric vehicle charging stations		
9	Establishment of a national ambient air quality monitoring information system (NAMIS)	Monitoring	By constructing a real-time ambient air quality monitoring system and preparing the foundation for producing reliable ambient air quality data by strengthening ambient air quality management capabilities, policymakers can prepare ambient air quality improvement policies based on scientific evidence.
10	Improvement of an air quality monitoring system of Mongolia (Agaar)		
11	Expansion of air pollution monitoring stations		
12	Introduction of mobile air pollution monitoring stations (vehicles)		

5.3 Method for Securing Funds

To promote the identified environmental cooperation project, it is essential to secure funds for implementing the project. If it is difficult for the Mongolian government to raise its own budget, it can utilize domestic and foreign Official Development Assistance (ODA), Other Official Flow (OOF), and Private Flow (PF) funds.

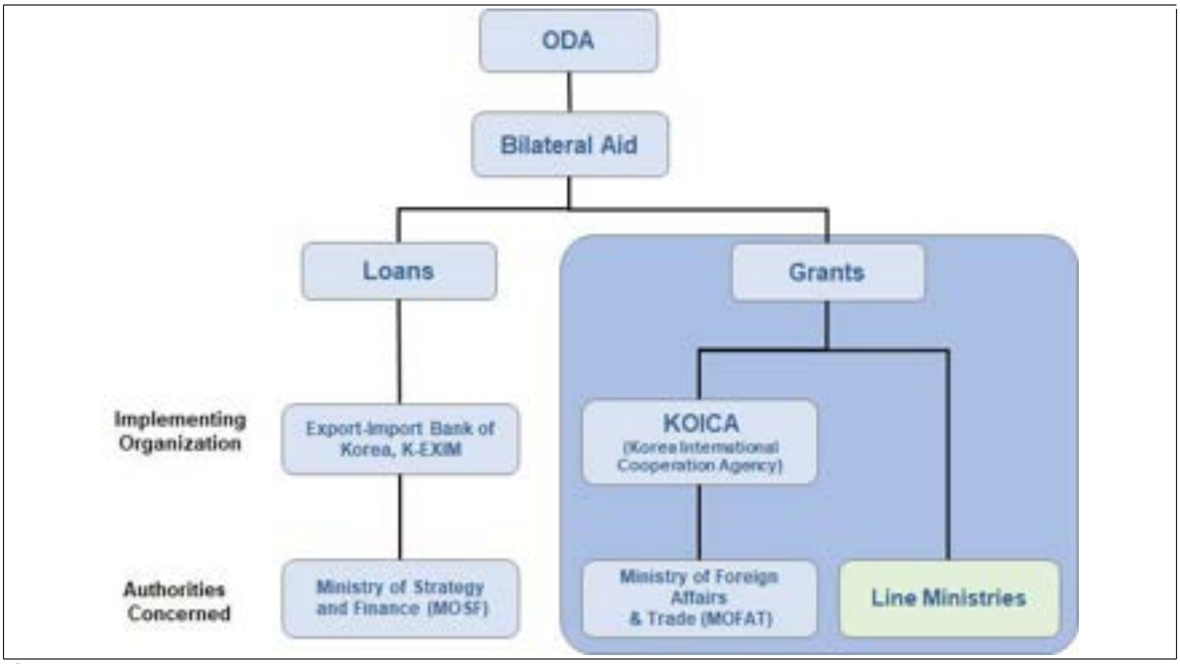
5.3.1 Method for Utilizing the Official Development Assistance Fund in Korea

The form of the Official Development Assistance in Korea can be divided into grants and loans.

Grants are cash or in-kind transfer that provides various forms of free support and does not accompany legal liabilities. In other words, the developing countries are not obligated to repay the donated assistance funds, and examples of these include technological cooperation, food assistance, and disaster relief. The execution agency in Korea is KOICA under the Ministry of Foreign Affairs. Other ministries also disburse grant funds for supporting specific sectors, such as "Infra ODA" by the Ministry of Land, Infrastructure and Transport, "Industry and Energy ODA" by the Ministry of Trade, Industry and Energy, and "Green ODA" by the Ministry of Environment.

Loans are cash or in-kind transfer accompanied by concessional public loans and legal liabilities given under favorable conditions compared to private funds in developing countries. In other words, the developing countries are obligated to repay the donated assistance funds, and examples include support for public development programs and projects in developing countries. The execution agency in Korea is the Export-Import Bank of Korea.

[Figure] Types of ODA funds in Korea



Source: Reviewed and written by the Research team

5.3.2 Method for Utilizing Funds from Multilateral Development Bank

The Multilateral Development Bank (MDB) is a bank that provides economic development funds, which refers to a bank in which multiple borrowing countries, developing countries, multiple financial donors, or developed countries participate without restriction on membership. Generally, the MDB includes the World Bank (WB) and four regional development banks (Interamerican Development Bank (IDB), African Development Bank (AfDB), Asian Development Bank (ADB), and European Bank for Reconstruction and Development (EBRD).

The MDB provides economic development funds only for businesses that are profitable and have a clear outlook for debt repayment by raising funds with investments and loans. Therefore, low-income developing countries with low external credibility and poor debt repayment capabilities are almost impossible to borrow from the MDB or raise funds in the international financial market. Therefore, as the long-term and low-interest concessional lending window for low-income developing countries, the MDB has established and operated special organizations or funds, separately, such as the International Development Association (IDA), the Africa Development Fund (AfDF), and the Asia Development Fund (AsDF).

5.3.3 Method for Utilizing Climate and Environment Funds

International funds that support the financing of projects necessary for developing countries to set and achieve sustainable development goals related to a response to climate change include the Global Environment Facility (GEF), the Global Climate Fund (GCF), and the Adaptation Fund (AF).

6. Implementation of the Environmental Cooperation Project

6.1 Identification of the Environmental Cooperation Project

In the process of establishing the master plan for ambient air quality improvement in Ulaanbaatar, Mongolia, 19 cooperation projects were identified, of which 12 projects can be commercialized locally in connection with implementation funds and are as follows.

<Table> List of proposed environmental cooperation projects

Number	Sector	Name of project
1	Stationary source	Improvement and installation of electrostatic precipitators in the combined heat and power plants in Ulaanbaatar city
2		Introduction of desulfurization facilities in the combined heat and power plants in the Ulaanbaatar city
3		Pilot installation of the workplace air pollutant management system (CleanSYS)
4		Introduction of gas fired heat only boilers (HOBs)
5	Mobile source	Introduction of measuring device for implementing the emission gas inspection system
6		Pilot installation of DPF for reducing emissions from old diesel vehicles in Mongolia
7		Expansion of LPG stations
8		Expansion of electric vehicle charging stations
9	Monitoring	Establishment of a national ambient air quality monitoring information system (NAMIS)
10		Improvement of an air quality monitoring system of Mongolia (Agaar)
11		Expansion of air pollution monitoring stations
12		Introduction of mobile air pollution monitoring stations (vehicles)

6.2 Method for Securing Resources for the Environmental Cooperation Project

The project was configured as “ICT-based integrated ambient air quality management system project in the UB City” by integrating “Establishment of a ambient air monitoring system (NAMIS)”, “Improvement of an air quality monitoring system of Mongolia (Agaar)”, “Expansion of air pollution monitoring stations”, “Introduction of mobile air pollution monitoring stations (vehicles)” and “Pilot installation of the workplace air pollutant management system (CleanSYS)”, and the project concept paper was promoted to implement it with ODA funds from the Ministry of Environment.

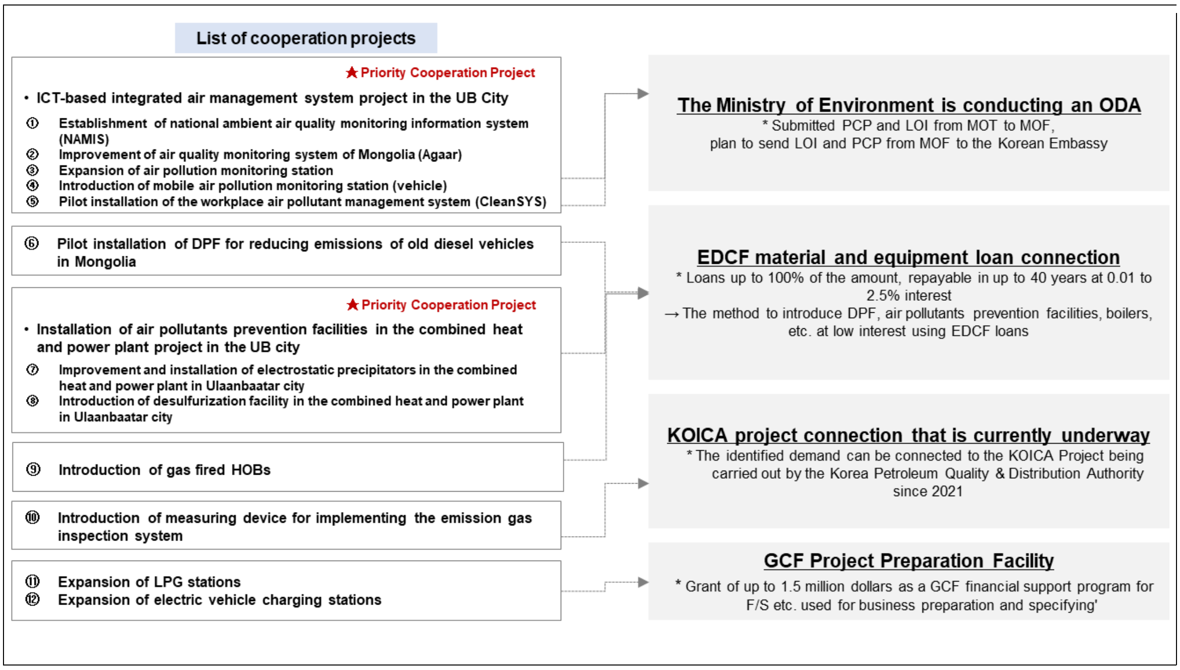
Types of projects that introduce material and equipment to Mongolia, such as “Installation of air pollution prevention facilities in the combined heat and power plant project in the UB City”, which integrates “Improvement and installation of electrostatic precipitators in the combined heat and power plants in Ulaanbaatar city” and “Introduction of desulfurization facilities in the combined heat and power plants in the Ulaanbaatar city”, “Pilot installation of DPF for reducing emissions from old diesel vehicles in Mongolia and “introduction of gas fired HOBs”, can be financed in connection with material and equipment loans provided by EDCF.

* The EDCF-served material and equipment loans can be up to 100% of the amount of material and equipment introduced into the target country, and repayment can be made over a 40-year period. The interest rate shall be between 0.01% and 2.5%.

“Introduction of measuring device for implementing the emission gas inspection system” is a KOICA project in Mongolia starting this year and the corresponding sector shall be handled by the Project to Build Capacity in Quality Control Management of Energy Resources to Improve Air Quality in Mongolia that is being carried out by the Korea Petroleum Quality & Distribution Authority, and therefore, can be carried out in connection with this project.

“Expansion of LPG stations” and “Expansion of electric vehicle charging stations” are projects in which large-scale funds are involved and the method promoted in connection with the GCF funds can be considered, and therefore, the project will be able to be promoted by utilizing GCF Project Preparation Facility that is the F/S funds that can be utilized for preparing and specifying the project prior to implementing the main GCF project.

[Figure] Method for connecting funds to the environmental cooperation project



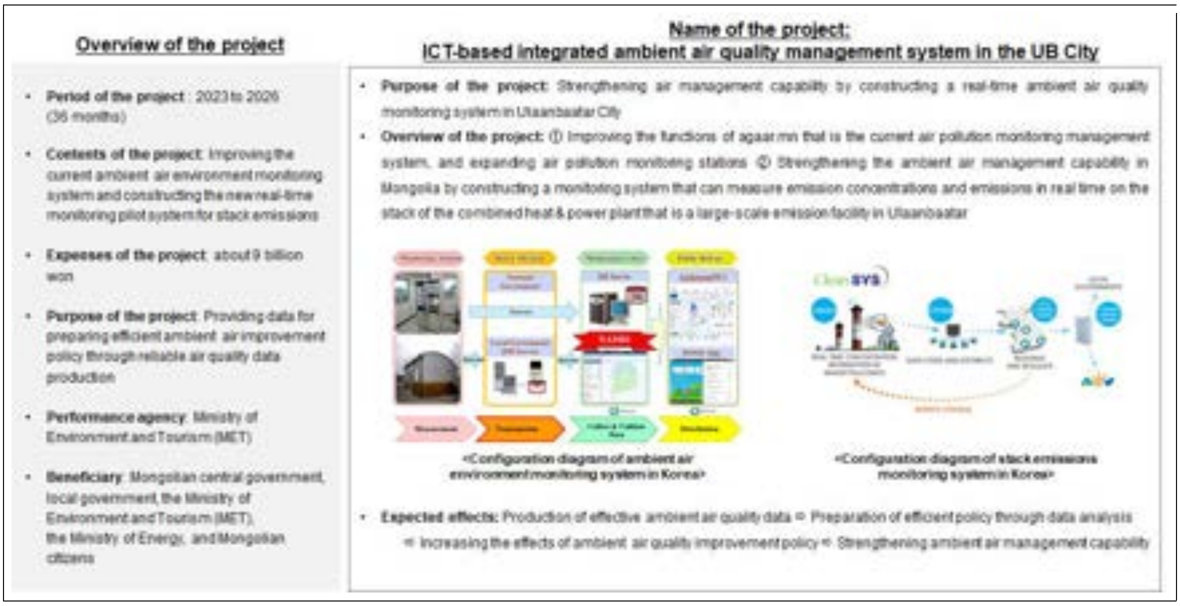
6.3 Overview of Priority Cooperation Project

Based on the urgency, justification, and impact from the perspective of the local introduction in Mongolia of the proposed cooperation projects, “ICT-based integrated ambient air quality management system project in the UB City” and “Installation of air pollution prevention facilities in the combined heat and power plant project in the UB City” were selected as priority cooperation projects.

In the case of “ICT-based integrated ambient air quality management system project in the UB City,” to implement the project with ODA funds from the Ministry of Environment, the Project Concept Paper (PCP) was written in cooperation with the Ministry of Environment and Tourism of Mongolia, and a Letter of Intent (LOI) of the Ministry of Environment and Tourism of Mongolia was submitted to the Ministry of Economy and Finance of Mongolia.

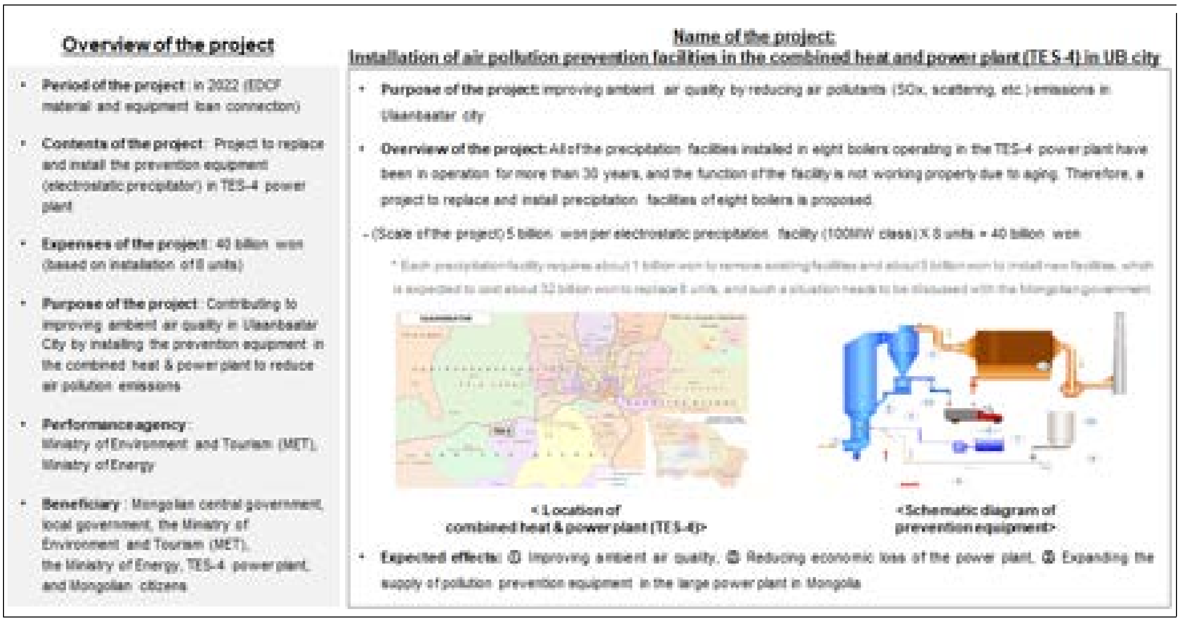
“ICT-based integrated ambient air quality management system project in the UB City” is a project that improves the ambient air monitoring system (Agaar) of Mongolia and increases the number of ambient air quality monitoring stations and introduces the Stack Air Pollution Emission Monitoring System (CleanSYS) that can measure and monitor air pollutants discharged from workplaces in real time on a trial basis.

[Figure] Overview of the ICT-based integrated ambient air quality management system project in the UB City



The project of "Installation of air pollution prevention facilities in the combined heat and power plants in the UB City" is intended to install the replacements for old precipitators of the TES-4 combined heat and power plant that accounts for 60% or more of the power supplied to Ulaanbaatar City and it has the country's largest power generation capacity of 700 MW.

[Figure] Overview of the installation of air pollution prevention facilities in the combined heat and power plant (TES-4) project in the UB City



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Chapter 1 Overview of the Project

Part 1. Establishment of the Environmental Improvement Plan

Chapter 1 Overview of the Project

1.1 Purpose and Necessity of the Project

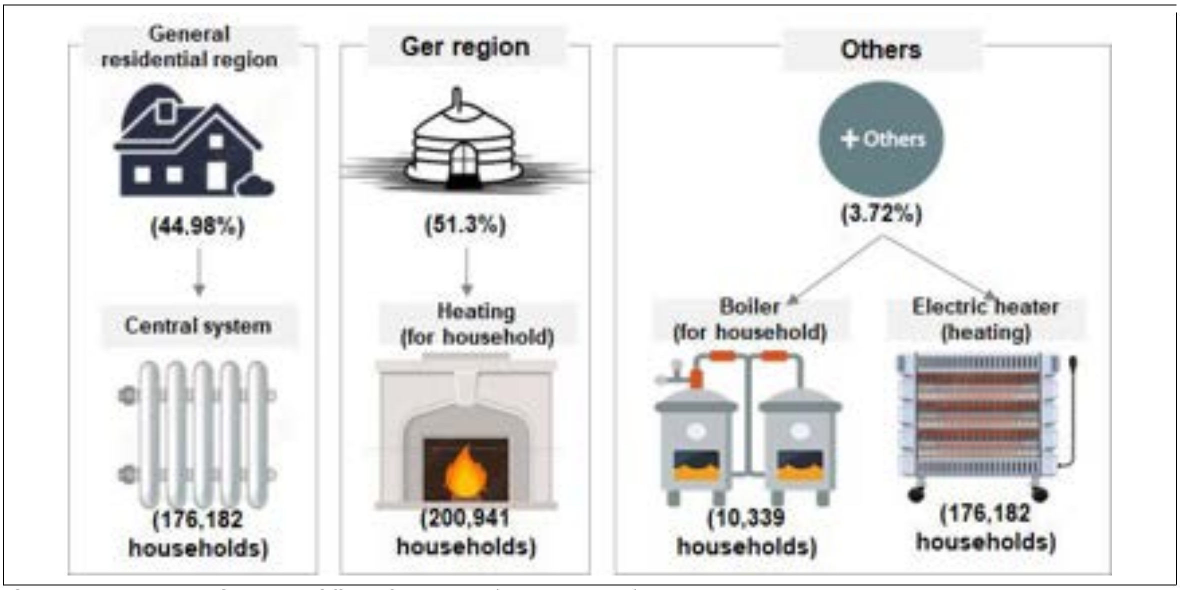
1.1.1 Background and Necessity of the Project

(1) Status of severe air pollution of Mongolia

Mongolia has been facing environmental problems, such as air pollution, because of its high industrialization and rapid economic growth over the past decade. In particular, the Ulaanbaatar City is densely populated, and the concentration of ultrafine dust (PM2.5) is an average of 128 $\mu g/m^3$ per year (IQAir, 2020) as of 2020, which is a serious urban environmental problem, consequently listing the city as one with the third highest level of fine dust in the world.

The biggest cause of air pollution in winter is heating using low-grade fuel in Ger villages. Over the past 10 years (2010 - 2020) throughout Mongolia, the average temperature in winter (November to March) was -28.9℃, and the average temperature in winter in Ulaanbaatar City was -27.5℃. In particular, heating in all households is a necessity, with the lowest temperature in Mongolia at -50°C and the lowest temperature in Ulaanbaatar City at -37°C. More than 47% of total population of Mongolia lives in Ulaanbaatar City, and low-income residents in Ger villages use low-grade fuels such as waste tires to produce heat for their homes, and therefore, the discharge of air pollutants is a serious health concern.

[Figure 1] The number of households and types of heating used in Ulaanbaatar City



Source: The National Statistical Office of Mongolia (www.1212.mn)

(2) Policy efforts of the Mongolian government for improving the air pollution problems

As the number of people dying of lung cancer and asthma attributable to air pollution increases, the Mongolian government has made efforts to remove low-pressure steam boilers, expand energy sources, and increase the number of ambient air quality monitoring centers. In 2016, as the Mongolian government introduced a night power discount policy for the households in the Ger region, electric heaters were encouraged to be used to heat households instead of coal.

As part of such efforts, in March 2017, the Mongolian government approved the National Program on Reduction of Air and Environmental Pollution (NPRAEP). This program is expected to reduce air pollutants by 80%, prohibit the use of untreated coal at all locations other than the thermal power plants in Ulaanbaatar, and reduce the air and environmental pollution by 50% or more by 2025.

Further, the Mongolian government has been making policy efforts to reduce air pollution, such as prohibiting the use of the raw coal in the households in six areas of Ulaanbaatar since May 15, 2019, by announcing Resolution No. 62 “Prohibition of the use of the raw coal” on February 28, 2018.

The Mongolian government includes environment as one of the major sectors of “VISION 2050, the long-term development policy of Mongolia” that is one of the national development strategies, and, suggests policies, as specific tasks, to reduce and prevent environmental pollution and introduce eco-friendly technologies.

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[Reference] Nine sections of VISION 2050

#1. Sharing national value
#2. Human development
#3. Improving the quality of life and expanding the middle class
#4. Economic development
#5. Good governance
#6. Green growth
#7. Peaceful and safe society
#8. Regional development
#9. Development of Ulaanbaatar and Satellite Cities

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

Mongolia has prepared the National Program on Reduction of Air and Environmental Pollution (NPRAEP) to ensure a safe living environment for Mongolian people by reducing environmental pollution through constituting and implementing activities to achieve the five goals.

[Reference] Five goals of NPRAEP

#1. Improving ambient air quality and environment of cities (efficient policies, infrastructure development, and regional distribution through regional development) #2. Reducing pollutant sources through the introduction of eco-friendly and advanced technologies #3. Performing comprehensive measures for reducing vehicle emissions #4. Managing and organizing air and environmental pollution activities, and establishing incentives for air and environmental pollution reduction #5. Increasing in citizens' participation and responsibility for reducing environmental pollution, cultivating healthy lifestyles and attitudes, and strengthening environmental monitoring and analysis capabilities

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

(3) Limitations and problems of the policy efforts of the Mongolian government

As the main reasons for halving these efforts to improve the ambient air quality in Mongolia, the lack of policy implementation by the Mongolian government, lack of consistency and coordination between policies, insufficient capabilities of public officials, and low level of participation have been highlighted (UN, 2019). To appropriately enforce the existing air pollution management laws and regulations, effective supervision of implementation is essential. To achieve this, it is necessary to increase the level of understanding and knowledge the officials in the air pollution management agency and supervision agency have about related technologies. Considering it, the proposed suggestion is an improvement plan to strengthen related capabilities through this project that supports the establishment of the master plan.

1.1.2 Purpose of the Project

(1) Purpose of the project

The goal of this project is to establish a master plan for improving the ambient air quality in Ulaanbaatar, Mongolia, and the project is expected to improve the ambient air quality in Ulaanbaatar, Mongolia and to provide opportunities for Korean environmental companies to enter the Mongolian market based on the bilateral cooperation projects identified through this project.

(2) Performance indicators of the project

In the early phase of the project, the main performance goal was to identify 12 cooperation projects, including policy proposals, write 2 Project Concept Papers (PCP) on the priority cooperation projects, and 1 master plan for improving the ambient air quality in Ulaanbaatar.

As a result of implementing the project, totally 19 cooperation projects, which consist of 7 policy proposals and 12 cooperation projects, were identified and 1 PCP on the project of introducing the ambient air quality monitoring system, which integrated the cooperation project for monitoring the ambient air quality and the cooperation project for monitoring the pollutants discharged from the workplaces, was created. In addition, the environmental technology capability strengthening event, which was scheduled to be held in Ulaanbaatar to strengthen the ambient air quality management capabilities of the officials of the Mongolian government and the invitational trainings for the officials of the Mongolian government in a visit to Korea were combined into an online session to strengthen the capabilities. However, the session was held once because of the COVID-19 situation.

<Table 1> Performance indicators of the project

Item	Original plan	Final performance
Identified project	Identified cooperation project: 12 cases	Identified cooperation project: 19 cases (7 cases of the policy proposals included)
	PCP on the priority cooperation projects: 2 cases	PCP on the priority cooperation projects: 1 case (Written as one case by integrating five projects)
Results	One concept design diagram of the ambient air quality monitoring system	One concept design diagram of the ambient air quality monitoring system
	One master plan for improving the ambient air quality in Ulaanbaatar	One master plan for improving the ambient air quality in Ulaanbaatar
Events	Invitational training for Mongolian government officials: 1 case	Online air management capacity building: 1 case
	Excellent environmental technology local outbound education: 1 case	

1.2 Scope of the Project

1.2.1 Target Area of the Project

The target area of the project in Mongolia is Ulaanbaatar, the capital of Mongolia, and the master plan was established for the sectors of stationary sources, mobile sources, and monitoring to improve the ambient air quality in Ulaanbaatar.

[Figure 2] Map of Mongolia

1.2.2 Details of Each Project Implementation Goal

This project was carried out by being classified into a total of five sectors, including identification of the cooperation projects in the sectors of stationary sources, mobile sources and monitoring, establishment of the master plan, and implementation of capability strengthening of the Mongolian government.

[Figure 3] Implementation contents and performance of the project

Goal of the project	Promotion contents of the project	Promotion performance
① Identification of cooperation projects for stationary source fuel and the prevention equipment sector	• Diagnosis for facility of power plant • Survey on operation systems of HOBs and heaters • Identification of improvement method and identification of (key) cooperation projects • Preparation of PCPs on key projects	• Identification of cooperation project related to installation of prevention equipment of power plant ('20.6~'20.12) • Performing survey on local power plants and HOBs ('21.3) • Survey on the status of gas boilers in the UB City and identification of cooperation project related to the introduction of HOBs ('21.7)
② Identification of cooperation projects for analysis of mobile source fuel and management system cooperation projects	• Survey on status of transport system management system • Identification of improvement method and identification of (key) cooperation projects • Preparation of PCPs on key projects	• Identification of cooperation project related to the introduction of DPFs for public buses in Mongolia • Proposal of policy in the area of mobile source
③ Identification of basic design of the monitoring system and additional cooperation projects	• Identification of air modeling-based measuring points • Basic design of ICT-based measuring monitoring system and preparation of PCPs • Identification of additional cooperation projects in the measuring monitoring sector	• One basic design of air pollution measurement data collection-management system • Evaluation of the current location of the ambient air pollution automatic monitoring station and proposal of six additional installation regions • Proposal to introduce a real-time management system for stack emissions from coal power plant
④ Establishment of the master plan	• Survey on policies, statistics, markets, and technology level • Establishment of policy proposals and master plan	• One copy of master plan report in Korean • One copy of master plan report in Mongolian and English, respectively
⑤ Strengthening capabilities of local governments	• Invitation training for officials in recipient country	• Conducting online capability strengthening ('21.7.21-22)
	• Excellent environmental technology Outbound training	• Unable to proceed due to "COVID-19"

(1) Identification of cooperation projects for stationary source fuel and the prevention equipment sector

In the stationary source sector, literature research on the laws, policies, and standards governing Combined Heat and Power Plant (CHPs), Heat Only Boiler (HOBs), and heaters used at home were conducted, and operation and management systems were diagnosed. Based on this, improvements in policy and administrative sectors were identified, and at the same time, the cooperation projects in the stationary source area were identified in consideration of technical alternatives.

To identify the cooperation projects, the statuses of facilities and operations of the stationary sources in Mongolia were identified with reference to reports and research data on ambient air-related projects previously conducted in Mongolia. Previously, it was planned to conduct joint on-site surveys with specialized agencies to identify cooperation projects, but due to the COVID-19 situation, on-site surveys were conducted through local offices of domestic agencies and interviews with the Mongolian government, interested parties, etc. were conducted.

Therefore, the cooperation projects for stationary sources led to the improvement and installation of electrostatic precipitators in the combined heat and power plants in Ulaanbaatar city, introduction of desulfurization facilities in the combined heat and power plants in Ulaanbaatar city, pilot installation of the workplace air pollutant management system (CleanSYS), and formulation of a project to introduce gas fired HOBs. Proposed policies were announced for carrying out the cooperation projects, Strengthening the implementation of installing air pollution prevention facilities, replacing the fuel of HOBs for reducing air pollution, etc. In particular, through discussions with local government agencies in Mongolia, the need for a remote monitoring system for managing air pollutants discharged from stacks at workplaces was identified. Therefore, a PCP was prepared for the stack remote monitoring system that measures the air pollutants discharged from stacks at workplaces constructed domestically with an automatic monitoring device for management 24 hours a day.

(2) Identification of cooperation projects for analysis of mobile source fuel and management system cooperation projects

Through the survey of the management system of the transportation system, such as diesel vehicles and buses, the status of mobile source management in Mongolia was identified, and then improvements were identified to launch the priority cooperation projects.

To identify the cooperation projects in the mobile source sector, the organizations, procedures, capacity of the management system for fuel quality inspection, approval and operational stages of transportations were investigated. After investigating the status of the sources in Mongolia with reference to the existing ambient air-related research data and national statistics in the transportation sector, the status was identified in detail through an interview with the Ministry of Road Traffic Development of Mongolia.

Based on the contents thus investigated, a list of the cooperation projects was prepared including the project for introduction of measuring device for implementing the emission gas inspection system, the project for pilot installation of DPF for reducing emissions from old diesel vehicles in Mongolia, and the project for expansion of the number of LPG gas and electric charging stations. As the policies for implementing the cooperation projects, the introduction of an old vehicle management system and the introduction of a vehicle fuel quality management system were proposed. Based on the cooperation projects thus identified, the priority projects were determined through consultation with local government agencies in Mongolia.

(3) Identification of basic design of the monitoring system and additional cooperation projects

The current ambient air quality monitoring system in Mongolia was investigated and analyzed, and based on these findings, it was decided to introduce the ICT-based ambient air quality measurement and monitoring system. Currently, 15 automatic monitoring networks are being constructed and operated in Ulaanbaatar, Mongolia, and through the 2019 EDCF feasibility investigation (service for the feasibility investigation of the expansion project of the National Environmental Research Institute in Mongolia), four additional Korean automatic monitoring devices are in progress of being installed with EDCF funds.

Through the monitoring system, the project for establishment of national ambient air quality monitoring information system (NAMIS in Korea) that collects and processes data from the automatic monitoring network currently installed in Mongolia, the project for improvement of air quality monitoring system of Mongolia (Air Korea in Korea) that delivers real time air quality to the public, the project for expansion of air pollution monitoring stations and the project for introduction of mobile air pollution monitoring stations (vehicles) were identified to prepare the PCP. Suggestions for policies to carry out the cooperation projects include establishment of the MP in the sector of air pollution monitoring networks, an air pollutant inventory system, and a hazardous air pollutant analysis system.

Further, since it is essential to strengthen the capabilities of related agencies in Mongolia in the ambient air quality management system, such as maintenance capabilities and data analysis abilities for the monitoring devices currently in operation, the PCP was prepared, including such contents.

[Reference] Ambient air measurement monitoring system in Korea

* National Ambient air Monitoring Information System (NAMIS): It is used as basic data for establishing air conservation policies by collecting, sorting, and statistically processing data from the national air pollution monitoring networks through the Internet and providing them to administrative agencies such as the national and local governments.
(https://www.namis.or.kr/cms/)

* Air Korea (National real-time air pollution level disclosure website): Through the disclosure of the national air pollution level and real-time pollution level, it meets public demand and contributes to preventing health consequences to people exposed to air pollution.
(https://www.airkorea.or.kr/web)

(4) Establishment of the master plan

Based on the ambient air quality management-related laws and policies (VISION 2050, NPRAEP, etc.) in Mongolia, the comprehensive master plan was established for the ambient air quality management sector.

To this end, laws, policies, emission standards, governance, status statistics, management systems, and technology levels for each source were investigated, and implementation strategies were determined to achieve the established goals. As the implementation strategies, not only the cooperation projects identified from this project but also the related support projects of other ministries were considered such that the projects could organically create a synergy. To increase the possibility of implementation, specific implementation plans for the formation of particular organizations, personnel, budgets, and financing plans are included for the priority cooperation projects.

It is very important to induce the active participation of the target country's government in projects targeting developing countries, such as the establishment of a master plan. This is because the form proposed unilaterally by the service agency is likely to lower its effect after the project is over. In this project, we tried to listen to local demand from the Mongolian government as much as possible through more than 30 official and practical meetings with the Ministry of Environment and Tourism and the related ministries of Mongolia, and therefore, to prepare solutions that can help solve local air management problems.

(5) Capacity building of local governments

Previously, it was scheduled that local government agencies and officials of Mongolia were invited to Korea where they would be shown the domestic ambient air quality management system and excellent ambient air quality technology. We planned on-site visits to the Korea Environment Corporation and the National Institute of Environmental Research, which operate the domestic atmospheric measurement monitoring system, and seminars to introduce policies such as recently strengthened domestic ambient air quality restrictions for Mongolian participants, but as the on-site visits and invitations to Korea became difficult due to COVID-19, the capacity building program was conducted online.

The online capacity building program invited excellent ambient air quality technology experts in Korea as instructors and was conducted for two days for government officials and experts who are performing ambient air quality-related work in Mongolia.

1.2.3 Project Implementation Entities

This project was carried out by constituting the consortium between ECO&PARTNERS Inc. and the Korea Environment Corporation. Further, the works were carried out by selecting the outsourced service agencies with expertise in individual sectors.

<Table 2> Status of the project implementation entities

Item	Name of agency	Contents of work
Host agency	ECO&PARTNERS Inc.	• Overall project management such as progress management, quality management, and report • Identification of the cooperation projects through consultation with each agency, consultation for selecting priority cooperation projects, writing, and supplementing the PCP, promoting the entry of domestic environmental companies in the ambient air quality sector, etc. • Literature research and master plan establishment, strengthening the capabilities and planning for post-program activities
Consortium	Korea Environment Corporation	• Preparation for the methods of standardization of the monitoring project-related system and the data collection system, and identification of the priority cooperation projects • Identification of the cooperation projects for the mobile sources (transport) management system • Planning and implementation of the invitational training for government officials of recipient countries
Outsourced service agencies	Incheon National University	• Investigating the air pollution influence factors and characteristics analysis through the ambient air quality modeling across Ulaanbaatar and designing the expansion (plan) of the air pollution monitoring stations
	KC Green Holdings	• Investigation of the status of stationary sources, and identification of improvement methods and cooperation projects
	CETECH Inc.	• Concept design diagram (proposal) of the ambient air quality monitoring system in Ulaanbaatar
	Soil&Habitat	• On-site investigation of the existing air pollution monitoring station in Ulaanbaatar (operation status and peripheral environment)
	Mongolian office of MIRECO	• Interview with the local ambient air quality management staff and collection of local data by visiting the relevant sites

1.3 Implementation Strategy and Method of the Project

1.3.1 Implementation Direction and Strategy of the Project

The most important thing of this project is to accurately identify the demands of the Mongolian government, and to this end, this task was carried out in consideration of three strategic directions.

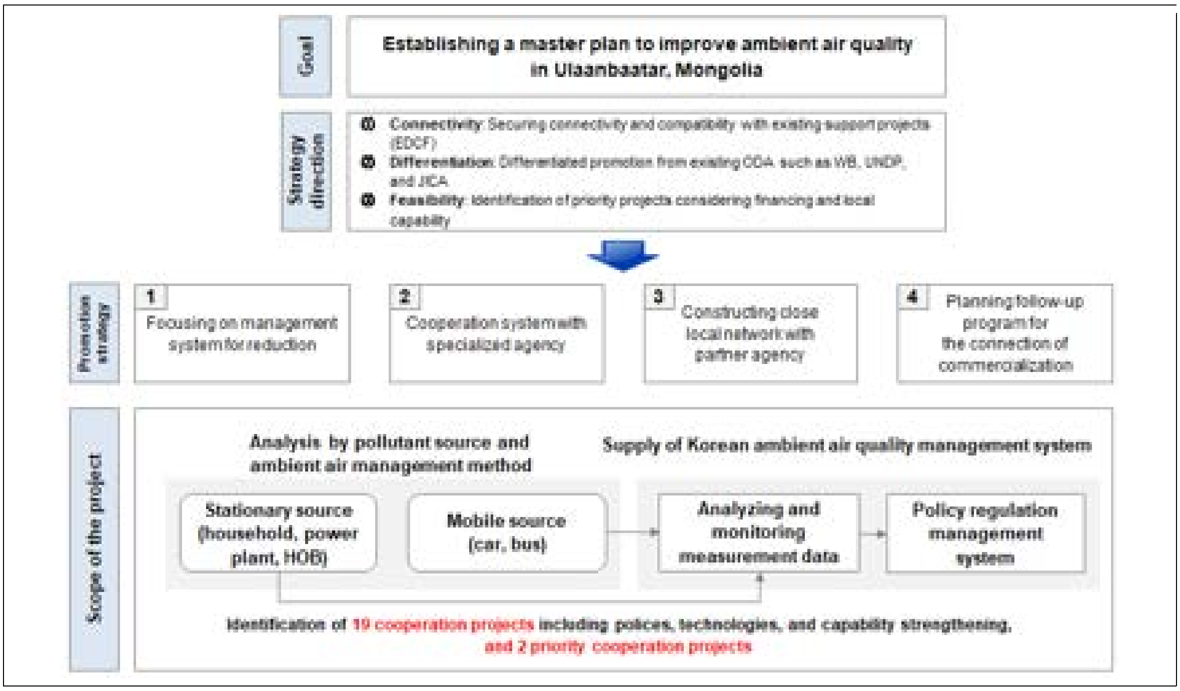
(1) Implementation direction

The first direction is connectivity. We intended to identify projects by firstly recognizing the existing domestic projects targeting Mongolia (e.g., the Economic Development Cooperation Fund (EDCF), the Korea International Cooperation Agency (KOICA), etc.) and connecting them to this project, to exhibit sysnergistic effiects.

The second direction is differentiation, and we checked the contents of projects carried out by other donation agencies such as the World Bank (WB), the United Nations Development Programme (UNDP), the Japan International Cooperation Agency (JICA), and the Asian Development Bank (ADB), and identified cooperation projects that compensate for the shortcomings of existing projects.

The third direction is feasibility, and we identified projects that were highly doable and within the capabilities and technology levels of the Mongolian government and proposed the financing method necessary for implementing them.

[Figure 4] Goals and scope of the project



(2) Implementation strategy

The first implementation strategy is to carry out a project focusing on a management system that reduces air pollution. In Mongolia, a number of projects focusing on air pollution reduction activities along with MDBs and donation agencies of other nations over the past 20 years were carried out. This project was promoted in a direction of fundamentally improving the ambient air quality management system by broadly investigating the management subject, restrictions, and operation status for each air pollutant source in Mongolia rather than individual activities targeting specific sources. In addition to the Ministry of Environment and Tourism that is the agency in charge in Mongolia, we sought to strengthen the ambient air quality management capabilities of Mongolia by listening to the ambient air quality management issues there and devising methods for improving them through several online meetings with related ministries and agencies for each pollutant source, such as the Ministry of Road and Transport Development, Ministry of Energy, National Agency of Meteorology and Environmental Monitoring.

The second implementation strategy is to construct a specialized agency for each pollutant source. ECO&PARTNERS Inc. identified local demand through communication with Mongolia and identified and specified the cooperation projects in consultation with specialized agencies in each sector. Further, it was in charge of establishing the master plan to investigate local governance, laws, systems, and the latest status of pollutants through literature and interviews and enhanced technical expertise of outputs by constructing a cooperation system involving specialized agencies for each air pollutant source such as stationary and mobile pollutant sources and monitoring them. KC Green Holdings participated, as experts, in stationary sources such as power plants and HOBs, the department of vehicle air pollutant management system operation in the Korea Environment Corporation, Ceracomb Inc., and INSUN Motors participated in the mobile sources, and the Korea Environment Corporation, Incheon National University, and CETECH Inc. participated in monitoring.

The third implementation strategy is work Implementation through close networking with local partners. We consulted several times online with the Nature Resource Management Bureau of the Ministry of Environment and Tourism of Mongolia that is the general business partner of this project, and ministries and management subjects in charge of each sector in Mongolia, and actively utilized the local network owned by the performing team.

The fourth implementation strategy is to propose a follow-up program for future commercialization. To practically implement the cooperation projects identified through this task, it was proposed as the priority cooperation project in connection with the ministry's ODA budget and EDCF loan for material and equipment.

[Figure 5] Organizational chart for the project execution

1.3.2 Implementation System of the Project

(1) Specialized agency cooperation system for each pollutant source

To successfully carry out the scope of tasks for various pollutants, the participation of specialized agencies for each pollutant source is essential, and there is a need for the specialized capabilities to integrate proposals and cooperation projects derived from each sector, and to establish a master plan encompassing all sectors of ambient air quality management. Therefore, ECO&PARTNERS Inc., the host agency was in charge of establishing a master plan that reflects the policy proposals and cooperation projects identified for each pollutant source, and the Korea Environment Corporation, which served to lead the air pollutant measurement monitoring sector, was formed as a consortium to carry out this task.

KC Green Holdings (KC Cottrell Holding Company) that is a leading company in the field of air pollution prevention equipment in Korea participated as the outsourced service agency in identifying the cooperation projects for the stationary sources such as power plants and heaters for households. The cooperation project in the field of mobile sources was promoted mainly by the Korea Environment Corporation, which operates the air pollutant management system for vehicles. Incheon National University identified the air pollution influence factors and designed the expansion plan of the air pollution monitoring stations, and CETECH Inc. developed the conceptual design diagram for the ambient air quality monitoring system.

(2) Form a close network with local partners

Along with the Ministry of Environment and Tourism of Mongolia, a cooperation system was established with local agencies with expertise for each pollutant source in Mongolia to identify cooperation projects for each sector. In particular, in situations where it is difficult to visit the site due to COVID-19, the project was smoothly promoted by recruiting an agency capable of visiting Mongolia and conducting interviews with officials on behalf of the performing entities.

[Reference] Current status of the Mongolian network construction

National Agency of Meteorology and Environmental Monitoring (NAMEM) and Central Laboratory for Environmental Monitoring (CLEM)	The Korea Environment Corporation maintains its related partnership in the monitoring sector through the National Agency of Meteorology and the Environmental Monitoring of Mongolia (NAMEM) and its sub-organization, the Central Laboratory for Environmental Monitoring (CLEM) when carrying out the FS service for expansion project of the Laboratory for Environmental Monitoring that is the Economic Development Cooperation Fund (EDCF) project of the Export-Import Bank of Korea.
Soil&Habitat	This agency was established to ensure sustainable soil and environmental management in Mongolia. The agency conducts joint research and education projects with the international community through a network of researchers, and in this task, provides data such as on-site investigation and measurement data for each air pollution monitoring station in Ulaanbaatar City.
MIRECO MGL (Mine Reclamation Corp. Mongolia)	It was established in Mongolia on May 27, 2010 as the Mongolian office of the Mine Reclamation Corporation in Korea, and has been in close cooperation with Mongolian government agencies by conducting business cooperation with the Mongolian government and international development cooperation projects (ODA) in the field of mining hazards prevention business for many years. Through this experience, it maintains partnerships with local government agencies (the Ministry of Environment and Tourism, the Ministry of Energy, etc.). In this project, this partnership conducts on-site investigations of this project, such as interviews with officials of each government agency and visits stationary source facilities.

1.4 Procedure for the Project Implementation

This project has been implemented through video conference between concerned parties both from Korea and Mongolia, literature research, site visits through a local consulting firm, etc. since it was launched on May 19, 2020. In particular, the work meetings were carried out through online video conferences using a video conference system considerting that it was difficult to visit the local sites because of COVID-19. The original project period was about 12 months—from May 2020 to May 2021, but the project was carried out for about 14 months as the project end date was extended to July 2021 because it was difficult to search the local data and to have meetings with the local agencies because of COVID-19.

The issues and necessary improvements for individual sectors were identified through video conferences with the Ministry of Environment and Tourism of Mongolia, which is in charge of the project, and four relevant authories (UB Mayor’s Office, the Ministry of Road and Transport Development, NAMEM, and APRD), and the literature research was performed by requesting the information, such as data, laws and regulations necessary for understanding the status of Mongolia. In addition, the response actions for the matters (PCP, LOI, etc.) necessary for implementing the priority cooperation projects in Mongolia was taken through continuous work meetings with the Ministry of Environment and Tourism in charge of this project.

[Figure 6] Main implementation status by month

This task was carried out through a close cooperation through the official and working meetings with Mongolia. The status related to works was shared through the interim report meeting, final report meeting, etc., and further, the works were implemented through capacity building progrmas, workshops and work meetings between domestic project agencies, etc.

❍ **Major meetings between Korea and Mongolia**

- **Korea·Mongolia kick-off pre-meeting (1st)**

Date	2020. 7. 1, 11:30-12:30
Venue	Video conference / KEITI
Participants	• Korea: KEITI, ECO&PARTNERS Inc., Korea Environment Corporation • Mongolia: Ministry of Environment and Tourism
Contents	• Introduction and greetings for the Korean performing entities formulating the project of establishing a master plan in Mongolia - ECO&PARTNERS Inc., Korea Environment Corporation • Introduction and greetings for the Ministry of Environment and Tourism of Mongolia • Pre-discussion on preparation for the kick-off meeting - Meeting schedule, meeting progress method, etc. • Request feedback and other opinions on the Inception Report (IR) sent from Korea • Request for designation of a person to be in charge of the project in Mongolia and provide necessary data
Pictures	 
IR (Mongolian)	 

- **Korea·Mongolia kick-off pre-meeting (2nd)**

Date	2020. 8. 7, 10:00-12:00
Venue	Video conference / Korea: KEITI
Participants	• Korea: KEITI, ECO&PARTNERS Inc., Korea Environment Corporation • Mongolia: Ministry of Environment and Tourism
Contents	• Request for confirming IR data and IA documents from Mongolia - Request for selection of projects that need to be reviewed intensively among cooperation projects • Request for cooperation in signing a contract for outsourcing services and visiting local agencies • Difficulties with on-site visits due to COVID-19 - Long term on-site work will be conducted, if a business trip to Mongolia is available • Specific discussion before Kick-off meeting • Re-discussion of the meeting schedule, request for a list of participants from Mongolia, etc. • Agreed that the main performance report will be written in Mongolian
Pictures	 
Meeting materials	 

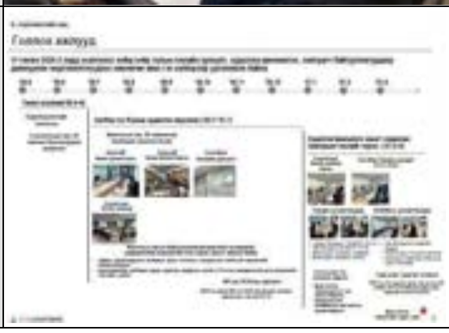
- **Korea·Mongolia online work meeting**

Date	2020. 9. 16, 10:00-10:50	
Venue	Video conference	
Participants	• Korea: KEITI, ECO&PARTNERS Inc., Korea Environment Corporation • Mongolia: Ministry of Environment and Tourism	
Contents	• Introduction of the agencies and officials in charge of sharing the contents of the project for the new director of the Ministry of Environment and Tourism in Mongolia - Mongolia: Introduction of the new director (Batmunkh) of the Ministry of Environment and Tourism - Korea: Introduction of the agencies in charge such as KEITI, ECO&PARTNERS Inc., and Korea Environment Corporation • Feedback on comments on IR data from Mongolia and confirmation of demand for priority cooperation projects - Korea's reflection of three priority cooperation projects preferentially considered by Mongolia in the master plan - Mongolia's planning to respond to data requests related to IR data of Korea • Discussion on contracts for local experts in Mongolia - Korea's request for video conferencing with local experts of the Ministry of Environment and Tourism of Mongolia - Mongolia's planning to share them after the schedule is established • Discussion on the schedule of the official Kick-off meeting - Mongolia's proceeding with the kick-off meeting after the personnel transfer of the Bureau of Climate Change Cooperation - Korea's trying to proceed with the work as soon as possible even if the official kick-off meeting is delayed	
Pictures		

- **Priority cooperation projects-related Korea·Mongolia meeting**

Date	2021. 2. 4, 13:00-14:30
Venue	Video conference / Inspire biz center
Participants	• Korea: KEITI, ECO&PARTNERS Inc., Korea Environment Corporation • Mongolia: Ministry of Environment and Tourism
Contents	• Korea's request for sharing of data investigation related to Mongolia's air pollution and feedback - Policies: (Mongolia) Investigation of national development plans, and ambient air-related policies and laws (Korea) investigation of ambient air-related laws, policies, standards, etc. - Policy proposal: Proposals (3 cases) such as the project of improving the management system of the Heat only Boilers (HOBs) • Share detailed contents of the priority cooperation projects (proposal) and exchange opinions therefor ① Establishment of a public air pollutant information disclosure system (Air Mongolia) (monitoring) - A function is proposed to collect and process data through an automatic monitoring network and to deliver real-time air pollution level to the public (Air Korea in Korea) ② Expansive installation of automatic monitoring stations in Ulaanbaatar (monitoring) - Currently, 13 automatic monitoring networks are being constructed and operated in Ulaanbaatar City, and additional installations of automatic monitoring stations are proposed. ③ [Candidate project] Project of streamlining the power plants and HOBs (stationary sources) - Confirmation of the degree of aging of the power plants and HOB facilities in Mongolia and improvement in energy efficiency • Re-request for establishing a meeting schedule with officials for each pollutant source in Mongolia - Mongolia is planning to establish and share the meeting schedule after February 23, the Mongolian New Year holiday • Discussion on the schedule of high-level video conference between Korea and Mongolia - Mongolia is planning to reply with an available schedule in February
Pictures	 

- **Intermediate reporting meeting**

Date	2021. 3. 25, 11:00-14:30
Venue	Video conference / Aloft Seoul Myeongdong
Participants	• Korea: KEITI, ECO&PARTNERS Inc., Korea Environment Corporation • Mongolia: The Ministry of Environment and Tourism, the Ministry of Road and Transport Development, the Department of Mine Heavy Industries, the National Agency of Meteorology and the Environmental Monitoring, the CLEM, the Mayor's Office of Ulaanbaatar, and the APRD
Contents	• Greetings and Sharing progress status • Sharing the contents of the data and status investigations for each sector - Results of literature research such as national plans, laws, policies, and standards - Status data of Mongolia identified through literature research, interviews, etc. • Sharing and discussion of details related to the priority cooperation projects - Priority selection of three priority cooperation projects and discussion on the possibility of connecting ODA projects ✓ (Project) Installation of prevention equipment of the power plants ✓ (Project) Improvements and expansions of the ambient air quality monitoring system ✓ (KSP) Introduction of the policy for the fuel quality management system - Sharing of work processes such as preparing the PCP for business connection of the priority cooperation projects and submission of the LOI to the recipient general organization • Sharing of future schedules (transmission of LOI of Mongolia, preparation of PCP, etc.)
Pictures	 
Data	 

- **Final reporting meeting**

Date	2021. 7. 23, 15:30-16:30	
Venue	Video conference / HJ biz center	
Participants	• Korea: KEITI, ECO&PARTNERS Inc., Korea Environment Corporation • Mongolia: Ministry of Environment and Tourism	
Contents	• Sharing the results of promoting the master plan project for improving the ambient air quality in the UB City - Details of the cooperation projects in stationary, mobile sources and monitoring - Details of the priority cooperation projects (2 cases) ✓ Project of the ICT-based integrated ambient air quality management system ✓ Installation of pollution prevention equipment of the combined heat&power plant (TES-4) in the UB City - Details of the main projects (2 cases) ✓ Introduction of gas fuel HOBs in the UB City ✓ Introduction of the DPF for reducing emissions from old diesel vehicles in Mongolia - ODA implementation status of the ministries (PCP, LOI, etc.) • Sharing the performance spread and sharing the implementation contents - Introduction of the work related to improving ambient air quality in Mongolia through the construction of webpage - Planning to be produced in Korean, Mongolian, and English for sharing the performance capabilities - Contents of performing the capacity building	
Pictures		
Data		

❍ **Work meeting for each pollutant source: stationary sources**

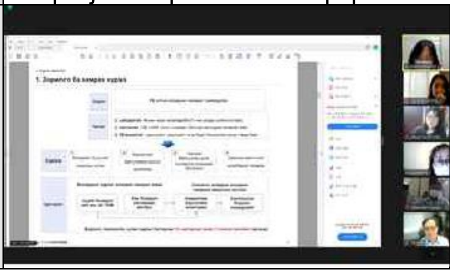
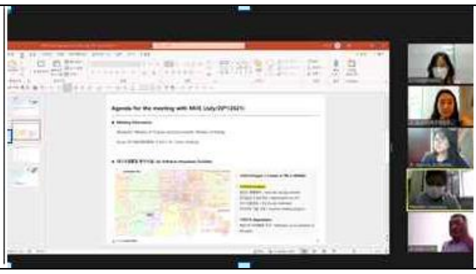
- **Expert advice in the area of stationary sources in Korea**

Date	2021. 3. 15. - 2021. 4. 14. (4 weeks)	2021. 3. 18, 10:00-11:30
Overview	• Consulting with local experts about on-site data investigation and on-site visits related to the stationary sources	• Discussion on the implementation direction and practical work of on-site investigation in the sector of stationary sources of Mongolia
Participants	• Korea: ECO&PARTNERS Inc., MIRECO MGL	• Korea: ECO&PARTNERS Inc., KC Green Holdings, Mine Reclamation Corporation, MIRECO MGL
Contents	• Due to the difficulty in visiting Mongolia because of COVID-19, interviews with local ambient air quality management officials and on-site visits are conducted by local agencies • Agencies scheduled to have interviews and visit facilities: The Ministry of Energy, the Mayor's Office of Ulaanbaatar, the APRD, etc.	• Introduction of each project official and MP project • Sharing the progress status of priority cooperation projects related to stationary sources • Discussion of requests related to cooperation projects • Other questions related to the status of Mongolia

- **Meeting with officials of the stationary sources (Mayor's Office of Mongolia)**

Date	2021. 2. 24, 12:00-14:30
Venue	Video conference / ECO&PARTNERS Inc.
Participants	• Korea: ECO&PARTNERS Inc., KC Green Holdings • Mongolia: The Ministry of Environment and Tourism, the Mayor's Office of Mongolia
Contents	• Sharing the contents of data investigation such as the status and laws related to stationary sources in Korea and exchange of opinions therefor • Discussion on the cooperation projects (introduction of the new gas Heat Only Boilers, introduction and replacement of prevention equipment in existing large HOBs, etc.) • Request for the necessary data for Mongolia
Pictures	 

- **Meeting with officials of the stationary sources in Mongolia (Ministry of Energy and TES-4 power plant)**

Date	2021. 7. 20, 11:00-13:30
Venue	Video conference / ECO&PARTNERS Inc.
Participants	• Korea: ECO&PARTNERS Inc., Korea Environment Corporation • Mongolia: Ministry of Environment and Tourism, Ministry of Energy, TES-4
Contents	• Sharing the contents of the master plan project of Korea • Inquires about the TES-4 operation status and prevention equipment • Inquiries to obtain the opinions of Mongolian officials on the installation project of prevention equipment for TES-4 boilers
Pictures	 

- **Request for expert advice in the area of stationary sources in Korea**

Date	2021. 7. 15 - 7. 31 (Two weeks)
Overview	Listening to the details of Gas Boiler and detailed advice on methods for improving the ambient air quality of Mongolia
Participants	• Daeyeol Boiler
Contents	• Shairng experiences of gas boiler installation in Mongolia - Detailed status of introducing gas boilers and related laws, etc. • Sharing of domestic gas boiler introduction experiences • Suggestions for detailed methods for improving the ambient air quality in the stationary sources of Mongolia - Proposal of improvement measure necessary for the introduction of Mongolia gas boilers
Results	1 copy of expert report

❍ **Work meeting for each pollutant source: Mobile source**

- **Meeting with officials of mobile sources in Mongolia (Ministry of Road and Transport Development**

Date	2021. 2. 24, 12:00-14:30
Venue	Video conference / ECO&PARTNERS Inc.
Participants	• Korea: ECO&PARTNERS Inc. • Mongolia: The Ministry of Environment and Tourism, the Ministry of Road and Transport Development
Contents	• Sharing the contents of literature investigation such as laws, policies, and standards related to the mobile sources in Korea and exchange of opinions therefor • Discussion on cooperation projects in the area of mobile sources (frequent regular inspections, attachment of diesel particulate filter (DPF), etc.) • Request for the necessary data for Mongolia
Pictures	 

- **Request for expert advice in the area of mobile sources in Korea**

Date	2021. 7. 15 - 7. 31 (Two weeks)
Overview	Listening to the details of DPF (Smoke Reduction Device) and detailed advice on methods for improving the ambient air quality of Mongolia
Participants	• Ceracomb Inc.
Contents	• Details of DPF technology - Technology overview, technology features, air pollution reduction effects, etc. • Sharing detailed status of entry of DPF into Mongolia of Ceracomb Inc. - DPF features that reflect domestic technology - Detailed status of introducing DPF of Mongolia • Proposal of detailed methods for improving the ambient air quality in the transport area of Mongolia
Results	1 copy of expert report

Date	2020. 10. 8 - 10. 31 (three weeks)
Overview	Understanding of detailed status for vehicle management through expert advice of mobile sources
Participants	• Ceracomb Inc.
Contents	• Status of vehicle management in Mongolia - Sharing laws and policies related to vehicle management - Data investigation such as national programs and plans in Mongolia • Status of vehicle management in Korea - Literature research on the status of laws and policies related to vehicle management in Korea • Sharing implementation status of the project for attaching smoke reduction devices in Mongolia • Proposal of the ambient air quality improvement (proposal) in the transportation sector of Mongolia
Results	1 copy of expert report

- **Request for expert advice and meeting concerning mobile sources in Korea**

Date	2021. 2. 22, 14:30-16:00
Venue	Korea Environment Corporation
Participants	• Korea: ECO&PARTNERS Inc., Korea Environment Corporation
Contents	• Sharing contents of investigation on laws and policies related to mobile sources in Korea - Law: Clean Air Conservation Act, Air quality management Area Act - Permissible emission standard: The permissible emission standard of the manufactured vehicle, the permissible emission standard of the operating vehicle, and the permissible emission standard of the low-pollution vehicle - Fuel quality standard: Gasoline quality standard for vehicles, diesel and gasoline quality standards • Sharing contents of investigation on laws and policies related to mobile sources in Mongolia - Law: Law on Air - Permissible emission standard: Diesel vehicle (MNS5014:2009), Gasoline vehicle (MNS5013:2009) - Fuel quality standard: Diesel fuel (MNS6861:2020), unleaded gasoline (MNS0217:2017) - Other standards: DPF installation and use standard (MNS6757:2019)
Pictures	 

❍ **Work meeting for each pollutant source: Monitoring**

- **Meeting officials of related agencies in Mongolia: APRD**

Date	2021. 2. 25, 12:00-13:00
Venue	Video conference / ECO&PARTNERS Inc.
Participants	Korea: ECO&PARTNERS Inc., Korea Environment Corporation Mongolia: The Ministry of Environment and Tourism, the Ulaanbaatar City Air Pollution Reduction Department (APRD)
Contents	• Sharing the status of air pollution measurement data management in Ulaanbaatar City • Inquires and discussions related to future monitoring improvement plans in Ulaanbaatar City • Sharing the status related to emission measurement of stationary sources • Request for the necessary data for Mongolia
Pictures	 

- **Meeting with officials of related agencies in Mongolia: NAMEM**

Date	2021. 2. 25, 13:00-15:00
Venue	Video conference / ECO&PARTNERS Inc.
Participants	• Korea: ECO&PARTNERS Inc., Korea Environment Corporation • Mongolia: The Ministry of Environment and Tourism, the National Agency for Meteorology and Environment Monitoring of Mongolia (NAMEM)
Contents	• Sharing the operational status of the air pollution disclosure system (Agaar) of Mongolia • Discussion related to cooperation projects in the monitoring sector • Request for the necessary data for Mongolia
Pictures	 

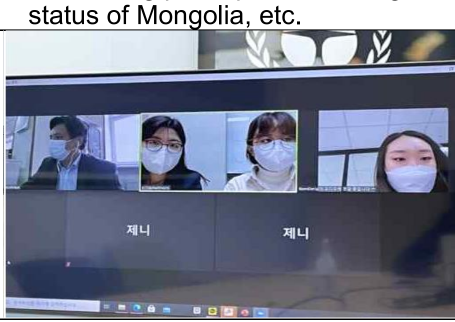
❍ **Work meeting with the Ministry of Environment and Tourism**

- **Sharing laws and data of Mongolia**

Date	2021. 2. 26, 16:30-19:00	2021. 3. 2, 13:00-15:00
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Sharing vehicle statistics and related laws of Mongolia	• Sharing data related to fuel use in Mongolia
Pictures		

Date	2021. 3. 3, 13:00-15:00	2021. 3. 31, 11:00-13:00
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Sharing detailed data on ambient air-related laws of Mongolia	• Sharing the Official Development Assistance (ODA) process of Korea • Sharing required materials of Mongolia side (LOI, PCP, etc.)
Pictures		

- **Pre-meeting of intermediate reporting meeting**

Date	2021. 3. 10, 13:30-15:00	2021. 3. 24, 10:00-11:00
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Detailed discussion on holding the intermediate reporting meeting	• Pre-consultation on the intermediate reporting meeting • Confirming participants, sharing the status of Mongolia, etc.
Pictures		

- **Meeting for PCP preparation and LOI submission process, and planning of capacity building program**

Date	2021. 4. 9, 12:30-14:30	2021. 4. 16, 14:00-16:00
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Sharing detailed contents related to the preparation of PCP • Sharing contents necessary for preparing for each item of PCP	• Modifying details of PCP and requesting necessary data thereof
Pictures		

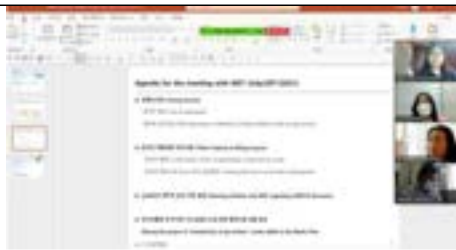
Date	2021. 4. 20, 14:00-16:00	2021. 4. 27, 14:00-15:30
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Reselecting PCP preparation project • Discussion on PCP implementation schedule	• Discussion on PCP preparation contents and future preparation direction • Discussion on the progress status of PCP administrative documents • Sharing contents of CleanSYS, Air Korea, and NAMIS
Pictures		

Date	2021. 6. 7, 14:00-16:30	2021. 6. 11, 12:00-13:00
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Discussion on PCP preparation contents • Discussion on the progress status of LOI and PCP • Discussion on implementation plans for the capacity building program	• Discussion on procedure and participant of the capacity building program • Discussion on scheduling the final reporting meeting • Inquires about the progress status of PCP and LOI
Pictures		

Date	2021. 6. 15, 09:00-11:30	2021. 6. 18, 10:00-12:30
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Discussion on procedure and participant of the capacity building program • Discussion on scheduling the final reporting meeting • Discussion on the progress status of LOI and PCP	• Discussion on the progress procedure of the capacity building program • Discussion on the progress status of PCP and LOI
Pictures		

Date	2021. 6. 23, 09:00-11:30	2021. 6. 28, 10:00-11:00
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Discussion on invitation training implementation plan (proposal) • Discussion on submission schedule of LOI and PCP • Inquiries about the status of meeting schedule established by the Ministry of Energy	• Request to share application documents for quarantine exemption • Discussion on submission schedule of PCP and LOI
Pictures		

Date	2021. 6. 29, 16:30-17:30	2021. 6. 30, 14:00-16:00
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Sharing changes related to the invitation training schedule • Discussion on details of flight ticket, participant list, etc.	• Discussion on invitation training schedule and invitation training (proposal)
Pictures		

Date	2021. 7. 8, 11:00-13:00	2021. 7. 20, 11:00-13:30
Venue	Video conference / ECO&PARTNERS Inc.	Video conference / ECO&PARTNERS Inc.
Contents	• Inquires about the role of the Ministry of Environment and Tourism • Discussion on project to convert fuel and replace boilers • Confirming the progress status of LOI	• Discussion on participants and presentation materials of the final reporting meeting • Discussion on project of introducing gas boilers
Pictures		

Date	2021. 7. 27, 11:00-13:00	2021. 7. 28, 14:00-15:00
Venue	Phone conference / Papain dessert cafe in Magok	Video conference / Magoknaru Business Center
Contents	• Discussion on preparation for submitting documents to the Ministry of Finance of Mongolia • Inquires about meeting schedule with the Ministry of Finance related to preparation of PCP	• Discussion on distribution of certificate of completion to capacity building participants • Discussion on submitting documents to the Ministry of Finance
Pictures		

Date	2021. 7. 29, 17:00-18:00
Venue	Video conference / ECO&PARTNERS Inc.
Contents	• Confirming whether the documents are submitted to the Ministry of Finance • Sharing modifications of PCP • Discussion on the schedule of sending the invitation training presentation materials
Pictures	

❍ Meeting between project performing entities

- **Meeting between host agency and consortium entities**

Date	2020. 7. 6, 15:00-16:30
Venue	ECO&PARTNERS Inc.
Participants	• Korea: ECO&PARTNERS Inc., Korea Environment Corporation
Contents	• Discussion on detailed implementation direction of the task • Discussion on holding workshop between domestic agencies • Detailed discussion on the progress of business expenses, such as outsourcing service contracts
Pictures	 

Date	2021.05.11., 14:55-16:30	2021.05.20., 14:50-17:00
Venue	Starbucks at Balsan Station	Starbucks at Balsan Station
Contents	• Discussion on PCP preparation method and submission schedule • Discussion on meeting agenda with the Ministry of Environment and Tourism of Mongolia	• Discussion on PCP preparation contents of the priority cooperation projects

Date	2021.06.22., 14:30-17:00	2021.07.15., 14:00-17:00
Venue	Starbucks at Balsan Station	Magoknaru Business Center
Contents	• Discussion on details of the invitation training program (such as flight ticket, quarantine issue, and progress method)	• Discussion on detailed implementation contents of online capacity building • Explanation of educational materials of online capacity building

- **Workshop between domestic agencies (1st)**

Date	2020. 7. 24, 14:00-16:30
Venue	Conference room of Vabien in Seoul
Participants	• Host agency: The Ministry of Environment, the Korea Environmental Industry & Technology Institute • Participating agency: ECO&PARTNERS Inc. the Korea Environment Corporation, KC Green Holdings, KC Cottrell, and CETECH Inc. • External expert agency: Insun Motors Co. Inc., Ceracomb Inc., and Korea Petroleum Quality & Distribution Authority
Contents	• Introduction of the project for supporting the establishment of the master plan for environmental improvement in developing countries - Business introduction, consultation trends of the Mongolian government, etc. • Progress plan and status of the project for supporting the establishment of the Master Plan for Ambient Air Quality Improvement in Mongolia - ECO&PARTNERS Inc.: Results of domestic and international literature research and future progress plan - Korea Environment Corporation: Ambient air quality monitoring system - KC Green Holdings: Method for reducing air pollutants of thermal power plants • Sharing previous experience of Mongolia for each participating agency - Insun Motors Co. Inc.: Experience on entry of waste vehicle disposal market into Mongolia - Ceracomb Inc.: Experience on entry of the air pollutant reduction device of transportation vehicles of Mongolia - Korea Petroleum Quality & Distribution Authority: Method for petroleum fuel management system of Mongolia and work schedule • Discussion on future implementation plan of MP business
Pictures	 
Materials	 

- **Workshop between domestic agencies (2nd)**

Date	2021. 2. 4, 15:00-17:30
Venue	Inspire Biz Center
Participants	• Host agency: The Ministry of Environment, the Korea Environmental Industry & Technology Institute • Participating agency: ECO&PARTNERS Inc. the Korea Environment Corporation, Incheon National University, KC Green Holdings, and CETECH Inc.
Contents	• Sharing the implementation status for each area such as the stationary and mobile sources, and monitoring - Sharing the status of laws, policies, and governance related to ambient air quality management (ECO&PARTNERS Inc.) - Stationary sources (KC Green Holdings): Sharing the investigation results of the emission standards for air pollutants related to stationary sources, status of combined heat and power plants and boilers, emission status, and fuel use status in Mongolia - Mobile sources (ECO&PARTNERS Inc.): Sharing the investigation results of the emission standards for air pollutants related to mobile sources, fuel standards, vehicle registration status, emission status, and other pollutant sources in Mongolia - Monitoring (Korea Environment Corporation): Correction of MP establishment goals in monitoring and sharing of investigation contents related to improving the monitoring network and the status of Mongolia's air pollution monitoring system • Exchange opinions on the data investigation contents for each area - ECO&PARTNERS Inc.: Need to verify investigation data in the sector of mobile sources - KC Green Holdings: Need to secure reliable data through service agencies in Mongolia - Korea Environment Corporation: Absence of reliability of the ambient air quality data of Agaar in Mongolia - Incheon National University: Sharing review opinions on installation locations for additional monitoring stations • Discussion on the future implementation schedule of the master plan project
Pictures	 
Materials	 

1.5 Main Implementation Activities

1.5.1 Performing Online capacity building Event

At the beginning of the project, the invitational visits to Korea and local seminar programs were planned to strengthen the ambient air quality management capabilities of the environmental policy managers in Mongolia, but because of COVID-19, those events were replaced with online education using Zoom. To enhance the educational effects, the training materials were translated into Mongolian, and the trainings were conducted as a simultaneous interpretation of Korean-Mongolian. The online capacity building was conducted for 2 days, in which on the first day, major environmental management policies in Korea were introduced with the educational contents centered on policies. On the second day, as practical contents were planned, it was possible to introduce expertise in operating the air pollutant prevention equipment of the thermal power plant, expertise in fuel quality management, and the main ambient air quality monitoring systems in Korea. After the sessions were completed, another session for questions and answers was held to allow the officials from Mongolia were able to freely discuss questions, local issues, etc. related to ambient air quality management.

<Table 3> Schedule for the capacity building program

Date (based on Korean time)		Name of curriculum	Educational agency
2021.7.21 (Wednesday) **Policy-level section**	10:00	Orientation	Korea Environment Corporation
	11:00	① Ambient air quality management system in Korea	Korea Environment Corporation
	13:00	Lunch break	
	14:00	② Eco-friendly automobile management policy	Korea Environment Corporation
	16:00	③ Total air pollutant amount management system	Korea Environment Corporation
2021.7.22. (Thursday) **Working-level section**	11:00	④ Understanding the prevention equipment of the thermal power plant	KC Green Holdings
	13:00	Lunch break	
	14:00	⑤ Fuel quality monitoring method	Korea Petroleum Quality & Distribution Authority
	16:00	⑥ Practice with the ambient air quality monitoring system	Korea Environment Corporation

This capability strengthening program was attended by a total of 15 people from 12 agencies, including the Ministry of Energy, the Ministry of Road and Transport Development, the Ministry of Mining and Heavy Industry, the National Agency of Meteorology and the Environmental Monitoring of Mongolia (NAMEM), the Air Pollution Reduction Department in Ulaanbaatar (APRD), the National Environmental Pollution Reduction Committee, the Energy Regulation Committee, TES-4 (combined heat and power plant), and the National University of Mongolia in addition to the Ministry of Environment and Tourism that is Mongolia's agency in charge of the project for supporting the establishment of the master plan in Mongolia.

<Table 4> Participants in the capacity building program

No.	Affiliated organizations		Name	Position
1	Ministry of Environment and Tourism	Environmental and Natural Resources Management Bureau	Munkhbat. Ts	Official
2	National Agency of Meteorology and the Environmental Monitoring of Mongolia (NAMEM)	Environmental Inspection Department	Batbayar.J	Department Head
3	National Agency of Meteorology and the Environmental Monitoring of Mongolia (NAMEM)	Environmental Inspection Department	Bayarmagnai.J	Official
4	National Agency of Meteorology and the Environmental Monitoring of Mongolia (NAMEM)	Central Laboratory for Environmental Monitoring (CLEM)	Barkhasragchaa.B	Department Head
5	Ministry of Mining and Heavy Industry	Petroleum Policy Bureau	Davaabayar.D	Official
6	Ministry of Road and Transport Development	Road Policy Execution Coordination Bureau	Khavidolda.Sh	Official
7	Ministry of Road and Transport Development	Road Policy Execution Coordination Bureau	Nansalmaa.S	Official
8	Ministry of Energy	Energy Policy Execution and Coordination Bureau	Enkhtur.B	Official
9	Ministry of Energy	Fuel Policy Execution and Coordination Bureau	Bekh-Ochir.N	Official
10	Ministry of Energy	TES-4	Burenjargal.B	Ecologist and control engineer
11	Ulaanbaatar City Air Pollution Reduction Department (APRD)	-	Tsolmon.Ts	Vice Chairman
12	Ulaanbaatar City Air Pollution Reduction Department (APRD)	Ambient Air Quality Monitoring Department	Davaajargal.D	Department Head
13	Energy Restriction Committee	Metropolitan Management Committee	Lkhagvadulam. B	Commissioner
14	National University of Mongolia	Environmental Chemistry and Geochemical Research Institute	Soyol Erdene.Ts	Professor
15	National Environmental Pollution Reduction Committee	-	Odontungalag.D	Commissioner

1.5.1.1 Status of capacity building (1st Day) (Policy-level)

(1) Ambient air quality management system in Korea

In this lecture, the Korea Environment Corporation explained the ambient air quality management system in Korea. In Korea, the ambient air quality management system is classified into two categories: emission source management and ambient air quality monitoring. First, concerning emission source management, the following management systems have been introduced: CAPSS that manages the total amount of emissions in the country, SEMS that manages stack emissions, Cleansys that monitors real-time stack emissions, and total amount management system that manages total emissions in the workplace. Regarding the ambient air quality monitoring system, NAMIS collects and manages data in real time from various types of monitoring stations.

[Figure 7] Status of capacity building (1st day) (Monitoring section)

(2) Eco-friendly automobile management policy

The Korea Environment Corporation shared the eco-friendly automobile management policy in Korea as the management policy in the sector of mobile sources. It explained the necessity and technology road map of supplying eco-friendly automobiles and explained policies of supplying various eco-friendly automobiles. The policies were introduced by being classified into ① Strengthening the supply target system for each stage, ② Developing the supply of various eco-friendly automobiles, ③ Implementing the mandatory purchase system for eco-friendly automobiles in the public sector, ④ Supplying the eco-friendly automobiles focusing on public transportation, ⑤ Expanding the installation of charging convenient facilities, and ⑥ Strengthening purchase support for eco-friendly automobiles.

[Figure 8] Status of capacity building (1st day) (Mobile source section)

(3) Total Air Pollution Load Management System

As an air pollutant management system for the stationary sources, the Total Air Pollution Load Management System were introduced by the Korea Environment Corporation. The Total Air Pollution Load Management System restricts the total amount of air pollutant emissions at workplaces in the ambient air quality management sector. This system supplements the limitations of the concentration management method by allocating the total amount of emissions allowed by a workplace, and the workplace is able to sell to other operators within the total amount of emissions allowed by year. After the installation of the real-time monitoring system for stacks in Mongolia, the need for general concentration restrictions and special total amount restrictions was explained as a means of utilizing the produced data.

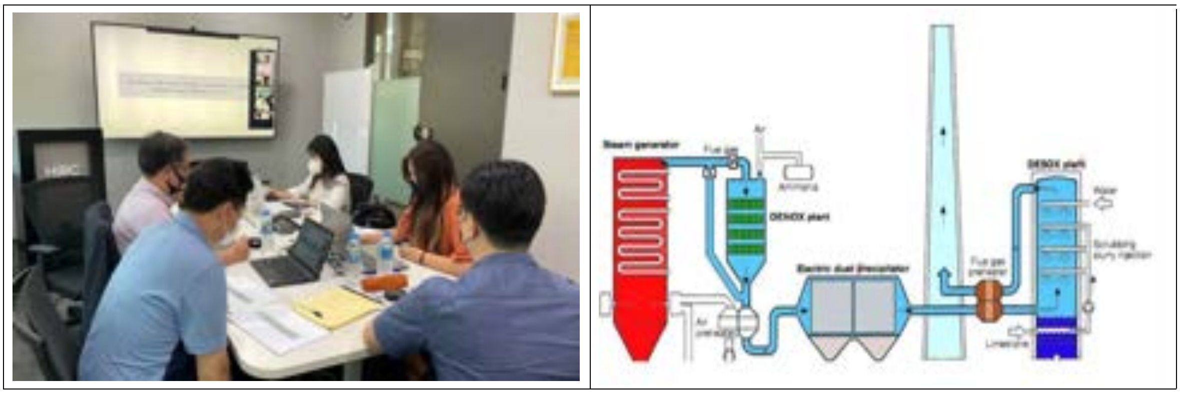
[Figure 9] Status of capacity building (1st day) (Stationary source section)

1.5.1.2 Status of capacity building (2nd Day) (working-level)

(1) Understanding the prevention equipment of the thermal power plant

KC Green Holdings, a domestic pollution prevention equipment specialized company, shared the air pollution prevention procedure technology and examples in Korea for thermal power plants, an example of a stationary source. Prevention equipment introduced included dust collecting equipment (electrostatic precipitators), desulfurization equipment (wet and dry), dehydration equipment (SCR), and ultrafine dust prevention equipment.

[Figure 10] Status of capacity building (2nd day) (Stationary source section)



(2) Fuel quality monitoring method

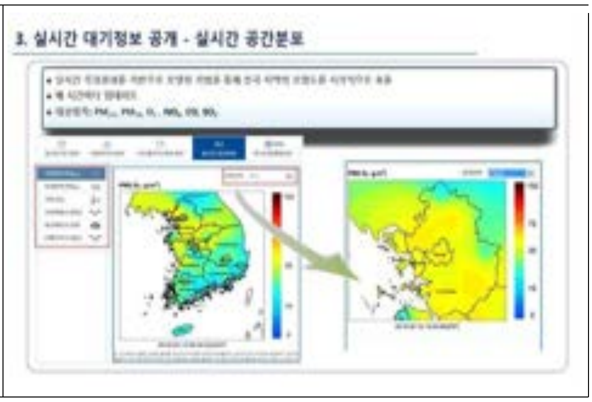
In practical training of mobile sources, the Korea Petroleum Quality & Distribution Authority shared Korea's petroleum quality management system. The fuel quality inspection was conducted in four stages including post-plan inspection, test analysis, and result report, and the progress of each step was explained in detail. The fuel quality inspection program was conducted by visiting business sites or collecting samples, and the process of introducing the results thereof to the government, the National Tax Service, and the police was introduced, and the need for collaboration between inspection agencies and judicial agencies was shared to introduce the fuel quality test system.

[Figure 11] Status of capacity building (2nd day) (Mobile source section)

(3) Practice with the ambient air quality monitoring system

In the monitoring section, the Korea Environment Corporation introduced the system practice contents. NAMIS, Korea's air pollution information management system, was explained, and methods such as data inquiry, monitoring station maintenance, and data confirmation were shared through demonstrations of the system. Further, Air Korea's real-time air pollution information system was introduced, and its operation was demonstrated including real-time data inquiry, air pollution forecast, alarm, real-time spatial distribution, and GIS information-based integrated maps.

[Figure 12] Status of capacity building (2nd day) (Monitoring section)



1.5.2 Performance sharing method

The webpage for introducing the contents, such as the main contents of the establishment of the master plan and the identified cooperation projects, was created to continuously monitor the performance of this project and to share the performance thereof. This webpage included the project implementation system and policy proposal status, the details of the key cooperation projects, etc. as well as the introduction of the master plan in the developing countries. Further, this project was intended to spread the performance of the master plan project by translating it into three languages: Korean, Mongolian, and English.

[Reference] Main contents of the webpage

- Status of the project for supporting the establishment of the master plan and the target country (Mongolia)
- Progress process of the project for supporting the establishment of the master plan
- Introduction of the project implementation system and participating agencies
- Status of cooperation projects and policy proposals by area
- Details of the priority cooperation projects
- Archive (Download the final report of the master plan)

The address of the webpage is www.cleanairmongolia.com, and the webpage will work as an online medium for sharing the usable information with visitors through continuous maintenance such as updating of the activities related to improvements in ambient air quality in Mongolia even after the project is completed.

[Figure 13] Status of webpage construction

Part 1 Establishment of the Environmental Improvement Plan

Chapter 2 Investigation on the Status of the Project Target Country

Chapter 2 Investigation on the Status of the Project Target Country

2.1 Investigation on the Country Status

2.1.1 General Status

2.1.1.1. General Status of the Country

Mongolia is an inland country located in the northern part of the Central Asian Plateau. Mongolia's area is about 1.564 million ㎢ that is about 7.1 times that of the Korean Peninsula. The total length of the border is 8,253 km, bordering Russia and China. (The Export-Import Bank of Korea, 2019; the National Statistical Office of Mongolia)

[Figure 14] Map of Ulaanbaatar

Source: the Export-Import Bank of Korea, 2020 World National Handbook (2019)

<Table 5> General status of Mongolia

Item	Contents
Name of country	Mongolia
Area	1,564,116㎢ (source: the National Statistical Office of Mongolia, as of June 2020)
Capital	Ulaanbaatar
Population	3,349,077 people (source: the National Statistical Office of Mongolia, as of November 2020)
Ethnic group (race)	Khalkha (90%), Kazak (5.9%), Buriad (2%), etc.
Language	Mongolian
Religion	Lama Buddhism
Climate	Cold dry climate, long, cold winters, and short summers
Head of country (As of August 2021)	• President: Ukhnaa Khurelsukh • Prime Minister: Luvsannamsrai Oyun-Erdene • Speaker of the National Assembly: Gombojav Zandanshatar
Major political parties	The People's Party (62 seats), the Democratic Party (11 seats), the People's Revolutionary Party (1 seat), the National Labor Party (1 seat), and the Independent Party (1 seat)
Political system	Dual government system (Characteristic of a semi-presidential system)
Congress	Unicameral system (76 seats)

Source: KOTRA, KOTRA country information (Mongolia) (2020); the Export-Import Bank of Korea, 2020 World National Handbook (2019); KOTRA, Country·regional information of Mongolia (https://news.kotra.or.kr), Mongolian news site (http://ikon.mn)

2.1.1.2 Status of natural environment

(1) Geographic and topographic status

Mongolia consists of deserts in 40% of the country, and extends from the Altai Mountains in the northwest to the plains in the southeast. The average altitude of Mongolia is 1,580m, with the highest point (4,366m) called Hairhany Orgil that rises at the border between Russia and China on the west, and the lowest area is about 522m on the eastern plains. (The Embassy of the Republic of Korea in Mongolia, 2006)

(2) Status of climate

Mongolia has a typical cold and dry continental climate, with long, cold winters and short summers. There are 257 cloudless days a year, and the average temperature drops below zero degrees Celsius from November to March. In particular, it falls below minus 40 degrees Celsius at night in winter, while summer temperatures reach 33 to 38 degrees Celsius. (The Embassy of the Republic of Korea in Mongolia, 2006)

2.1.1.3 Diplomatic Status

(1) General diplomatic status

The current diplomatic status of Mongolia was investigated, and the status of Russia, China, the United States, Japan, and North Korea was examined in detail. Russia is the second-largest trading partner of Mongolia, and most of its petroleum imports are from Russia. China, as the first trading investor of Mongolia, also has the nearest port, and Mongolia's dependence on China is intensifying. (The Ministry of Foreign Affairs, 2016)

<Table 6> Diplomatic status of Mongolia

Target country	Contents
Russia	• After diplomatic relations in 1921, close cooperative relations were formed based on socialist solidarity. • After democratization in 1990, the previous subordinate relationship was oriented toward equal diplomatic relations. • A strategic partnership was formed between Mongolia and Russia through continuous cooperative diplomacy in August 2009. • Russia is the second-largest trading partner of Mongolia and fourth-largest investor of Mongolia. Mongolia relies mostly on Russia for petroleum imports. • Based on pro-Russian sentiment in Mongolia, Russia is interested in exercising political influence in Mongolia, participating in Mongolia's resource development-related railway, operating the Erdenet mines, and participating in uranium development.
China	• Mongolia and China maintained an uncomfortable relationship for a long time due to national sentiment and border disputes caused by the Qing Dynasty's rule over Mongolia for more than 200 years but restored diplomatic relations in August 1971. • During President Xi Jinping's visit to Mongolia in August 2014, the relationship between Mongolia and China was upgraded to a "full-scale strategic partnership." • China is the first trading and investment country of Mongolia, and Mongolia's dependence on China is intensifying as a resource export market, consumer goods supplier, and nearest port provider.
USA	• Diplomatic relations were established in January 1987, and as relations between Mongolia and Russia weakened after the dissolution of the Soviet Union, relations between Mongolia and the United States enjoyed reflective interests. • The United States positively evaluates Mongolia's participation in international peacekeeping activities and the peaceful settlement of democracy, paying attention to Mongolia's geopolitical characteristics. • The United States is the third-largest trading partner of Mongolia ($3.8 million in exports to the United States in 2013, $51 billion in imports).
Japan	• Since the establishment of diplomatic relations in 1972, close cooperative relations have been formed based on Japan's enormous economic assistance. • A "strategic partnership" was established for the first time as the third neighboring country in the wake of President Ts. Elbegdorj's visit to Japan in 2010.
North Korea	[Before the Democratic Party came to power] • After diplomatic relations began between Mongolia and North Korea in October 1948, both parties maintained a "traditional friendly cooperative relationship" based on socialist solidarity. • After diplomatic relations between Korea and Mongolia became official in March 1990, Mongolia strengthened relations with Korea to promote reform and open its economy. • In August 2002, the relationship was restored with the signing of the "new friendly cooperation protocol" between Mongolia and North Korea • In February 2005, relations between both countries temporarily cooled as the Mongolian government seized $1 million that the Daedong Credit Bank of North Korea tried to deposit to the Golomt Bank of Mongolia on charges of counterfeiting.

	• In September 2006, after the Director General's meeting of the Department of Asian Affairs, efforts were made to restore relations such as visit of the Vice Minister of the Culture and Education to North Korea in December of the same year. • Mongolia is seeking its own diplomatic role through the equidistant diplomacy between Korea and North Korea on the basis that stability and peace in Northeast Asia meet the national interest in the process of economic development. • Maintaining continuous relations, such as upgrading the dialogue channel of the Ministry of Foreign Affairs to the level of the vice minister in 2009, visiting North Korea by Foreign Minister, G. Zandanshatar in April 2010, and holding the 8th Mongolian-North Korean Economic, Trade, Science and Technology Committee in October of the same year. [After the Democratic Party came to power] Close relationships according to individual interests • Mongolia demonstrated active diplomacy with North Korea to enhance "the international presence of Mongolia" after the ruling of the Democratic Party and the success of President Ts. Elbegdorj's re-election. • North Korea is maintaining close relations with Mongolia to secure foreign currency among the recent strengthening of sanctions against North Korea and the cold relations between North Korea and China.

Source: The Ministry of Foreign Affairs, 2016 Mongolia overview (2016)

(2) Relations with Korea (Hereby referred to as South Korea)

The date of establishment of diplomatic relations between Korea and Mongolia was March 26, 1990, and starting with the trade agreement signed in 1991, additional agreements have been signed in the economy, energy, and society sectors. In September 2017, a joint study of the Korea-Mongolia Economic Partnership Agreement (EPA) was undertaken and negotiations for its conclusion are currently underway. (KOTRA, 2021; KOTRA, 2020)

<Table 7> Korea-Mongolia agreement enforcement status

Name of agreement	Effective date	Contents
Trade agreement	1991-03-28	Trade agreement between Korean and Mongolian governments
Investment agreement	1991-03-28	Agreement on the mutual implementation and protection of investments between both countries
Double taxation prevention agreement	1992-04-17	Agreement for preventing corporate activities from shrinking due to double taxation of companies in both countries
Agreement on the donation of the Foreign Economic Cooperation Fund loans to Mongolia	1996-12-06	Agreement on the donation of the Foreign Economic Cooperation Fund (EDCF) loans to Mongolia
Agreement on the cooperation in the area of energy and mineral resources	1999-11-08	Agreement between the Mongolian government and the Korean government in the area of energy and mineral resources
Tourism cooperation agreement	2003-11-24	Agreement on the cooperation in the area of tourism between Korean and Mongolia
Social security agreement	2006-05-08	Agreement on the cooperation of social security between both countries
Civil and commercial judicial cooperation treaty	2008-10-15	Agreement on laws
Agreement to simplify visa	2012-05-31	Agreement to simplify visa
Memorandum of exchange for the Foreign Economic Cooperation Fund loans	2015-12-16	Memorandum of exchange for extension Basic agreement on the Foreign Economic Cooperation Fund (EDCF) loans (2011 - 2015) for Mongolia
Loan donation agreement between the Export-Import Bank of Korea and the Mongolian government necessary for implementing the "Information Education Project."	2016-07-16	Loan grant agreement
Loan agreement on the implementation of two stages of the project for constructing the public transportation support system between countries, and between cities, between the Export-Import Bank of Korea and the Mongolian government	2016-07-16	Loan agreement
Agreement between the Korean government and the Mongolian government on the culture exchange methods from 2016 to 2019	2016-07-16	Agreement on the method for expanding the culture exchange

Source: KOTRA, Country·regional information of Mongolia (https://news.kotra.or.kr)

<Table 8> Trade agreement enforcement status

Item	Name of agreement	Signed date	Effective date	Remarks
Signed	EPA between Mongolia and Japan	2016-05-08	2016-06-07	• Customs reduction or exemption for 5,700 items - Tariffs on 3,723 items are abolished immediately after entry into force - Tariffs on 1,977 items will be phased out for at least 4 to 20 years step by step
	Trade agreement between the Korean government and the government of the Mongolian People's Republic	1991-03-28	1991-04-30	• Trade agreement agreed to expand and develop the trade relations between both countries
Discussion progress	EPA between Korea and Mongolia	EPA between Korea and Mongolia is being negotiated		

Source: KOTRA, Country·regional information of Mongolia (https://news.kotra.or.kr)

2.1.1.4 Political and Administrative Status

(1) Government type

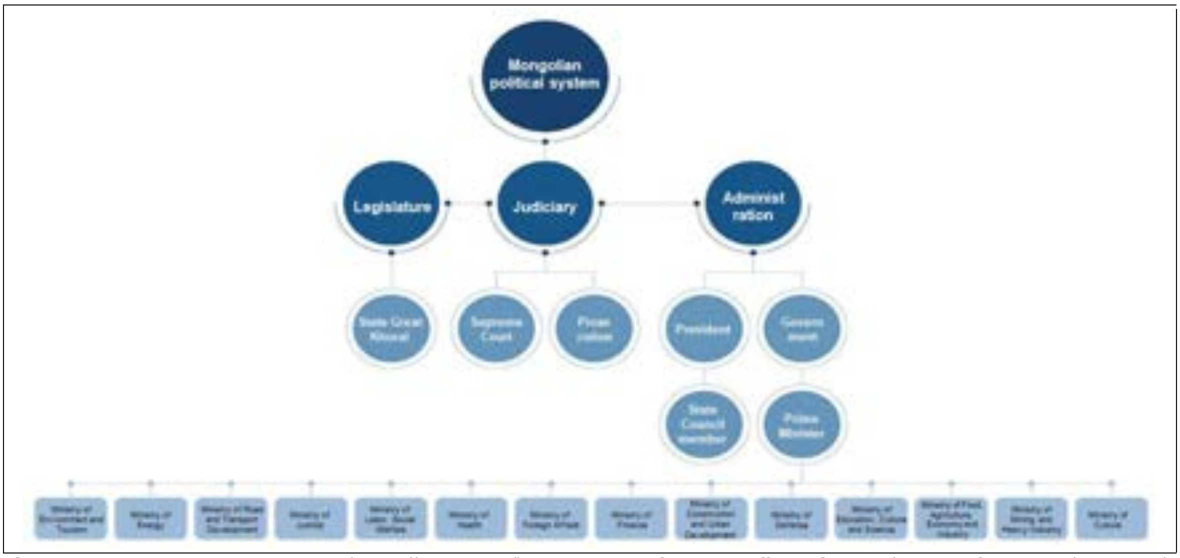
Mongolia is a democratic republic and a dual government system with a strong parliamentary system. Formally, it is a structure of separation of legislature, judiciary, and administration, but is a structure in which major national agencies are closely connected and the main functions thereof are mixed in three bodies. (KOTRA, 2021)

Mongolian presidential candidates are usually nominated by parliamentary parties, and their term of office is four years (the term of office will be revised to six years from 2025 pursuant to a constitutional amendment) and elected by referendum. The president of Mongolia is the supreme head of state, supreme commander of the Mongolian army, and chairman of the National Security Council. The President has authority to veto bills (which can be overridden by receiving more than 2/3 of the votes of Parliament), the right to head the military, the right to nominate and appoint the Prime Minister (consent from Parliament is required), the right to nominate and appoint ministers at the request of the Prime Minister, and the Chief Justice. In the case of the Prime Minister, it is common for the leader of the majority to serve as Prime Minister, and the Prime Minister leads the administration as an administrative head of internal affairs and is responsible for enforcement of parliamentary bills. (KOTRA, 2021; the Ministry of Foreign Affairs 2016)

The legislature is the supreme body of the country's power under the Constitution. The legislative power comes from the Great Khural, which consists of 76 lawmakers, and the term of office of the National Assembly, the only agency with this legislative power, is four years. (KOTRA, 2021)

The judiciary consists of the Supreme Court, District Courts, and County District Courts, and the Chief Justice and judges are appointed by the President after deliberation by the General Judiciary Committee and the Parliament. The Prosecutors' Office is an independent agency, and the Prosecutor General and Deputy Prosecutor General are nominated by the President and appointed with the consent of Parliament, and the term of office is six years. (The Ministry of Foreign Affairs, 2016)

[Figure 15] Organization chart of government agencies of Mongolia



Source: Mongolian government site (https://zasag.mn/), the Ministry of Foreign Affairs, Country/region information (Mongolia) (www.mofa.go.kr) (reviewed and written by the research team)

(2) Status of major political parties currently in power

The Mongolian People's Party was launched simultaneously with the independence of Mongolia in 1921 and then maintained a one-party dictatorship guaranteed by the Constitution until 1990, but after transition of the system, was defeated in the general election in June 1996 and became an opposition party. Since 2000, it has won a majority of seats again and has maintained its status as Mongolia's strongest political party. (KOTRA, 2021)

Since its birth as the first opposition party in 1990, the Democratic Party emerged as a strong opposition party with 50 out of 76 seats in 1996. However, due to public sentiment issues, it seemed to lose power again, such as obtaining only one seat in the 2000 general election, but after forming a coalition cabinet with the People's Party with 36 seats in the 2004 general election, it has now maintained its position as a second ruling party. (KOTRA, 2021 Strategy for entering Mongolia, 2021) As a result of the election on June 24, 2020, the Mongolian People's Party is the first ruling party, and the Democratic Party maintains its position as the second ruling party with 11 seats. (News site of Mongolia (ikon), 2020)

(3) Political trends

As a result of the June 2020 general election, political stability has been maintained with a landslide victory of the People's Party. The People’s Party’s approval rating declined due to its involvement in cases such as “government post sales” and “small and medium-sized business support funds” discovered in 2018, and thus was found to be inferior to the opposition Democratic Party as a result of a survey conducted in 2019, but the People's Party won by a landslide with 62 seats and the Democratic Party won 11 seats as a result of the 2020 general election. This seems to have been in response to the strong leadership of the incumbent Prime Minister, who succeeded in ending the power struggle among the internal factions of the People’s Party, and the driving force of the policy to reduce air pollution. (KOTRA, 2021)

Currently, only two of the 14 governments established from 1990 to 2020 have completed their normal terms, and only 203 of the 567 policies and policy programs announced from 1990 to the present are valid, indicating that policies changed every time when the government was replaced. Therefore, the People's Party government announced VISION 2050, the long-term development policy, with policy consistency and eradication of corruption as election pledges, promising consistency, and continuity of economic and industrial development policies. (KOTRA, 2021)

In November 2019, the National Assembly, led by the People's Party, revised the Mongolian Constitution for the first time in 19 years. Among the constitutional provisions, as the main changes related to the President, the provision that the President can serve a second term with 4 years in office was revised to six years in office and no second term, but the effective date of the amendment was 2025, allowing the incumbent President to be re-elected. (KOTRA, 2021)

2.1.1.5 Social Status

(1) The latest status of the region

After recording a high economic growth rate of up to 17% in 2011, it fell for five consecutive years, hitting a 1.2% lowest level in 2016. As a countermeasure, the IMF EEF program was accepted in February 2017, and macroeconomic indicators and government finances began to stabilize in 2017, maintaining an economic growth rate of 5-6%. However, in the first half of 2020, economic growth was -9.7% due to a decrease in mineral exports, the major product, because of COVID-19, foreign trade amount and FDI also declined, and foreign debt planned for repayment is estimated to be a big economic burden from 2021. As the Chinese economy is expected to grow despite numerous uncertainties due to COVID-19, the Mongolian economy, which relies heavily on mineral exports to China, is also expected to recover. (KOTRA, 2021)

Since the enactment of the Constitution of the Liberal Democratic Ideology on January 13, 1992, seven provisions were revised in 2000, and 19 years later, the Constitutional Amendment was passed on November 14, 2019, and took effect on May 25, 2020. This amendment significantly affected 19 out of 70 articles of the Constitution, which are a total of 36 provisions in four sections: 1) Provisions to strengthen Parliamentary responsibilities and regulations, 2) Provisions related to the rights of the administration, 3) Provisions to secure judicial responsibilities and independence, and 4) Provisions related to self-government's rights and regional development. (KOTRA, 2021)

[Reference] Contents of the amendment to the Mongolian Constitution

- In Article 30(2) of the New Constitution related to the President, the existing provision that "a 45-year-old person with Mongolian nationality who has resided in Mongolia for the past five years is elected for four years in office and can have one second term" was amended to the provision that "a 55-year-old person with Mongolian nationality who has resided in Mongolia for the past five consecutive years is elected for a six-year term in office with no second term."
- It is expected that the frequent "populist" behavior, such as not resolving the country's serious matters due to the exercise and sanctions of the right to veto the National Assembly and cabinet decisions for the purpose of the re-election of the former President while the presidential and general elections have been held every other year, will be resolved by the revision which removes the possibility of serving a second term.
- As the major provisions on strengthening the rights of the administration in the New Constitution, the existing provision that "the Prime Minister consults with the President to appoint the cabinet ministers at the National Assembly with the advice and consent of the National Assembly, and the members of the National Assembly can concurrently serve as the cabinet ministers" was amended to the provision that "the Prime Minister directly appoints or dismisses the cabinet ministers, and no more than four members of National Assembly can concurrently serve as cabinet ministers."
- The revision of such provisions is expected to normalize the weak mechanism of the National Assembly's audit of government administration as most cabinet ministers consist of lawmakers under the existing system of appointing cabinet ministers by the National Assembly.

Source: KOTRA, 2021 Strategy of entering Mongolia (2021)

There was a lack of policy consistency and connection as government ministries for each area separately established development policies due to an absence of connection between the previously executed policies, financial operation activities focusing on four-year government operation plans, and an absence of a national agency dedicated to national development policies. In 2019, the Mongolian government established a wide range of long-term development policy of Vision 2050 to deal for the first time with human, social, environmental, and economic issues. This policy has suggested 9 goals and 50 detailed goals and plans to implement 187 projects over 30 years in three 10-year stages. Unlike the previously established Sustainable Development Policy 2030, this policy is evaluated as a national development model that includes not only economic and social development, but also comprehensive policies to boost global competitiveness of Mongolians, strengthen the nation and culture, increase the quality of life and social safety of Mongolians, reduce the difference between urban and rural development orders with environmental protection and regional development, and develop economically through dispersion of the urban population. (KOTRA, 2021)

The Information and Communication Technology Department of Mongolia has developed a comprehensive government electronic service portal (www.e-mongolia.mn) through e-government model learning in Estonia since 2018 and began pilot operation of the portal and mobile applications in October 2020 on a trial basis. Currently, 181 services from 23 government agencies can be provided on the preferential basis, in electronic or operation mode through the portal, and the Mongolian government aims to gradually digitize all government administrative services (111,250) through this program and supply them to the public as one channel. The digitization of government services can be expected to eradicate bureaucratism and corruption, secure promptness and transparency, and shorten service procedures and processes. (KOTRA, 2021)

(2) Status of population

According to the results of the 2020 Mongolian Population and Housing Survey, Mongolia's population was about 3.29 million and the number of households was about 890,000. In comparison with the census from 2010, the average annual population growth rate over 10 years was 2.2%. It was surveyed that on average, the size of the household was about 3.6 people, and the average age at marriage was 27.7 years old. In terms of age structure, the proportion of children aged 0 to 4 accounts for 31.5% of the total population, the proportion of those aged 15 to 64 accounts for 64.4%, and the proportion of those aged 65 or older accounts for 4.1%. (National Press Agency of Mongolia (Montsame), 2020)

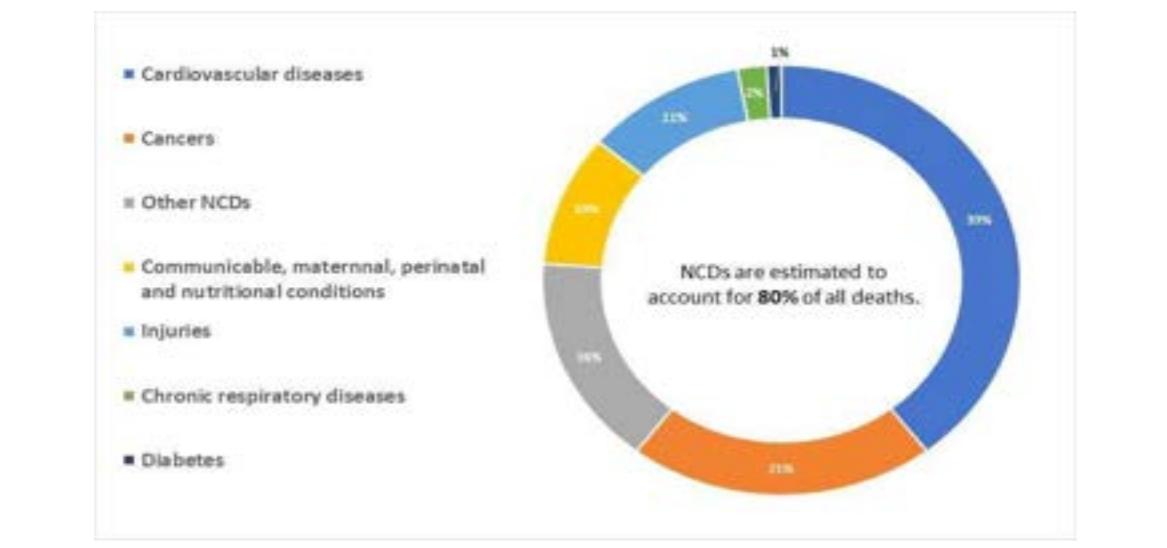
It was found that 46% of Mongolia's population lives in the capital city of Ulaanbaatar, 19% in the Khangai region, 16% in the central region, 13% in the western region, and 7% in the eastern Aimag region. About 7% of Mongolia's total population was found to have lived abroad for more than 6 months. (National Press Agency of Mongolia (Montsame), 2020)

In 2019, the Ministry of Labor and Social Security predicted that the population of Mongolia would reach 4 million people in 2030 and 5 million people in 2045. (National Press Agency of Mongolia (Montsame), 2020)

(3) Status of public health

According to WHO statistics, it was found that the total number of deaths in Mongolia as of 2016 was about 19,000, and about 80% of deaths were from non-infectious diseases. Listing the percentage of major causes of death, cardiovascular disease was the highest at 40%, followed by cancer at 20% and chronic respiratory disease at 2%. (WHO, 2018)

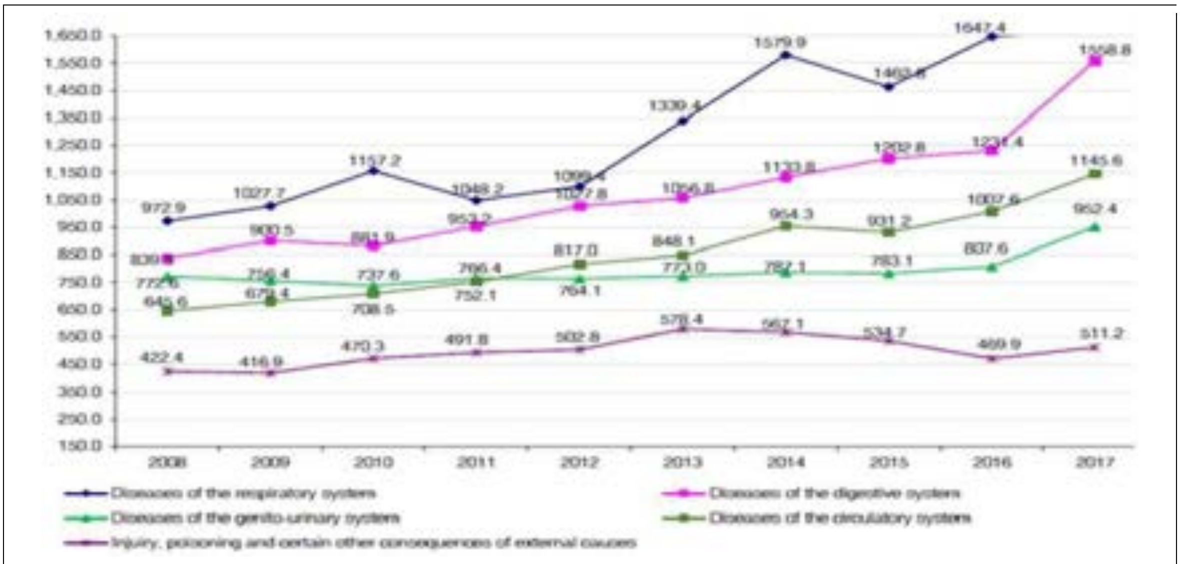
[Figure 16] Percentage of causes of death in Mongolia (unit: %)



Source: WHO, Noncommunicable Diseases (NCD) Country Profiles (2018)

Diseases caused by air pollution in Mongolia include respiratory diseases and lung cancer, and the incidence of respiratory diseases in Mongolia increased from 972.9 per 10,000 people in 2008 to 1,647.4 in 2017. (Davaasuren, O., 2019)

[Figure 17] Incidence of respiratory diseases in Mongolia (unit: number per 10,000 people)



Source: Davaasuren,O., Situation of Lung Cancer among the Population of Mongolia (2019)

Lung cancer in Mongolia ranked third among cancer diseases in 2017, and a total of 4,004 patients (2,262 males/1,742 females) died of lung cancer, accounting for 25.4% of Mongolia's total death toll in 2017. The incidence of lung cancer in 2017 was 14 per 100,000 people, an increase of 4.1 times compared to 2007 (9.9 per 100,000 people), and diseases caused by air pollution in Mongolia are on the rise. (Davaasuren, O., 2019)

[Figure 18] Incidence and mortality of lung cancer in Mongolia

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Incidence of lung cancer	9.9	13.2	12	13	13.2	11.8	14.2	13.9	13.3	14.3	14
Mortality percentage	12.2	11.8	10.2	12.3	11.7	11.3	11.5	13.3	11.8	11.3	13.03

Source: Davaasuren,O., Situation of Lung Cancer among the Population of Mongolia (2019)

(4) Urbanization rate

After the transition to the capitalism from socialism in 1992, Mongolia's industrial structure shifted from agriculture and livestock to manufacturing, rapidly accelerating the influx of population into cities. According to data from the Korean Statistical Information Service (KOSIS), the urbanization rate of Mongolia remained at about 68% from 2011 to 2021. (Road Policy Research Center, 2019)

2.1.1.6 Status of Trade

(1) Trends of Trade (KOTRA, 2021)

The volume of trade between Korea and Mongolia is about $200-300 million. After reaching an all-time high of $480 million in 2012, the volume of trade continued to decline, but the volume of trade began to recover in 2018. In 2018, the volume of trade increased 37% year-on-year, and in 2019, it increased 1.8% year-on-year to $267 million, but in 2020, it was found to decline due to COVID-19.

As of July 2020, the total volume of trade between Korea and Mongolia was $140.7 million, with Korea's exports to Mongolia being $130.1 million and imports being $10.6 million, which reduced 18.5% and 21.8%, respectively, compared to the same period last year.

(2) Status of major import and export items (KOTRA, 2021)

Korea's major export items to Mongolia include favourite foods, automobiles, construction and mine machinery, and petroleum products, of which vehicle-related items such as trucks and heavy construction equipment account for a large portion. Korea's major import items from Mongolia are metallic minerals, clothing, and wool, of which minerals account for about 35%.

<Table 9> Major export-import items between Korea and Mongolia (as of July 2020)

Exports from Korea			Imports to Korea		
Rank	Item (based on MTI 3 unit)	Amount	Rank	Item (based on MTI 3 unit)	Amount
1	Favourite foods	20 million USD	1	Metallic minerals	4 million USD
2	Automobiles	19 million USD	2	Clothing	3.6 million USD
3	Construction and mine machinery	12 million USD	3	Wools	1.8 million USD
4	Soap, toothpaste, and cosmetics	10 million USD	4	Non-metallic minerals	0.5 million USD
5	Petroleum products	6 million USD	5	Livestock by-products	0.4 million USD
6	Agricultural processed products	6 million USD	6	Printout	0.2 million USD
7	Pesticides and medicines	5 million USD	7	Livestock processed products	0.2 million USD
8	Paint and ink	4 million USD	8	Aluminum	0.17 million USD
9	Plastic products	4 million USD	9	Alloy steel and scrap metal	0.11 million USD
10	Automobile products	4 million USD	10	Processed agricultural products	0.07 million USD
Others		60 million USD	Others		0.25 million USD
Sum		150 million USD	Sum		11.3 million USD

Source: KOTRA, 2021 Strategy of entering Mongolia (2021)

(3) Status of major importing and exporting countries

Mongolia's imports and exports amount from 2016 to 2019 were steadily increasing. The major exporting countries to Mongolia include China, Russia, Japan, and Korea, whereas the major importing countries from Mongolia include China, the UK, Russia and Singapore, etc.

<Table 10> Major import status of Mongolia from 2016 to 2019

Year	2016		2017		2018		2019	
Ranks	Name of Country	Amount (USD)	Name of Country	Amount (USD)	Name of Country	Amount (USD)	Name of Country	Amount (USD)
1	China	1,040,232,836	China	1,412,561,606	China	1,968,833,499	China	2,036,805,066
2	Russia	861,885,671	Russia	1,219,188,124	Russia	1,710,347,258	Russia	1,729,863,706
3	Japan	330,608,393	Japan	363,149,952	Japan	561,042,245	Japan	585,477,274
4	Korea	197,888,962	US	208,563,327	Korea	262,365,972	US	289,626,805
5	US	139,377,416	Korea	197,703,548	US	211,547,365	Korea	266,965,194
6	Germany	120,024,448	Germany	128,349,174	Germany	168,721,898	Germany	188,807,014
7	Malaysia	41,075,583	Poland	48,349,980	Poland	58,027,051	Poland	64,450,569
8	Poland	40,754,446	Italy	45,840,574	Italy	54,726,543	Italy	60,052,835
9	Vietnam	40,139,187	Malaysia	39,988,259	India	51,751,571	Australia	57,069,468
10	Ukraine	35,046,259	Vietnam	39,798,749	Malaysia	50,277,519	Vietnam	56,968,655

Source: UN Comtrade Database (https://comtrade.un.org/)

<Table 11> Major export status of Mongolia from 2016 to 2019

Year	2016		2017		2018		2019	
Ranks	Name of Country	Amount (USD)	Name of Country	Amount (USD)	Name of Country	Amount (USD)	Name of Country	Amount (USD)
1	China	3,883,128,125	China	5,268,938,071	China	6,505,529,538	China	6,772,662,873
2	The United Kingdom	786,875,707	The United Kingdom	660,535,695	The United Kingdom	172,856,021	The United Kingdom	291,092,228
3	Russia	55,769,058	Russia	67,661,068	Russia	85,935,954	Singapore	154,580,629
4	Germany	43,386,472	Italy	43,299,934	Italy	54,078,081	Switzerland	74,986,343
5	Italy	33,579,288	Other Asian countries	26,215,956	Singapore	30,008,422	Russia	68,093,301
6	Singapore	16,913,245	Singapore	26,119,535	Japan	26,468,390	Italy	45,298,764
7	Japan	14,031,747	Japan	14,816,466	Other Asian countries	25,471,472	Australia	39,612,579
8	Hong Kong	10,482,769	Hong Kong	12,277,771	Korea	21,200,429	Korea	27,814,983
9	US	10,461,515	Germany	11,648,021	Germany	12,280,691	US	25,997,482
10	Korea	8,470,417	Korea	11,617,792	Hong Kong	11,823,802	Iran	21,137,919

Source: UN Comtrade Database (https://comtrade.un.org/)

(4) Import restrictions and tariffs

Looking at the status of import restrictions of Mongolia against Korea, Mongolia currently has no related restrictions such as anti-dumping, countervailing tariff, safeguards, or import quota system, and prohibits only imports of some prohibited items. Mongolia operates an import permit system for items such as alcohol, tobacco, and oil, and only companies that have obtained prior import permits can import them.

MNS is the only national quality mark that applies to all products produced in Mongolia and the product marked with the MNS mark means that it conforms to related standards such as people's lives, health, and environmental safety. Attaching the MNS mark is not a prerequisite, and companies, agencies, individuals, etc. can apply for permission to use it by applying for certification of the relevant product and service to the competent certification authority. There are eight types of certifications: import product certification, export product certification, service certification, domestic product certification, system certification, product, service certification, and eco-display certification, which are implemented within Mongolia. Mongolia has a weak manufacturing base and relies on imports for 80% of daily necessities, and therefore, there are no special non-tariff barriers.

After the adoption of the new Harmonized commodity description and coding System (HS) in January 1993, the changes of the tariff system of Mongolia are introduced in the Mongolian classification table. Mongolia adopted HS 2002 in January 2002. Currently, the tariff system of Mongolia consists of 5,541 8-digit HS Code. The first six digits are the general code address of HS, and the last two digits are the sub-national units. Before joining the World Trade Organization in 1997, Mongolia applied a 15% closing tariff to most imported goods. Since the introduction of the Tariff Fixed Rate Act, the tariff rate has been revised several times.

Since 2000, tariffs have been exempted on some products, such as equipment and goods imported by international treaties and cooperation programs for various purposes. Further, the tariff rate of Mongolia is adjusted between 5% and 30%, and the item that applies the highest tariff rate is agricultural products. The Mongolian government added and changed the contents of the 27th “agricultural product tariff increase” decision in 1999 with the 35th decision of the Parliament on May 1, 2020, raising the tariff rate (20%) on some fruits and vegetables by 10% to up to 30%. It took effect on August 1, 2020 with the aim to encourage Mongolia's local production of fruits and vegetables and to protect its agriculture. Items to which a high tariff rate (15%) is applied include dairy products and flour. In the case of imported goods, there are some items subject to special consumption tax in addition to tariffs, which are adjusted depending on the quantity. In the case of export tariffs, the tariff rate on all exports is 0%, except for some raw materials.

The tariff and additional exempted items include gas, gas barrels, mechanical equipment, special machinery (effective January 1, 2016), mechanical equipment and parts for research and production of renewable energy (effective April 4, 2016), breeding plants (effective December 8, 2017), air purifiers, and energy-saving heaters (effective January 12, 2018). (KOTRA Country·region information of Mongolia)

2.2 Market Research

2.2.1 Status of Economic-related Policies and Industrial Structure

2.2.1.1 General Status of economy

<Table 12> General status of economy of Mongolia

GDP	USD 13.6 billion ('19)
GDP per capita	USD 4,133 ('19)
Monetary unit	Tugrik(Tug)
Fiscal year	1.1 - 12.31
Industrial structure	Service industry 50%, manufacturing 38%, and agriculture 12% (2017)
Major export items	Copper, clothing, livestock, cashmere, wool, leather, fluorspar, non-ferrous metal, coal
Major import items	Machinery, fuel, automobiles, groceries, industrial consumer goods, chemicals, construction materials, cigarettes, household equipment, soap and detergent
Major natural resources	Petroleum, coal, copper, molybdenum, tungsten, phosphate, tin, nickel, zinc, and fluorspar
International credit rating	OECD Grade 6, Moody's B3, Fitch B

Source: The Export-Import Bank of Korea, 2020 World Country Handbook (2019)

2.2.1.2 Status of Industrial Structure

(1) Status of GDP trend by industry (KOTRA, 2021)

As of the first half of 2020, it was found that the largest proportion of GDP by economy and industry was mining at 24.3%, followed by wholesale and retail at 16.2%, with manufacturing coming in third at 11.2% followed by agricultural and livestock at 10.1%, the real estate industry at 5.3%, and the financial insurance industry at 4.9%. As for the proportion of industrial production, the mineral mining industry accounts for 57.5%, manufacturing and processing industries account for 32.8%, electric power, heating and ventilation industries account for 8.4%, and water, sewage, and waste disposal industries account for 1.2%.

(2) Status of core industry (KOTRA, 2021)

Mongolia is promoting economic development from a traditional livestock country (proportion of GDP: 27% in 2000 → 10% in 2019) to the mining industry (10% in 2000 → 27% in 2019), and is promoting industrial diversification policies by producing value-added finished products and fostering service industries through mineral processing to reposition from an excessive mining-dependent economic structure.

Mongolia's main industries are food, agriculture, livestock, light industry, mining, and heavy industry, and to diversify its industrial and economic structures according to the long-term national development policy (VISION 2050) and the industrial policy, high value-added creation and sustainable green growth are presented as major policy tasks through the processing of agricultural and livestock products and minerals, which are raw materials in Mongolia.

2.2.1.3 Economic Trends and Economic Prospects

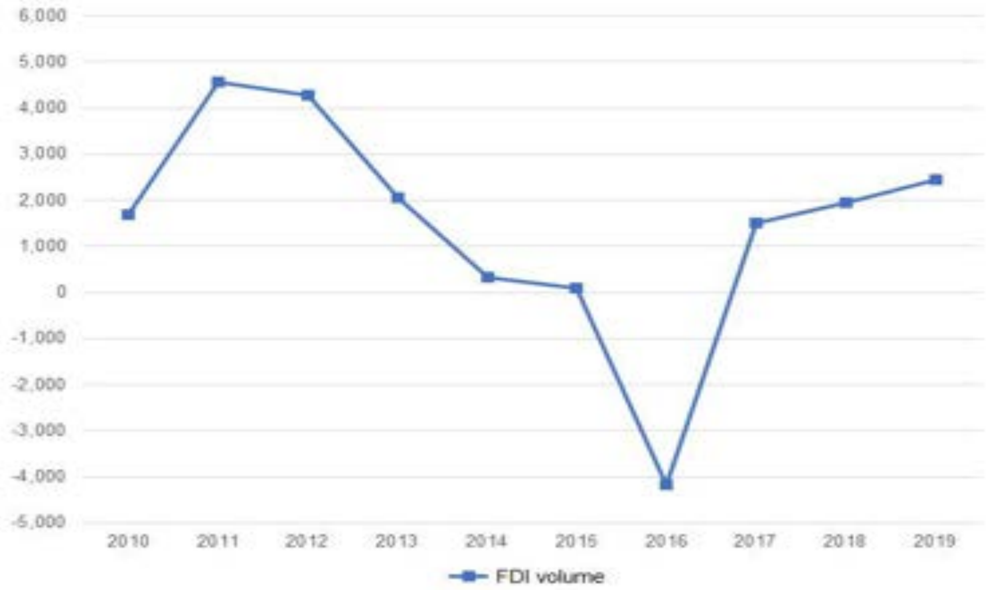
(1) Investment status

Looking at the status of Korea's direct investment in Mongolia, after diplomatic relations between Korea and Mongolia began on March 26, 1990, Korea started making official investments in Mongolia in 1994. Total investments in 2019 were $167.31 million, and the cumulative amount of direct investment in Mongolia as of June 2020 reached $498.31 million. The largest investment proportion by area is in mining at 26%, followed by wholesale and retail industries at 19%, construction industry at 12%, real estate and rental industries at 11%, and investments are currently being made in more than 20 sectors. (KOTRA, 2021)

There have been 671 corporations established by Korean investment in Mongolia over the past 30 years, focused primarily on the wholesale and retail sector (173), manufacturing (96), construction (82), science and technology services (50), mining (49), and real estate (40). Korean small and medium-sized enterprises (the proportion of new corporations: 46.2%) and individual investors (the proportion of new corporations: 44.2%) are actively entering into the Mongolian market. (KOTRA, 2021)

From 2010 to 2019, Mongolia's scale of Foreign Direct Investment (FDI) steadily declined after a steep increase in 2010 and decreased to minus $4.156 billion in 2016. However, in 2017, the scale of FDI increased to $1.494 billion that continued to increase until 2019.

[Figure 19] Scale of Foreign Direct Investment from 2010 to 2019 (unit: $ million)



Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Scale of FDI	1,691	4,571	4,272	2,060	338	94	-4,156	1,494	1,952	2,443

Source: World Bank data (https://data.worldbank.org/) (reviewed and written by the research team)

(2) Foreign investment conditions

Regarding foreign investment conditions in Mongolia, the Mongolian Investment Law, which is a law related to foreign investment, incentives for investment (tax/non-tax), and restricted and prohibited businesses were investigated.

<Table 13> Status of foreign investment attraction system

Item	Contents	Details
Foreign investment -related law	**Mongolian Investment Law (2013)**	• Mongolia does not have a separate law governing foreign investment, but foreign investment is regulated by the Mongolian Investment Law. The Mongolian government passed the New Investment Act in 2013, entered into force on November 1, 2013, and is still valid. This law eliminates restrictions previously put on private foreign investment and reduces government approval requirements for foreign government investment, and under the Investment Law, domestic or foreign investors can invest in any industry without restrictions or government approval. • It prescribes that a foreign company is required to be registered as a Business Entity with Foreign Investment (BEFI) or a liaison office pursuant to the Investment Law to carry out business activities in Mongolia. * The BEFI refers to a company established in Mongolia with a minimum corporate contribution of $100,000 per investor and with at least 25% of the contribution by foreign investors. * A liaison office is an entity established to operate only as the liaison office for a foreign parent company and does not have the authority to earn profits from business activities in Mongolia.
Investment incentive (non-tax incentive)	**Granting the right to use the land**	• Land lease and license up to 60 years are provided on a contractual basis, and the term of the contract can be extended by 40 years only once depending on the main conditions of the contract.
	Investment attraction for free trade zone and industrial technology complex	• In the case of establishing factories in free trade zones and industrial technology complexes, corporate registration and immigration control procedures are being mitigated to business operating investors.
	Encouragement of investment in major sectors	• In the case of an increase in foreign personnel and experts hired by investors in infrastructure, manufacturing, science, and education sectors, employment fees can be exempted and the process of issuing related permits can be simplified.
	Support for innovative industries	• Finance can be guaranteed when financing the production of export-oriented innovative products to support the implementation of such innovative projects.
	Issuing a residence permit for investors	• Multiple visas and residence permits are issued to foreign investors and their family members who have invested in Mongolia pursuant to the relevant laws of Mongolia.
Investment incentive (tax incentive)	**Tax cut**	• The Mongolian government issues a tax cut certificate for corporate taxes, tariffs, value-added taxes, and mineral development royalties for at least 5 to 18 years to foreign investors who invest more than 10 billion Tugriks. • On documents submitted by the investors who invest more than 30 billion Tugriks in mining, heavy and other key industries, 10billion Tugrks in others, the tax cut certificate is issued based on 1) business plans and feasibility studies, 2) environmental impact assessment, 3) stable job creation, 4) introduction of high-tech, new technologies, etc.

	Signing investment guarantee contract	• Investors who invest more than 500 billion Tugriks and the Mongolian government can legally sign investment contracts specifying provisions related to investment guarantees, tax rate stabilization, and financial guarantees.
	Exemption from tariff and VAT	• The Mongolian government exempts tariffs and VAT on petroleum development, woodworking, gas fuel, agriculture, renewable energy, and imports of equipment and materials related to air pollution relief.
	Support for small and medium-sized manufacturing industry	• The Mongolian government exempts tariffs on imports of machinery and equipment necessary for establishing small and medium-sized manufacturing plants as a policy to foster manufacturing industries.
	Investment attraction for free trade zone	• The reduction benefits for various taxes and land usage fees are provided to investors in the free trade zone designated by the Mongolian government.
Restricted and prohibited business	**Investment restricted sector**	• The Mongolian government restricts foreign state-owned companies from investing in mining, banking, and media and telecommunications sectors. When purchasing 33% or more of the shares issued by a company in the relevant area or merging with other companies, permission must be obtained from the Mongolian government.
	Prohibited businesses	• Production, import, and sales of Opium and other types of drugs, casino business, multi-level marketing business, obscene video production and sales, and propaganda advertising businesses are prohibited.

Source: KOTRA, Country·regional information of Mongolia (https://news.kotra.or.kr)

(3) Issuance of government bonds and credit ratings (The Export-Import Bank of Korea, 2020)

Looking at Mongolia's government bond issuance (foreign debt repayment attitude), as of September 30, 2019, the OECD member ECA's loan balance to Mongolia was $1.455 billion (short-term $63.5 million, mid- to long-term $1.3915 billion). Among them, Mongolia's foreign debt repayment history is good because of the mid- to long-term debt, only $6.6 million is overdue, and the overdue ratio is insignificant at 0.4%.

Mongolia has received six IMF bailouts since 1991, and has maintained a high level of foreign debt burden, such as raising foreign currency from international organizations and various creditor countries due to chronic current account deficit records and worsening foreign exchange reserves.

Mongolia's credit rating maintains a similar rating based on 2020 data. This was evaluated by both the OECD and major international credit rating agencies comprehensively considering abundant mineral resources of Mongolia, efforts to improve fiscal balance, growth potential and excessive debt, risk of fluctuations in international prices of raw materials, and vulnerabilities in the financial sector.

<Table 14> Credit rating by major agency

Evaluation agency	Recent evaluation grade	Previous evaluation grade
OECD	Grade 6	Grade 6
Moody's	B3	B3
Fitch	B	B

Source: The Export-Import Bank of Korea, Mongolia's National Credit Rating Report (2020)

2.2.2 Status of major economic indicators

Mongolia's major economic indicators were surveyed for population, nominal GDP, consumer inflation rate, total export size, and import size. Recently, the export and import volumes of Mongolia have been increasing, and nominal GDP per capita has also been on the rise.

<Table 15> Major economic indicators of Mongolia

Major indicators	Unit	2014	2015	2016	2017	2018	2019	2020	2021
Population	Million people	2,996	3,058	3,120	3,178	3,238	3,296	3,354	3,418
Nominal GDP	Billion dollars	12.227	11.750	11.187	11.135	13.006	13.225	13.825	13.5
Nominal GDP per capita	Dollar	4,643	4,218	3,854	3,780	4,009	4,012	4,123	N/A
Real growth rate	%	7.9	2.4	1.2	5.3	6.9	6.6	6.2	5.0
Rate of unemployment	%	7.9	8.3	8.6	9.1	6.9	7.8	6.6	N/A
Consumer inflation rate	%	12.8	6.6	0.7	4.3	6.8	8.5	7.5	N/A
Fiscal balance (compared to GDP)	%	-11.5	-4.0	-4.07	-4.4	3.7	N/A	N/A	N/A
Total exports	Million dollars	5,774	4,669	4,916	6,201	7,012	7,685	8,507	N/A
(Exports to Korea)	Million dollars	13.5	66.6	8.5	11.6	21.2	22.6	25.2	N/A
Total imports	Million dollars	5,237	3,797	3,358	4,337	5,875	6,462	7,153	N/A
Imports from Korea	Million dollars	352.5	258.7	197.9	197.7	262.3	288.5	302.1	N/A
Trade balance	Million dollars	539	872	1,558	1,863	1,137	900	1,354	N/A
Current balance	Million dollars	-1.934	-948.5	-669.7	-1,078	-441	-393	N/A	N/A
Exchange rate (annual average)	Local country/ USD	1,818	1,971	2,145	2,440	2,472	2,660	2,750	N/A
Overseas Direct Investment	100 million dollars	1.07	0.11	0.14	0.49	0.37	0.45	N/A	N/A
Foreign Direct Investment	100 million dollars	3.37	0.94	-40.72	14.46	21.37	18.7	N/A	N/A

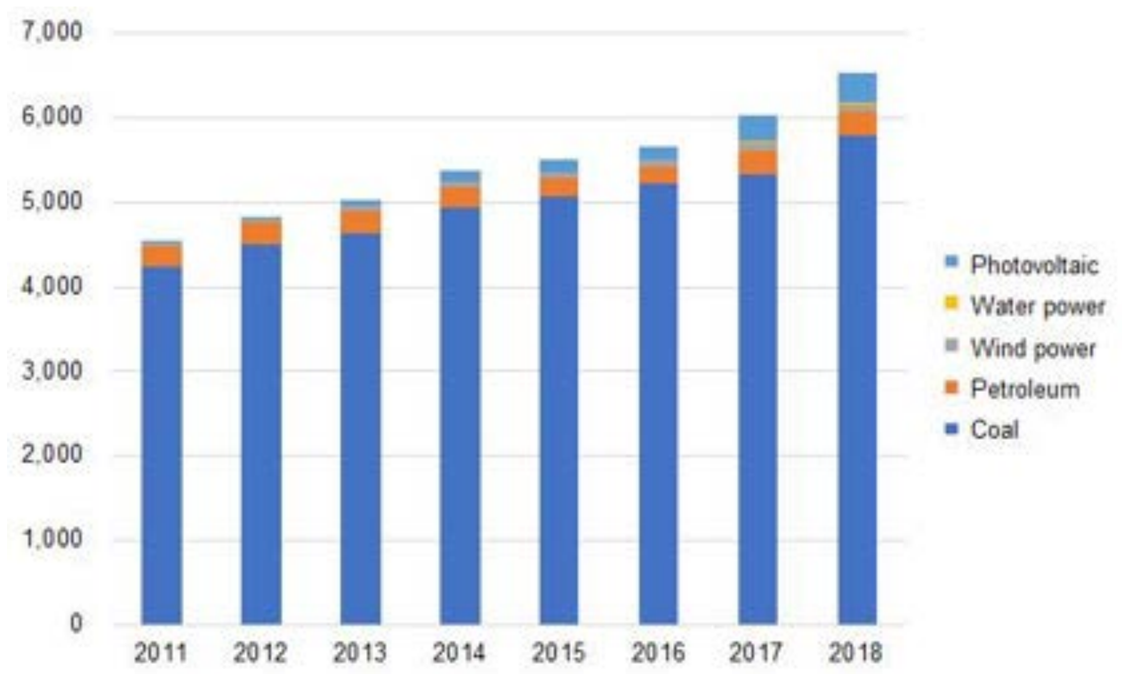
Source: KOTRA, 2021 Strategy of entering Mongolia (2021)
Source: IMF, the Central Bank of Mongolia, the National Statistical Office of Mongolia, UNCTAD

2.2.3 Status of Energy

2.2.3.1 Energy Mix Status

The energy generation volume of Mongolia has been steadily increasing every year, and thermal power generation using coal was found to be the main source of energy. As of 2018, thermal power generation accounted for 88% of the total power generation, and the petroleum power generation accounted for 5%. As for renewable energy sources, it was surveyed that photovoltaic power generation accounted for 5%, and wind power generation and hydroelectric power generation accounted for 1% and 1%, respectively.

[Figure 20] Power generation for each energy source of Mongolia (2011 to 2018) (unit: GWh)



<Table 16> Power generation for each energy source of Mongolia (2011 to 2018) (unit: GWh)

	2011	2012	2013	2014	2015	2016	2017	2018
Coal	4,238	4,502	4,629	4,934	5,062	5,227	5,331	5,782
Petroleum	236	253	269	242	230	193	279	295
Wind power	53	52	60	66	59	85	85	85
Hydroelectric power	8	8	8	8	8	8	25	33
Photovoltaic	1	1	54	126	154	154	307	340
Sum	4,536	4,816	5,020	5,376	5,513	5,667	6,027	6,535

Source: IEA website (https://www.iea.org) (reviewed and written by the research team)

2.2.3.2 Status of Electric Power Production and Consumption in Mongolia

Electrical power generation in Mongolia steadily increased to reach 6,900 GWh in 2019, and power generation per capita is also increasing. Electricity imports have accounted for 20% of total usage since 2013. In terms of electricity consumption by sector, it was surveyed that the electricity consumption in the industrial and construction sectors was the highest with a steady increase, and the household and apartment sector's electricity consumption was also high.

<Table 17> Status of electric power supply and demand in Mongolia (2011 to 2019) (unit: million kWh)

	Item	2011	2012	2013	2014	2015	2016	2017	2018	2019
Electric power consumption	Total generation	4,536.4	4,815.6	5,019.5	5,375.8	5,513.2	5,667.1	6,027.3	6,535.3	6,900.4
	Import volume	275.5	366	1,195.5	1,349.2	1,416.8	1,446.3	1,574.3	1,665.7	1,722.7
	Total	4,811.9	5,181.6	6,215.0	6,725.0	6,930.0	7,113.6	7,601.7	8,201.0	8,623.1
Electric power consumption by area	Industry and construction	2,140.8	2,338.9	2,930.7	3,171.6	3,261.4	3,356.3	3,692.0	4,003.0	4,249.2
	Transportation and communication	143.7	156.8	196.9	211.4	216.5	222.9	247.5	268.3	284.8
	Agriculture, forestry, fishing, etc.	36.4	39.8	49.9	63.7	54.8	56.6	62.8	68.1	72.3
	Residence	829.5	906.7	1,139.2	1,251.4	1,277.5	1,321.3	1,426.6	1,546.7	1,641.9
	Others	302.6	330.4	415.4	460.4	473.3	488.6	519.8	563.6	598.3
	Total	3,453.0	3,772.6	4,732.1	5,158.4	5,283.5	5,445.7	5,948.7	6,449.7	6,846.4
Other losses and consumption	Transmission and Distribution losses	644.3	675.4	739.5	792.6	782.6	817.1	810.9	875.3	891.6
	Amount used inside the power plant	690.8	712.4	725.3	772.4	778.2	748.7	816.4	849.3	860.9
	Export volume	23.8	21.2	18.2	33.4	50.8	36	25.7	26.7	24.1
	Power generation per capita (kWh)	1,693.2	1,762.3	1,797.9	1,866.2	1,860.0	1,872.2	1,945.8	2,068.8	2,163.1

Source: The National Statistical Office of Mongolia (www.1212.mn) (reviewed and written by the research team)

Mongolia imports and uses electric power from neighboring countries such as China and Russia, with about 78% of electric power imports from China and the remaining 22% from Russia. The amount of electric power imports remained on the rise for six consecutive years, up 3.4% year-on-year in 2019.

<Table 18> Trends for the amount of electric power imports of Mongolia (2014 to 2019) (unit: million kW)

Item	2014	2015	2016	2017	2018	2019
China	928.1	1086.5	1117.9	1216.3	1261.9	1342.1
Russia	421.1	298.3	302.3	358.0	403.8	380.6
Total amount of imports	1,349.2	1384.8	1,420.2	1,574.3	1,665.7	1,722.7

Source: Mongolian Customs (https://www.customs.gov.mn) (based on HS CODE 2716, reviewed and written by the Research team)

2.2.3.3 Status of Energy Supply by Administrative District in Mongolia

The central energy system of Mongolia consists of five thermal power plants. The central energy system supplies electric power to Ulaanbaatar City, Mongolia's capital, Darkhan City, Erdenet City, Baganuur City, and 10 Aimag (corresponding to the provinces of Korea) regions. The 10 Aimag regions are Töv, Dundgovi, Dornogobi, Khentii, Selenge, Bulgan, Arkhangai, Övörkhangai, Khövsgöl, and Bayankhongor.

The eastern energy system supplies electric power to Dornod, Sükhbaatar, and Khentii Aimags from the thermal power plant (36MW) located in Choibalsan City of Dornod. The western energy system supplies electric power to Uvs, Bayan-Ulgii, and Khovd Aimags using electric power imported from Russia in addition to the power generated (12MW) from the hydroelectric plant of Durgun.

The Altai energy system supplies electric power to the Zavkhan Aimag and the Gobi-Altai Aimag from the hydroelectric plant (11MW) of Taishir.

The southern energy system also uses renewable energy.

As of 2018, it was found that 312 of 329 Sums (districts) of Mongolia received energy through the central energy system, of which 12 Sums received it from photovoltaic power plants, 11 Sums received it from photovoltaic and wind combined power plants, 4 Sums received it from wind power plants, 13 Sums received it from hydroelectric power plants, and 7 Sums received it from diesel-powered power plants.

<Table 19> Energy supply structure for each of 21 Aimags (unit: ea)

No	Aimag	Sum (ea)	Central energy system	Photovoltaic power plant	Photovoltaic and wind combined power plants	Wind power plant	Hydroelectric power plant	Diesel-powered power plant
1	Arkhangi	19	19					
2	Bayan-Ulgii	13	13					
3	Bayankhongor	20	17	2	3			
4	Bulgan	16	16					
5	Gobi-Altai	18	16	3	1		2	1
6	Gobisumber	3	3					
7	Darkhan_uul	4	4					
8	Dornod	14	13		1			
9	Dorno-Gobi	14	12	2	1	1		
10	Dundgobi	15	15					
11	Zavkhan	24	19	2	1		4	4
12	Orkhon	2	2					
13	Uvurkhangai	19	19	1	1	1	1	
14	Umnu-Gobi	15	12	1	1	1		2
15	Sukhbaatar	13	13		1	1		
16	Selenge	17	17					
17	Tuv	27	27					
18	Uvs	19	19				1	
19	Khovd	17	16	1			4	
20	Khentii	17	17					
21	Khuvsgul	23	23		1		1	
Total		329	312	12	11	4	13	7

Source: The Ministry of Energy of Mongolia (http://energy.gov.mn/), KOTRA webpage, as of 2018

2.2.3.4 Status of Power Grid and Power Plant

The power grid of Mongolia consists of the Central Energy System (CES), the Eastern Energy System (ESS), the Western Energy System (WES), the Altai-Uliastai Energy System (AUES), and the South Gobi Region (SGR).

The total amount of power generated by the CES is 1,044MW (peak demand 965MW), and TES-2, TES-3, TES-4, and Darkhan supply electric power and heating to major cities such as Ulaanbaatar and Darkhan.

About 88% of electric power production depends on coal-fired power generationHowever, the supply capacity is insufficient to meet the electricity demand, thus resulting in power outages, which implies the unstable situation between electricity supply and demand in Mongolia. It was surveyed that 19.6% of the total electric power demand was imported from China and Russia.

There are seven coal-fired power plants in Mongolia of the combined heat and power plant-type (total installation capacity of 1,041MWe), and small diesel generators operate in areas not connected to the power supply grid. However, small portable solar power generators are used by the nomads. (KEMCO, 2012)

[Figure 21] Energy supply system and power transmission grid of Mongolia

Source: KEMCO, Status and policy of Mongolian energy (2012)

As of November 2020, it was surveyed that 13 coal-fired power plants were in operation in Mongolia due to the closure of TES-1 in the UB City, and six coal-fired power plants were located in Ulaanbaatar.

2.2.3.5 Status of Fuel Supply and Demand

Mongolia is the world's 10th richest country in mineral resources and has coal reserves of 175 billion tons (world's 4th largest) and crude oil reserves of 4.5 billion barrels. Coal is one of Mongolia's major exports, with production of 30.123 million tons in 2013, and an export volume of 18.188 million tons (USD 1.12 billion). Petroleum is also one of major export resources of Mongolia, exporting 5,244,000 barrels in 2013 (USD 510 million).

Mongolia's coal production began on a small scale in 1922, and then began in earnest in 1965 with production from Shariin gol, a large-scale open-air mine. Most mines are produced in an open-air mining method, and more than 30 mines are currently in operation. In 2013, it recorded production of more than 30 million tons of coal. Four of the 15 Mongolian strategic mines[1)] are coal mines, and the largest coal mine is Tavan Tolgoi, consisting of 7 mining areas covering 7㎢, with reserves of 6 billion tons recorded. (Global Energy Center, 2014)

<Table 20> Location and reserves of 15 strategic mines in Mongolia

Name of mines	Location	Reserves
Tavan Tolgoi	Umnugobi(Tsogttsetsii)	6 billion tons
Nariin Sukhait	Umnugobi(Gurvantes)	125.5 million tons
Baganuur	Ulaanbaatar(Baganuur)	600 million tons
Shivee Ovoo	Gobisumber(ShiveeGobi)	646.20 million tons

Source: Global Energy Center, Status and policy of energy and resources of major countries (2014)

The major coal-producing areas of Mongolia are the eastern and central and northern regions, and most of them produce brown coal. Some of the brown coal produced in mines is supplied to thermal power plants in Mongolia, but most is exported to China through land transport; however, disgareements between both countries on export conditions in the Chinese export sector can interfere with production and export.

[Figure 22] Locations and reserves of 15 strategic mines in Mongolia

Source: Google Search

1) The strategic mines refer to the mines with an annual production scale of more than 5% of GDP. 15 major strategic mines are designated and operated, and approval from the Parliament is required for license approval, government equity ratio, and investment guarantee contracts.

In 2019, the thermal power plants of Mongolia generated electric power using a total of 7.5 million tons of coal. Among them, 68% were used in TES-2, TES-3, and TES-4 power plants located in Ulaanbaatar, with most coal being used in TES-4.

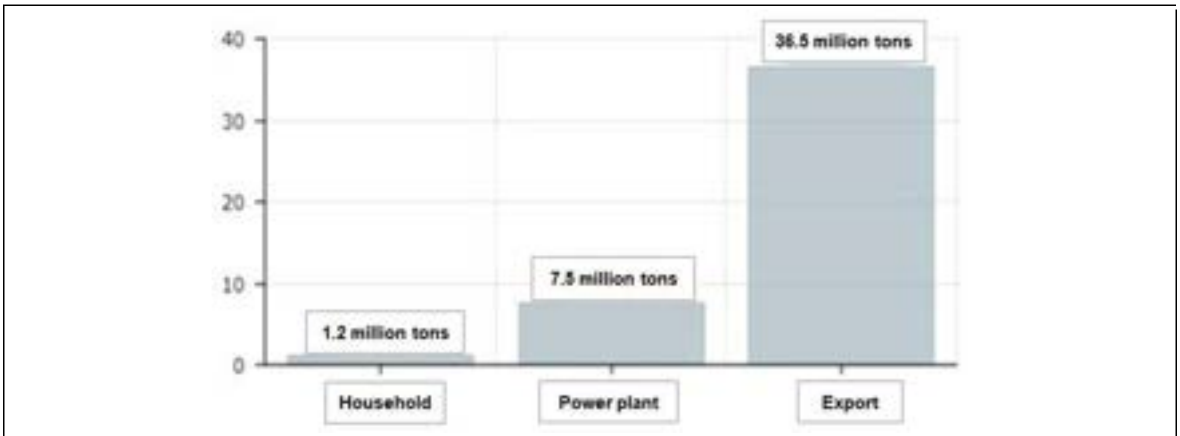
[Figure 23] Volume of coal used for producing electric power in 2019 (unit: 1,000 tons)

Source: ikon news site of Mongolia (www.ikon.mn) (reviewed and written by the research team)

※ From the left, TES-2, TES-3, TES-4, Darkhan, Erdenet, Erdenet Mining Corporation, Dornod, Dalanzadgad, Baganuur, Nalaikh, Amgalan, and local license holders (HOB)

Prior to the introduction of briquettes, residents of Ulaanbaatar used 1.2 million tons of raw coal annually, and the power plant used 7.5 million tons of coal. Compared to the volume of coal exports (36.5 million tons) for the year, the volume of the domestic coal used in Mongolia is insignificant.

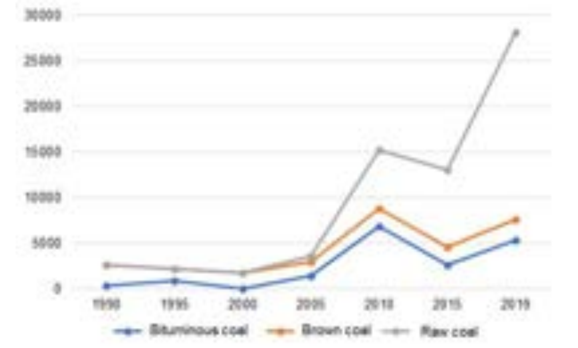
[Figure 24] Volume of coal used and export volume of coal by sector in 2019



Source: ikon news site of Mongolia (https://ikon.mn/n/1yo0) (reviewed and written by the research team)

According to the IEA data, Mongolia has the largest production of raw coal and has shown rapid growth since 2015. In terms of coal consumption, the volume of raw coal and brown coal consumed in Mongolia is high and the coal consumption in the household has been steadily increasing since 2000.

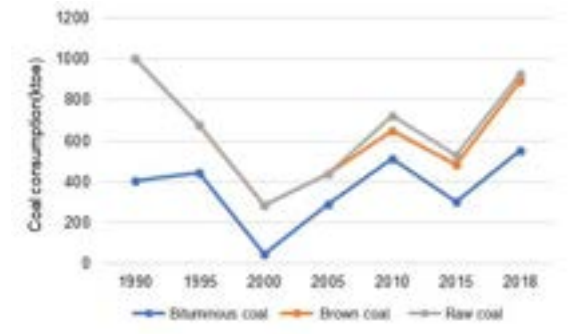
[Figure 25] Volume of coal production (1990 to 2018) (unit: Ktoe)



Year	Bituminous coal	Brown coal	Raw coal
1990	406	2,257	-
1995	881	1,283	-
2000	48	1,760	-
2005	1,497	1,493	662
2010	6,847	1,969	6,375
2015	2,651	1,980	8,495
2019	5,323	2,295	20,555

Source: IEA statistics (www.iea.org/data-and-statistics)

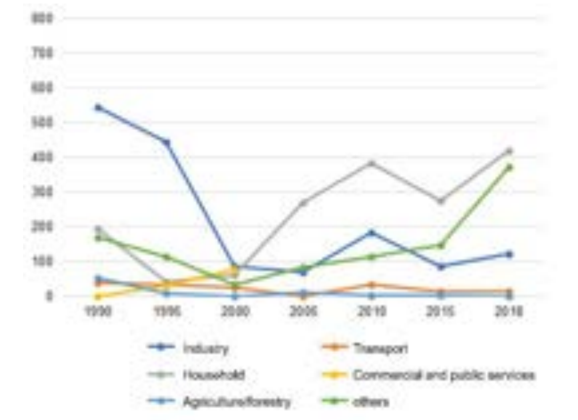
[Figure 26] Consumption for each type of coal (1990 to 2018) (unit: Ktoe)



Year	Bituminous coal	Brown coal	Raw coal
1990	406	595	-
1995	445	230	-
2000	48	238	-
2005	292	144	-
2010	511	139	71
2015	305	178	48
2018	550	346	32

Source: IEA statistics (www.iea.org/data-and-statistics)

[Figure 27] Coal consumption by sector (1990 to 2018) (unit: Ktoe)



Year	Industry	Transport	Household	Commercial/ public services	Agriculture/ forestry	Others
1990	544	39	194	1	55	169
1995	445	33	42	31	10	115
2000	86	25	62	78	1	34
2005	71	1	270	-	11	83
2010	184	33	383	1	3	116
2015	86	16	277	-	3	149
2018	122	14	419	-	1	373

Source: IEA statistics (www.iea.org/data-and-statistics)

2.3 Status of National Development Plan Related to the Ambient Air Quality

It was surveyed that there have been national development plans, such as VISION 2050, the Five-Year General Guidelines for the Development of Mongolia 2021-2025, the Action Program of the Government of Mongolia 2020-2024, the Green Development Policy, and the Energy Policy of Mongolia 2015-2030. The Long-Term Development Policy of Mongolia 2015-2040 established in 2015 was replaced with VISION 2050 that was the first long-term development policy of Mongolia and therefore was excluded from this survey.

2.3.1 VISION 2050, the Long-term Development Policy of Mongolia

In May 2020, the "VISION 2050", which is the long-term development policy of Mongolia was finally approved by the congress. It is Mongolia's first long-term development plan for 30 years, and it emphasizes sustainable growth, macroeconomic stability, human development, and fostering of middle class, and to achieve them, consists of 9 sectors, and 50 development goals and 187 projects under each sector. This policy will be carried out in three phases: 2021-2030, 2031-2040, and 2041-2050.

<Table 21> Contents of Vision 2050

No	Area	Development goal
1	Sharing national value	1.1 National pride, patriotism, and unity through national traditions, historical and cultural monuments, literature, and art 1.2 Conserving Mongolia's nomadic civilization based on the national spirit and cultural heritage 1.3 Using Mongolian language and script as components of national value 1.4 Achieving a high level of social enlightenment by conducting research on history, language, culture, customs, nomadic civilization, religion, and philosophy of Mongolia, and disclosing it to the public. 1.5 Establing national value of Mongolia in the world, and forming good cooperation between locally residing Mongolians and expats
2	Human development	2.1 Creating equal opportunities for everyone to receive quality education and strengthen the lifelong learning system as the basis of individual, family, and national development. 2.2 Developing a high-quality, accessible and effective health care system by developing citizens with healthy and active lifestyles 2.3 Promoting sustainable population growth and construct active and creative citizens and families 2.4 Developing internationally competitive national science, technology, and innovation systems **2.5 Creating a comfortable and hygienic environment for people** 2.6 Balancing the labor economy, creating a knowledge economy, and providing jobs and income to all citizens 2.7 Protecting Mongolian gene pools, strengthening risk prevention capabilities, supporting development of Mongolia
3	Improving the quality of life, and expanding the middle class	3.1 Developing social security services that strengthen the life security and social insurance system for improving the quality of life 3.2 Providing conditions for providing affordable housing that satisfies the purchasing power of households 3.3 Promoting employment, developing entrepreneurship and skills, and improving the competitiveness of the small and medium-sized companies 3.4 Providing financial services and protecting them from risks for the purpose of expanding the middle class 3.5 Supporting citizens and families with an active lifestyle and creating a friendly environment for physical culture and sports 3.6 Ensuring equality, justice, national economic security, and sustainable development by implementing a smart and citizen-centered integrated land management system

4	Economic development	4.1 Creating a stable macroeconomic environment and fostering the middle class as a dominant group in society 4.2 Developing economic priority areas and creating an export-oriented economy 4.3 Developing a multi-pillar, comprehensive financial system connected to international financial markets 4.4 Participating in regional economy and trade integration and promoting trade 4.5 Developing internationally competitive small and medium-sized enterprises and increasing employment 4.6 Establishing internationally recognized resources and funds that can support economic diversification, innovation, new technologies, human development, and green growth
5	Good governance	5.1 Ensuring power distribution, control and balance rationalization and management stability 5.2 Clarifying the distinction between functions and authority through the structure and organizational definition of administrative agencies 5.3 Effective and efficient e-government development that supports human development 5.4 Developing civilized, professional, competent, transparent, effective, and intelligent civil service 5.5 Constructing an appropriate system for interested parties to participate in national development policies, plans, and implementation by strengthening the partnership between civil society-private sector-government 5.6 Reducing corruption and official misconduct by strengthening the national judicial system
6	Green growth	6.1 Maintaining the values and benefits of nature and balancing major ecosystems 6.2 Delivering the benefits of nature to future generations, such as restoring natural resources, reducing deficits, and creating available resources 6.3 Providing conditions to meet demand by preventing water shortages and accumulating surface water **6.4 Contributions to international efforts for low carbon, development of a productive and inclusive green economy, and mitigation of climate change**
7	Peaceful and safe society	7.1 Improving the national defense system and strengthening capabilities 7.2 Ensuring inviolability of national boundaries and security of the border areas, developing the structures of military at the borders to improve border protection abilities 7.3 Strengthening the capabilities to reduce, prevent, and mitigate non-traditional risks, and creating a peaceful human society environment 7.4 Improving the legal environment in the law enforcement sector, supporting development, improving working conditions, and training qualified personnel and developing competitiveness 7.5 Ensuring integrity, confidentiality, and accessibility of public, private information
8	Regional development	8.1 Full connection with the regional economic integration through the integrated infrastructure networks and providing basic conditions that ensure rapid economic growth 8.2 Developing regional tourism based on major economic sectors and geographical advantages 8.3 Developing agriculture as a major sector of the economy that is eco-friendly, adaptable to climate change, and responsive to social development trends, needs, and requirements, and is responsible, productive, and sustainable
9	Development of Ulaanbaatar and satellite cities	9.1 Creating cities with healthy, creative, and intelligent residents with a high value for work such that productive citizens can be developed **9.2 Creating cities with a healthy and safe environment, balance of ecosystem, low greenhouse gas emissions, and healthy living environment with green technology** 9.3 Expanding efforts to create internationally competitive large cities by rapidly developing satellite cities with a well-planned space settlement system 9.4 Creating a city with a stable legal environment and excellent governance that ensures compliance with city rules and standards 9.5 Creating services and industries for tourism and culture and developing satellite cities that have become the center of transportation, logistics and international relations in Northeast Asia

Source: Legal site of Mongolia (www.legalinfo.mn), archive site of Mongolia (mongolmedleg.org/) (reviewed and written by the research team), Among the nine areas, this project for improving ambient air quality management is related to ② human development, ⑥ green growth, and ⑨ Development of Ulaanbaatar and satellite cities.

Development goal 2.5 is to create a comfortable and hygienic environment for people. In the short term (2021 to 2030), it is to create a safe and hygienic green facility and environment, and to construct and strengthen a system for environmental monitoring and evaluation. It contributed to implementation of the programs of Project 2.5.7, ensuring citizen participation and attitude change to reduce air pollution, and Project 2.5.8, reducing air and environmental pollution and preventing land degradation nationwide. This goal is expected to contribute to creating a healthy environment with the short-term goal (2020 to 2030), creating an advantageous living environment and creating an environment that meets life needs with the mid- to long-term goal (2031 to 2050).

Development goal 6.4 is to reduce carbon dioxide and promote efficient green growth for the public interest. Through this goal, in the short term (2021 to 2030), we plan to strengthen the climate change response management system, improve the green economy system through government-private cooperation, and promote eco-friendly green programs and projects using foreign investment and funds. It is expected to plan to save environmental resources and promote its circulation through eco-friendly industrial development with less waste with the mid-term goal (2030 to 2040) and support eco-friendly industries to contribute to international efforts to alleviate climate change with the long-term goal (2040 to 2050).

Development goal 9.2 is to create a city with healthy living environment, having a safe and sound environment, balanced ecosystem, low greenhouse gas emissions, and green technologies. It contributes to the air pollution reduction by systematically implementing Project 9.2.8 strengthening environmental quality monitoring capabilities, and Project 9.2.9 reducing vehicle emissions, redeveloping Ger area, improving air-conditioning, and addressing housing problems in high pollution areas. Through this goal, it is expected to contribute to ensuring a healthy and safe living environment for citizens by reducing air and soil pollution with the short-term goal (2020 to 2030) and establishing a green smart technology era balancing the city ecosystem and increasing environmental sustainability with the mid- to long-term goals (2031 to 2050).

<Table 22> Excerpt from the environment, air, and energy areas of 2021-2030 execution actions of Vision 2050

NO.	Contents
2.5.4.	Supplying renewable energy as heating and energy sources for housing
2.5.7.	Implementation of education and promotion to expand citizen participation and change citizens' attitudes to reduce air pollution
2.5.8.	Execution of the national air and environmental pollution reduction program, and the national program for soil protection and land degradation reduction
4.2.34.	Ensuring the reliability, safety, and consistency of energy, expanding the capacity of thermal power plants, constructing new power plants that can sufficiently supply domestic consumption, and export excess electric power
4.2.37.	Expanding the installation capacity of renewable energy to 30%, and using 10% of the outflow threatening river and lake streams for power generation and other consumption
6.4.	Developing a low-carbon, efficient, and sufficient green economy, and contributing to international endeavourrs to mitigate climate change
6.4.1.	Financially support eco-friendly, economic use, and efficient advanced green technology
6.4.4.	Reducing pollution and waste, introducing savable resources, advanced eco-friendly technologies, and machines, and financially supporting efficient production and economic consumption
6.4.7.	Implementing the Paris Agreement, ensuring the implementation of Nationally Determined Contribution (NDC) documents, and developing renewable energy to reduce greenhouse gas emissions from energy, agriculture, construction, transportation, industry, and waste setors
6.4.14.	Constructing and developing a public-private joint green financial system to fund eco-friendly green projects and activities
6.4.16.	Eco-friendly sustainable production development, distribution of smart consumption, financing eco and socially friendly projects and activities, and improving the level of national green financial systems (green banks, green bonds, green exchanges, and green insurance)
6.4.17.	Developing renewable energy with the United Nations Green Climate Fund and other international financial instruments, reducing greenhouse gas emissions, reducing waste, executing green projects and programs to increase resource efficiency
9.2.1.	Determining the value and ecological capabilities of ecological systems in urban areas, evaluating climate change vulnerabilities and risks, developing a comprehensive disaster risk management system, and constructing an ecological pathway for green areas
9.2.4.	Preparing an environment that can reduce, neutralize and reuse (inactivate) all pollutants by introducing advanced eco-friendly technologies and machines
9.2.13.	Reducing air pollution by systematically implementing projects that reduce vehicle emissions of pollutants, strengthen redevelopment in the Ger region, and replace Ger regions with high air pollution with houses step by step
9.3.37.	Efficiency improvement of central heating supply system through the connection with the partial and independent heat sources equipped with eco-friendly and advanced technology that can operate at load time in the remote area of the UB city
9.3.47.	Using the renewable energy by connecting the Ger region to the central, and partial and independent engineering supply devices through the urban redevelopment project

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

2.3.2 Five-year General Guidelines for the Development of Mongolia in 2021-2025

The five-year general guidelines for the development of Mongolia took effect on August 28, 2020. For the development of the nation, the guidelines established individual goals, as well as detailed goals under each of them, in nine categories—national value, population development, quality of life and middle class, economy, governance, green development, social security, infrastructure, Ulaanbaatar and satellite cities. Concerning the contents related to air pollution, “9.2.1 Reduction of the air pollution in Ulaanbaatar by 80%,” and “2.5.3 Reduction of air, water, and soil pollution and also reduction of noise for expanding clean green areas” are specified.

<Table 23> Goals of the Five-year guidelines for the development of Mongolia in 2021-2025

Item	Details
Goal 1	Social enlightenment, restoration of collective national pride, and fostering Mongolian citizens who respect mother tongue, history, and cultural heritage, and value patriotism and unity
Goal 2	Strengthening equality in access to quality basic social services, fostering Mongolian citizens respected in the world, and establishing family-friendly human development policies
Goal 3	Expanding the middle class and improving the quality of life through employment support, increased household income, and housing provision
Goal 4	Growing into a country with economic growth that can be beneficial and sustainable to all people by increasing the middle class, reducing poverty, continuous implementation of economic development policies, achieving self-sufficiency of petroleum and gas supplies, increasing exports, and improving investment and savings capabilities
Goal 5	Growing into a corruption-free country by constructing optimal public services for sustainable smart governance that guarantees human development and ensuring human rights and judicial systems through increased e-service and public, private, and civil society cooperation in all areas
Goal 6	Ensuring people the right to live in a healthy and safe environment by implementing climate change reduction and adaptation policies designed to reduce environmental pollution and deterioration, promote proper use and restoration of natural resources, and introduce eco-friendly green technologies
Goal 7	Ensuring the safety of individuals and society by strengthening national defense power, protecting human rights and freedom, protecting the social order and safety of the civil living environment, and reducing disaster risk
Goal 8	Pursuing competitive and relatively balanced regional development tailored to the integration of the local economy through respect for Mongolian culture, sustainable residence, nature conservation and ecological balance to be inherited by future generations, consistent green production combined with economic diversification and specificity
Goal 9	Developing a human-centered smart city that is comfortable to reside in and eco-friendly

Source: Legal site of Mongolia (www.legalinfo.mn), Mongolian cabinet secretariat webpage (https://cabinet.gov.mn/) (reviewed and written by the research team)

2.3.3 Action Program of the Government of Mongolia 2020-2024

The National Assembly approved the Action Program of the Government of Mongolia 2020-2024 in accordance with "Vision-2050, the long-term development policy of Mongolia, the five-year guidelines for the national development from 2021 to 2025."

The "Action Program of the Government of Mongolia 2020-2024" specifies 6 categories and 23 priority and sub-priority goals for successfully overcoming social and economic difficulties caused by the COVID-19 pandemic, and achieving human, social and economic development, environmental balance, governance improvement, zone and regional development, and rural development support. (Mongolian national assembly government site (vip76), 2020)

<Table 24> Action Program of the Government of Mongolia 2020-2024

No.	Category	Development goal
1	Successfully overcoming social and economic difficulties caused by the coronavirus (COVID-19) pandemic	• Special policy measures to overcome social and economic difficulties caused by coronavirus (COVID-19) pandemic in the short term
2	Human development	• Health • Physical education and sports • Education • Science, technology, and innovation • Labor and social protection • National pride and culture
3	Economic policy	• Financial and budget restrictions • Mining and heavy industries • Food, agriculture, and light industry • Tourism • Energy • Transportation and logistics • Construction and urban development
4	Governance policy	• e-Mongolia quick service • Professional and responsible government officials • Peaceful and safe society • Independent judicial and legal reforms that respect human rights • Stable and unified foreign policy • National defense
5	Green development policy	• Green development
6	Water, zone, regional development policy	• Ulaanbaatar, capital • Zone and regional development

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

As the contents related to ambient air quality management specified in the Action Program of the government of Mongolia, it can be confirmed that there are provisions related to the ambient air quality management in Goals 3, 5, and 6, and in particular, Goal 5 specifies the reduction in air pollution in Ulaanbaatar by 80%, and the gradual elimination of urban air pollution in other cities.

<Table 25> Excerpts of environment, air and energy sectors from the Action Program of the Government of Mongolia 2020-2024

Goal 3. Economic policy: Energy

No.	Contents
3.5.1.	Preparing an environment where continuously increasing consumption can be fully supplied in Mongolia by expanding the production capacity of electricity and heat
3.5.1.1.	Expanding and upgrading the capacity of TES-4 to 46 MW and the capacity of the Erdenet power plant to 35 MW
3.5.1.7	Expanding the capacity of the Amgalan power plant to a combined 50MW
3.5.1.8	Starting to construct gas power plants with public-private investment based on the infrastructure of TES-2 in Ulaanbaatar City to ensure a stable operation of its power system to meet the ever-increasing need for power and heat in Ulaanbaatar City
3.5.1.9	Expanding and improving thermal power plants in the Baganuur and Nalaikh regions of the capital; constructing new energy sources and power plants
3.5.6.	Executing green production projects to develop renewable energy production and reduce greenhouse gas emissions. Implementing a project of two 15MW wind power plants and four 35MW photovoltaic power plants
3.6.3.	Developing stable, sufficient, and safe services that meet eco-friendly targets and demand

Goal 5. Green development policy

No.	Contents
5.1	Protecting the environment, properly using natural resources, introducing advanced technologies, reducing environmental pollution, and providing conditions for citizens to live in a healthy environment
5.1.1	Reducing air pollution in Ulaanbaatar City by 80%, and solving the problem of air pollution in other large cities and regions step by step
5.1.9	Eco-friendly and efficient resources production and support Recycling waste Building plants for power generation and hazardous waste treatment

Goal 6. Capital, zone, and regional development policy (Ulaanbaatar, capital)

No.	Contents
6.1.4	Planning to build a second coal processing plant (supplied fuel) as part of Ulaanbaatar's policy measures to reduce air pollution

2.3.4 Green Development Policy

This policy aims to escape the threats of survival, such as global climate change, rapid population growth, and resource depletion, the policy is intended not only to switch to eco-friendly “green,” encompassing the meanings about green energy, green city, green purchase, green money, and green tax in addition to green economy and green growth, and also intended to change the trend and pattern of economic and social developments. (Korea Environment Industry Association, 2019)
Six strategic goals have been set for the purpose of a prosperous nation that maintains environmental stability and provides opportunities for future generations to enjoy the benefits of economic growth based on the concept of green development. (Korea Environment Industry Association, 2019)

<Table 26> Green development policy strategy goals

Item	Details
Goal 1	Reducing greenhouse gas emissions and waste production, and utilizing and developing natural resources
Goal 2	Strengthening environmental protection and recovery, reducing environmental pollution and destruction, and maintaining ecosystem balance
Goal 3	Introducing optimal incentives for the green economy, taxation, and credit for supporting a green economy, environment protection, human development, and expansion for investment in clean technology
Goal 4	Promoting green employment, reducing poverty, and making green lifestyle a habit
Goal 5	Developing cultural values suitable for nature, education, science, technology, and innovation
Goal 6	Planning and developing population settlement according to climate change, natural resources, and development abilities

Source: Korea Environment Industry Association, Guide to enter the promising environment market of Mongolia (2019)

The action plan for green development policy stipulates the specific activities to be implemented and agencies in charge to achieve the six goals between 2016 and 2030.

The contents related to ambient air quality in the green development policy included are’6.1 Setting urban and rural land use and construction zones, improving and implementing infrastructure plans, and reducing air, water, and soil pollution by preparing legal restrictions for responsibility’ of Goal 6; ‘1.1 Reducing wasted consumption and losses by upgrading energy production and technology, improving energy efficiency upto 20% till 2030 by rationalizing the price policy, achieving a 20% energy production from renewable sources by 2020 and 30% by 2030, and reducing greenhouse gas emissions in the relevant areas’ and ‘1.12 Developing eco-friendly infrastructure and transportation networks not adversely affecting human health or the ecosystem’ of Goal 1.

Other activities include ‘1.1.8 Setting requirements for advanced clean technologies for new thermal power plants and heating boilers, improving efficiency, and reducing greenhouse gas emissions per unit of production’, ‘Activities 1.1.9 Revising existing power plants, heating boilers, and industrial incineration stoves step by step, reducing emissions, and meeting international standards and requirements’, ‘Activities 1.12.4 Expanding road networks, introducing intelligent traffic control systems, reducing vehicle emissions’, etc.

2.3.5 Energy Policy of Mongolia 2015-2030

This policy suggested detailed goals that should be achieved in the use of energy in Mongolia and classified them into two phases: the first one for 2015–2023 and the second for 2023–2030.

Specified in the policy, the goal of the first phase is to construct combined heat and power plants, thermal power plant and hydroelectric power plants with an aim to expand the capacity of energy installations and lay down a foundation for renewable energy power generation, and the goal of the second phase is to build infrastructures and expand the capacities of the photovoltaic, wind, and hydroelectric power plants with an aim to make the proportion of the renewable energy power generation reach 30% of the energy mix.

[Reference] Details of the energy policy of Mongolia

4.1 Implementing the country's energy policy in two main stages

- **First stage (2015-2023): Constructing fuel and energy source capacity, laying the foundation for renewable energy development, improving the energy norm document system, adopting international standards and criteria, and improving the legal environment**

4.1.1 Goals to be achieved in the first stage: Doubling the installation capacity of Mongolia's energy sources, using high-efficiency equipment, generating more than 10% of the total installation capacity by hydroelectric power, increasing the reserve capacity by 10%, proposing an environment for intensive development of renewable energy, establishing a realistic tariff system, and facilitating an economic development environment in the energy area

4.1.1.1 Construct TES-5 combined heat and power plant in Ulaanbaatar City and thermal power plants in Tavantolgoi and Baganuur

4.1.1.2 Implement the project to build a large-capacity power plant for export and a DC power line

4.1.1.3 Build a hydroelectric power plant in Egiin gol

4.1.1.4 Build a thermal power plant in the western region, a hydropower plant in Khovd gol, and the Dornod thermal power plant in the eastern region

4.1.1.5 Build the power transmission lines connecting the regions Baganuur-Choir, Ulaanbaatar-Mandalgovi, Bagnuur-Ulaanbaatar, Baganuur–Undurkhaan–Choibalsan, Choir-Sainshand, Mandalgovi-Arvaikheer, and Durgun-Ulaistai-Ulaanbaatar

4.1.1.6 Energy prices and energy areas are operationally and economically independent depending upon restricted competitive market principles

4.1.1.7 Maintain the power transmission network under state ownership, while gradually privatizing state-owned power plants responsible for power supply and transmission, and establishing a national funding system for technology installation and expansion of power plants

4.1.1.8 Pursue domestic energy-related research, ensure the long-term operation of development research institutes, and facilitate expert energy education by enhancing the quality of education at training institutions to reach the standards of developed countries

4.1.1.9 Convert to the automation and information control system of power generation, power transmission, distribution, and supply operations

- **Second stage (2024-2030): Electric power exports and sustainable development of renewable energy**

4.1.2 Goal to be achieved in the second stage: Increasing the reserve capacity of energy sources in Mongolia to more than 20%, connecting to the large power grid those regions where the ratio of renewable energy to the total installation capacity reaches 30%, and constructing an integrated smart system of energy with a comprehensive system for information control. Completely privatizing power transmission and supplying networks and operating the energy area in a restricted competitive form. Exporting electric power by being connected with neighboring countries through high-capacity DC power lines

4.1.2.1 Construct a nationwide energy integrated system

4.1.2.2. Build high-capacity hydroelectric power plant in the Selenge River basin, 300MW wind and photovoltaic power plants in the southern region, high-capacity power plant for export, and power transmission lines

4.1.2.3 Achieve the standards of developed countries in terms of power quality and stable supply

4.1.2.4 Active participation in the energy trading market in Northeast Asia

4.1.2.5 Establishment of National Energy Research System with innovative and advanced technologies

4.1.2.6 Expanding private participation in the installation capacity and gross production of energy sources

4.1.2.7 Complete conversion to a system that includes automation and information control of power generation, power transmission, distribution, and supply, and construct an integrated smart network

Source: Legal site of Mongolia (https://www.legalinfo.mn/)

2.4 Management Status in the Environmental Sector

2.4.1 Status of Relevant Laws and Policies in the Environmental Sector

<Table 27> Status of relevant laws and policies in the environmental area

Item	Law	Main contents
Overall environ-ment	Law on Environmental Protection (1995)	• The resource development and economic development of Mongolia aim to guarantee human rights to live eco-friendly, healthily and safely. • This law is prescribed to protect natural resources (land and soil, land resources, water, plants, animals, and air) and to prevent environmental imbalance.
Overall environ-ment	Law of Mongolia on Environmental Impact Assessments (2012)	• This law is prescribed to protect the environment, prevent environmental imbalance caused by human activities, and use natural resources while protecting the environment, and to assess policies, development projects, and programs that affect the environment. • The environmental impact assessments include the following evaluations: Environmental strategy assessment, status assessment, impact assessment, and cumulative impact assessment
Air	Law on Air (2012)	• This law is prescribed to protect the ambient air quality, prevent air pollution, reduce and control air pollutants emissions, and monitor ambient air quality
	Law on Air Pollution Tax (2010)	• This law imposes a tax in the event of air pollution (coal combustion, automobile, organic matter, and other resources).
Water	Law of Mongolia on Water (2012)	• This law is prescribed to protect, reasonably use, and reproduce water resources.
	Law on Water Pollution Tax (2012)	• This law imposes a tax on individuals and businesses responsible for polluting Mongolia’s water resources.
Forest	Law of Mongolia on Forest (2012)	• This law is prescribed to protect, restore, reproduce, own, and use the forest, and to prevent fires in the forest and grassland.
Waste	Law of Mongolia on Waste (2017)	• This law is prescribed to reduce and prevent the negative impact of waste on human health and the environment, to put waste into economic circulation, and to save natural resources. • This law is prescribed to conserve the environment by suppressing the generation of the waste as much as possible and treating the generated waste in an eco-friendly manner.

Source: Legal site of Mongolia (https://www.legalinfo.mn/)

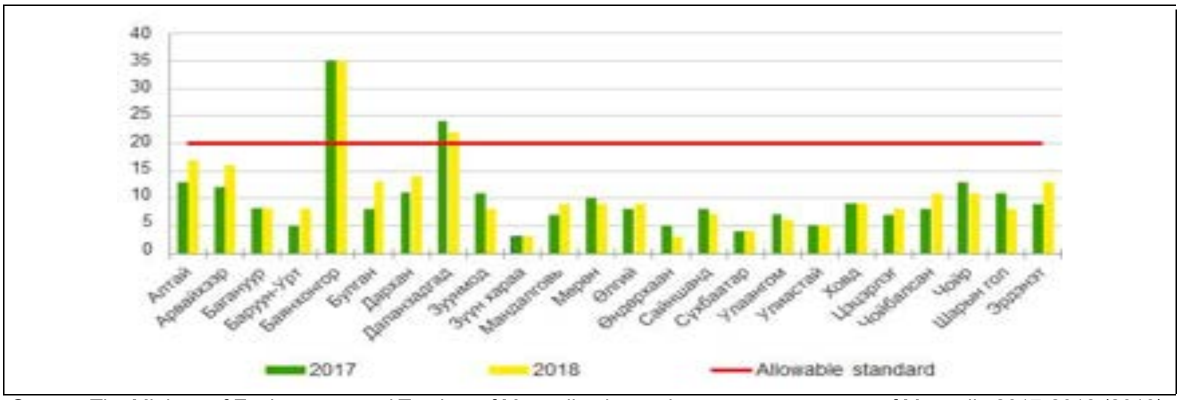
2.4.2 Status of Issues in the Environment Area

(1) Status of the ambient air quality management

Air pollution is serious due to the population concentration in Ulaanbaatar and the use of stoves in the Ger region. In January 2019, the concentration of ultrafine dust in the UB City was about 24 times that of the recommended standard of the World Health Organization (WHO), and as one of the countermeasures therefor, in May of the same year, a policy was passed to prohibit the use of raw coal to reduce air pollution in the Ger region and to attach filters for reducing emissions discharged from vehicles. (Korea Environment Industry Association, 2019)

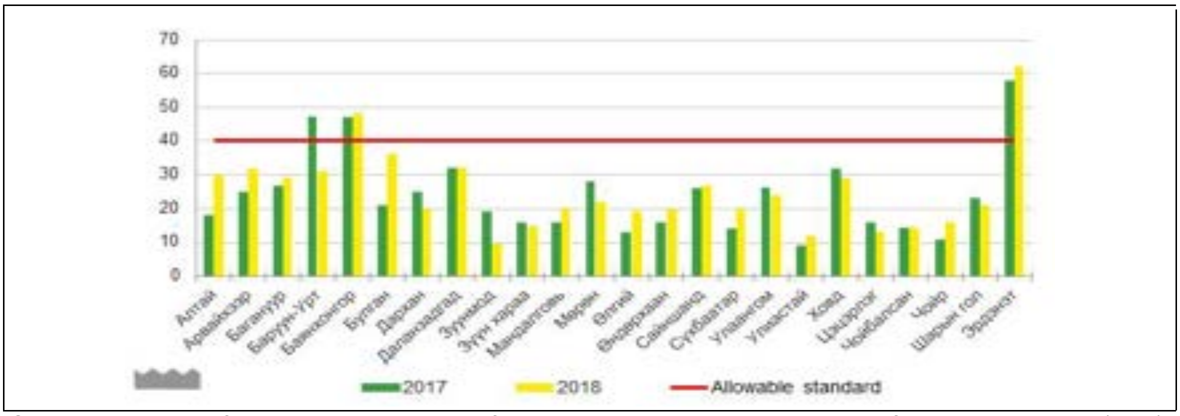
Compared to the average annual concentrations of air pollutants in Ulaanbaatar in 2017, in 2018 PM2.5 ($12\mu g/m^3$) is 14% lower, and nitrogen dioxide ($5\mu g/m^3$) is 13% lower, but the concentrations of PM10 and sulfur dioxide were shown to maintain the same level as in the previous year. In 2018, major winter air pollutants in Ulaanbaatar were shown in the order of the Ger region and HOBs (80%), vehicles (10%), combined heat and power plants (6%), and waste and soil contamination (4%). (Ministry of Environment and Tourism of Mongolia, 2019)

[Figure 28] Average annual concentration of sulfur dioxide in the air (unit: μg/m^3)



Source: The Ministry of Environment and Tourism of Mongolia, the environment status report of Mongolia 2017-2018 (2019)

[Figure 29] Average annual concentration of nitrogen dioxide (NO2) in the air (unit: μg/m^3)



Source: The Ministry of Environment and Tourism of Mongolia, the environment status report of Mongolia 2017-2018 (2019)

(2) Status of water quality management

Water resource pollution is intensifying due to problems such as rapid urbanization, wastewater in the mining industry, livestock processing chemicals, and grazing livestock manure. The indicator water quality monitoring network of Mongolia measures and evaluates the chemical composition and water quality standard, and water quality pollution indexes of 127 points and 191 points in 94 rivers and 18 lakes. The water quality pollution index follows the MNS4586-98 water quality standard, and the average annual concentration is measured based on oxygen dissolved in water (dissolved oxygen), easily oxidized organic materials, minerals, phosphorus, chromium, and copper. (Ministry of Environment and Tourism of Mongolia, 2019)

(3) Status of waste management

There is a surge in waste generation due to the population concentration and industrialization, and the absence of a hazardous and medical waste treatment system. About 50% of all waste appears to be recyclable, but the actual recycling rate was only 0.31%. (Korea Environment Industry Association, 2019) Based on the amount of waste treated in the central waste disposal plant, it is steadily increasing from 2,102,721.8 tons in 2016, to 2,480,745.54 tons in 2017, and 3,353,548.73 tons in 2018. (Ministry of Environment and Tourism of Mongolia, 2019)

As of 2018, there were 390 approved waste treatment sites in Mongolia. Of total waste treatment volume in 2018, 8.2% were for industrial waste and 91.8% were for household waste. The recyclable waste accounts for 50% of the total waste, but the currently recycled waste is less than 10%, and improvement in the waste separation system is a top priority. As of 2018, about 40% of all waste in Ulaanbaatar came from apartment complexes, and about 30% came from the Ger regions. (Ministry of Environment and Tourism of Mongolia, 2019)

2.4.3 Status of the Project Related to the Ambient Air Quality Management

(1) Status of other aid agencies entering the ambient air quality management sector in Mongolia

World Bank (WB), Asian Development Bank (ADB), United Nations Development Programme (UNDP), and countries such as USA, Switzerland and Japan carried out or are carrying out projects in various areas for improving the ambient air quality of Mongolia.

<Table 28> Detailed status of other aid agencies entering the ambient air quality management area of Mongolia

Donor	Name of the project	Period	Main contents of the project
Germany, France	Setting-up an Ulaanbaatar air pollution monitoring network	− 2010	Installing an automatic ambient air monitoring station and constructing a network
USA	Clean air project	2009-2013	Supplying cooking stoves
Switzerland	Air Pollution Impact on Health	2018-2022	Conducting research on the impact of air pollution on mother and children
ADB	Energy Conservation and Emissions Reduction from Poor Household	2008-2011	Replacing Ger cover
	Ulaanbaatar Clean Air	2010-2011	TA project to introduce stoves
	Energy Efficiency and Urban Environment Improvement	2014-2016	TA project to improve power grid
	Coal to Cleaner Fuel Conversion for Heating in Ger District and Power Generation	2015-2016	TA project to introduce coal liquefaction technology
	Ulaanbaatar Air Quality Improvement Program	2017-2018	Air pollution-related policies/methods identification consulting
	Ulaanbaatar Air Quality Improvement Program	2018-2019	Strengthening the efficiency of implementing the air pollution management restriction framework and action plan (integrated city, energy, transportation system mechanism)
	Strengthening Knowledge and Actions for Air Quality Improvement	2018-2021	TA to strengthen the knowledge and capabilities for policy action and technology solution development for ambient air quality management
	Ulaanbaatar Air Quality Improvement Program – Phase 2	2019-2020	Strengthening the efficiency of implementing the air pollution management restriction framework and action plan
	Methane Gas Supply Chain Development Master Plan	2020-2022	Establishing a methane gas supply chain infrastructure development strategy
	Supporting Renewable Energy Development	2020-2022	Developing TA project to support utilizing renewable energy (strengthening power transmission, installation of hydroelectric power storage/geothermal power generation pilot projects, and thermal technology)
WB	Air Quality Analysis of Ulaanbaatar Improving Air Quality to Reduce Health Impacts	2008-2009	Surveying baseline for ambient air quality monitoring/ suggesting reduction plan and modeling
	Ulaanbaatar Clean Air Project (UBCAP)	2012-2021	Supporting stove purchase subsidies and replacing about 50 large old heat only boilers Carrying out urban greening pilot projects and implementing campaigns to improve public awareness

JICA	Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 1 in Mongolia	2010-2013	Strengthening the air pollution management capabilities in Ulaanbaatar City through the development of human resources by a Mongolia's air quality management agency
	Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2 in Mongolia	2013-2017	Improving technological capabilities, such as analyzing air pollution sources in Ulaanbaatar, Mongolia and evaluating the efficacy of countermeasures, and supporting the construction of a series of management cycles for implementation of air pollution measures
	Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 3 in Mongolia	2018-2023	Improving capabilities of air pollution management of Ulaanbaatar city, implementing air pollution reduction measures, and establishing coordinating system between ministries

(2) Status of other domestic agencies entering the ambient air quality management

The main projects that are in progress and carried out by other domestic ministries for managing the ambient air quality of Mongolia were reviewed.

All aid projects carried out by other domestic agencies for managing the ambient air quality of Mongolia were investigated and found to be project-type activities, such as supplying and installing devices locally or creating forests. When the projects are classified by target according to the investigation, two projects were for supporting heaters in the Ger region related to the household sector, two projects were for supporting renewable energy related to the power generation sector, one was for the installation of weather monitoring systems, and one was for afforestation.

<Table 29> Detailed status of other domestic agencies entering the ambient air quality management area of Mongolia

Name of the project	Overview of the project	Contents of the project
Project to Build Capacity in Quality Control Management of Energy Resources to Improve Air Quality in Mongolia	Period of the project: 2021-2025 Scale of the project: $4.5M Implementation agency: KOICA Performance agency: Korea Petroleum Quality & Distribution Authority	1) Contents of the project - Establishing the mid- and long-term road map of the central laboratory of the Implementing agency of the Mongolian Government Mineral Resources and Petroleum Authority - Establishing regulations (draft) for quality inspection work of petroleum products and regulations (draft) for testing and analysis work to enhance reliability - Constructing material and equipment related to testing and analysis of petroleum products and minerals - Remodeling design/construction of the central laboratory of the Implementing agency of Mongolian Government Mineral Resources and Petroleum Authority - Capacity building for the central laboratory staff of the Implementing agency of Mongolian Government Mineral Resources and Petroleum Authority 2) Performance of the project - N/A (plan to proceed)

The Pilot project to Reduce Air Pollution by Improving Heating Culture in Ulaanbaatar, Mongolia	Period of the project: 2008-2009 Scale of the project: $0.7M Implementation agency: KOICA Performance agency: The Mine Reclamation Corporation	1) Contents of the project - It contributes to reducing air pollution and improving the environment of Mongolia by improving the heating culture through briquette stove support in the Ger villages. - Details: Material and equipment support (briquette stove, briquette), dispatch of experts (constructing coal industry infrastructure), and inviting trainees (coal/briquette production and technical training) 2) Performance of the project - When local fuel is replaced with Korean-style briquettes, air pollution is reduced, and combustion efficiency is improved. ※ (Additional project) In 2018, idle coal analysis equipment was donated to the Mongolian government as a means of global Corporate Social Responsibility (CSR) for the exchange and cooperation of coal quality management technologies between Korea and Mongolia. By conducting training on theory and equipment operation on coal analysis, Korea's coal quality management technology was transferred (KOTRA, the Mine Reclamation Corporation).
Project to construct a Meteorological disaster monitoring system	Period of the project: 2004-present Scale of the project: 5.7 billion won Implementation agency: Korea Meteorological Administration Performance agency: -	1) Contents of the project - In 2008 and 2010, the meteorological tower(20m-high) that could monitor real-time yellow dust in the Gobi Desert were installed - Two yellow dust monitoring towers were installed in the Gobi Desert, and observation data were transmitted to the National Agency for Meteorology and Environmental Monitoring of Mongolia in real time. - Yellow dust observation information can be transmitted by satellite every 5 minutes to monitor the air in real time. 2) Performance of the project - In 2017, 11 automatic weather observation systems were installed to automatically measure temperature, wind direction, wind speed, air pressure, precipitation, and humidity throughout Mongolia. In the future, a total of 32 systems will be installed. - Korea's weather observation can be improved by improving Mongolia's weather observation.
Project to improve heating efficiency for low-income families in Mongolia	Period of the project: 2015 Scale of the project: 3.35 billion won Implementation agency: KOICA Performance agency: Good Neighbors/Good Sharing (Mongolian social enterprise)	1) Contents of the project - Supplying heat accumulators to 52,000 low-income families living in a Ger, a mobile home in Mongolia 2) Performance of the project - Improving ambient air quality by increasing heating efficiency and reducing coal consumption through the supply of heat storage devices
Project to supply customized wind power generation systems in Mongolia	Period of the project: 2016-2019 Host ministry: The Ministry of Industry Host agency: Korea Renewable Energy (KOGY) Co., LTD./Korea Testing Laboratory/ Korea Institute of Energy Research/ Chung-Ang University/Chosun University	1) Contents of the project - Korea's first customized wind power generator was installed in a mining region outside UB, Mongolia to supply electricity to mining offices and staff accommodations (Mongolian 3kW small wind power generation systems were designed and manufactured), which is an example of supplying electric power to developing countries with pure domestic technology. - KTL's participation in the core technology development project for renewable energy (Ministry of Industry) and development of customized wind power generation systems in Mongolia

		2) Performance of the project - Contributing to solving the problem of local greenhouse gas by supplying customized renewable energy technology through environmental improvement and technical support in developing countries
Project to create eco-friendly energy towns in Mongolia	Period of the project: 2018 Scale of the project: - Implementation agency: Korea Southern Power Co., LTD. Performance agency: Geogeny consultants group Samwon Millennia Co., LTD, Korea Institute for Development Strategy Busan TechnoPark Korean Foundation for Quality	1) Contents of the project - Project to construct a complex power generation complex combined with photovoltaic power generation and ESS, restore facilities or spaces that people avoid, such as mine damage contaminated regions, in the Nalaikh region of Ulaanbaatar, Mongolia, and produce renewable energy from photovoltaics and wind-powered turbines 2) Performance of the project - Produced power (production of about 400KW, with wind and photovoltaic systems producing 200KW, respectively) will be supplied to GMIT (German-Mongolian Institute for resources and Technology) and Ger villages near an energy town
Project to create forest in Ulaanbaatar City	Period of the project: 2018-2021 Host agency: Korea Forest Service Performance agency: Mine Reclamation Corporation (MIRECO)	1) Contents of the project - Creating an urban forest to inform the citizens of Ulaanbaatar who are experiencing the environmental effects of yellow dust and pollution of the importance of forests 2) Performance of the project - In the future, various follow-up management projects such as planting trees connected to resident income and agroforestry will be prepared.

(3) The status of domestic private companies entering the ambient air quality management of Mongolia

Among domestic private companies, projects that provided air cleaning products or energy-saving heating devices to improve the ambient air quality in Mongolia as part of Corporate Social Responsibility (CSR) activities were investigated.

<Table 30> Detailed status of domestic private companies entering the ambient air quality management of Mongolia

Name of the project	Overview of the project	Contents of the project
Haatz's Spring (improving indoor air quality)	Period of the project: 2017 Performance company: Haatz Inc.	1) Contents of the project - It is a clean business project of Haatz Inc. and is an indoor air quality improvement project that provides clean air through an outdoor air cleaning system and vertical green wall through free donation of air cleaning products. 2) Performance of the project - Additional outdoor air cleaning systems and vertical green walls were installed at daycare centers where only air purifiers had been previously used. Measurements for fine dust and CO_2 were taken in classrooms with the new installations and those with the previous setup, and the results for the classrooms with the new installations showed a decrease in fine dust levels of 55% - 70% and CO_2 concentrations decreased by 25% - 50%. Interestingly, attendance increased by 21% due to fewer cases of bronchial disease.

Free donation of Hot Water Floor Heating to a region outside Ulaanbaatar * Hot Water Floor Heating: Energy-saving *ondol* heating	Period of the project: 2012 Performance company: GEO E&C	1) Contents of the project - According to the MOU, GEO E&C made a hot water floor heating system worth $1 million and constructed it in 150 Ger houses, a Mongolian tent, outside Ulaanbaatar. 2) Performance of pilot project - First, after the pilot construction of the Hot Water Floor in Ger, it was reported on the National Broadcasting System as it reduced fuel by 50% compared to the existing heating cost and allowed the indoor temperature to maintain a comfortable environment at 20 degrees Celsius. - In 2011, the Mongolian government asked Korea for help through diplomatic documents in Mongolia, but couldn't get an answer, and GEO E&C supplied the product for free.

Part 1 Establishment of the Environmental Improvement Plan

Chapter 3 Status of Environmental System · Policy and Suggestion of Improvement Proposal

Chapter 3 Status of Environmental System·Policy and Suggestion of Improvement Proposal

3.1 Status of Ambient Air Quality Management in Mongolia

3.1.1 Status of Governance Related to Ambient Air quality management Areas

(1) Ministry of Environment and Tourism of Mongolia

The Ministry of Environment and Tourism is a national central administrative agency in charge of nature and environment. The Ministry provides opportunities for green development and tourism development, ensures environmental balance, and guarantees the right to live in a healthy and safe environment through cooperation and efforts among individuals, industries, and organizations.

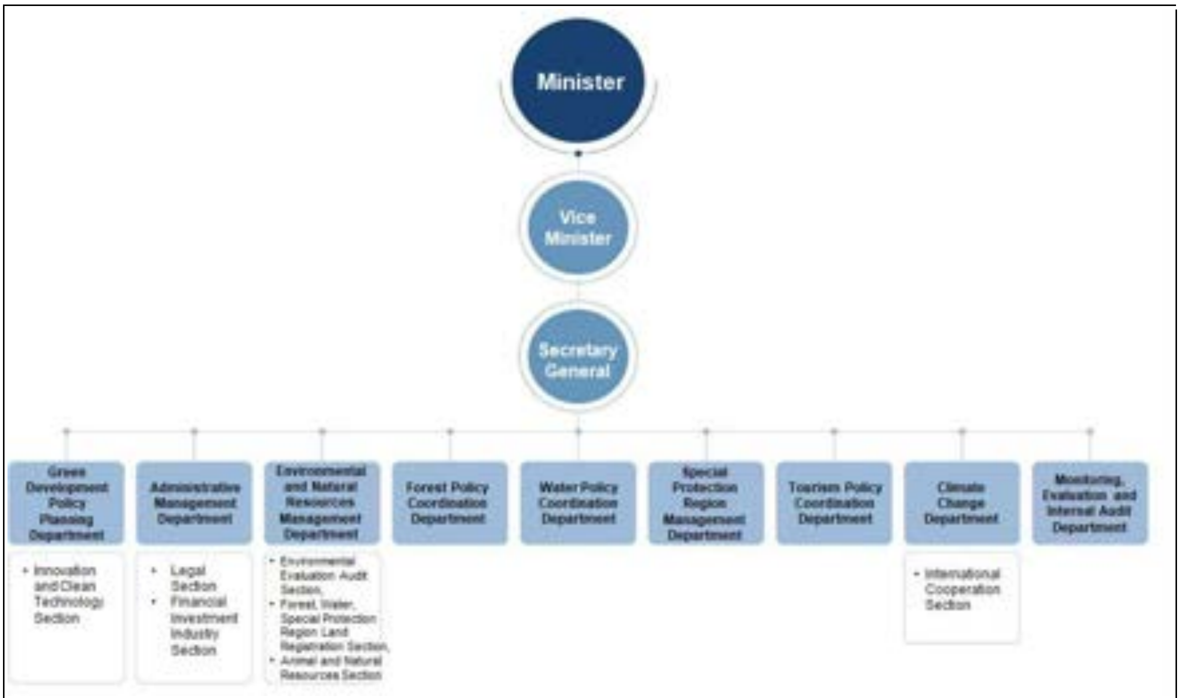
The main functions are to develop and approve drafts of laws, policies, and programs on the environment, green development, and tourism, and to establish and enact policies and guidelines. The Ministry is also in charge of forest management, maintaining groundwater, land, atmospheric and animal databases, green development policies, tourism policy coordination, and special protection area management.

[Reference] History of the Ministry of Environment and Tourism of Mongolia

- December 9, 1987, "Ministry of Environment Protection" was first established
- July 30, 1992, Changed to "Ministry of Environment"
- August 16, 2012, Changed to "Ministry of Environment Green Development”
- December 4, 2014, Changed to "Ministry of Environment Green Development and Tourism”
- July 21, 2016, Changed to "Ministry of Environment and Tourism”

The Ministry of Environment and Tourism of Mongolia consists of nine departments, including the Environmental and Natural Resource Management Department and the Climate Change Department.

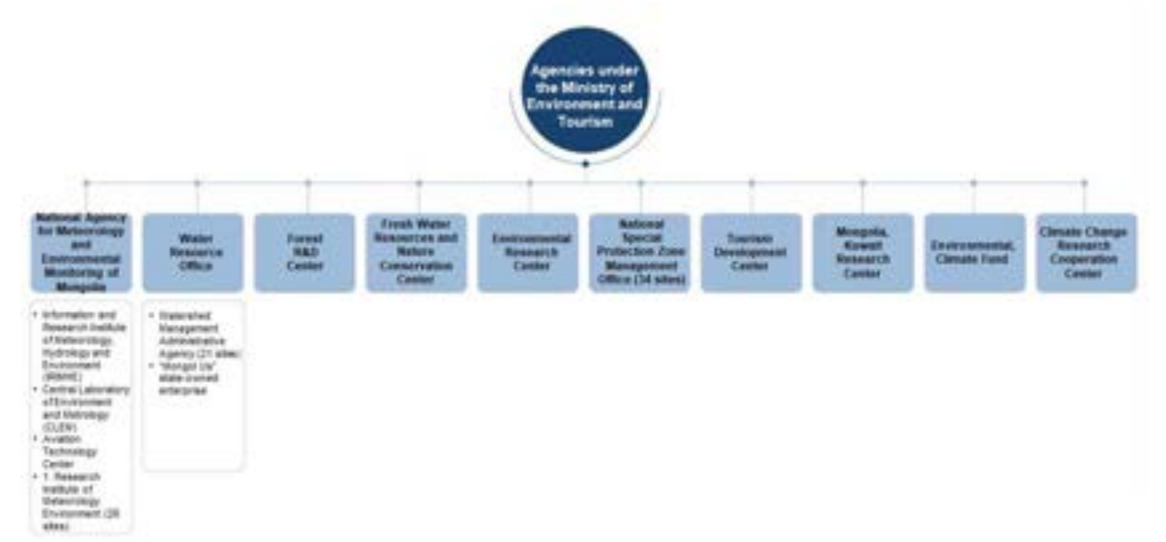
[Figure 30] Organization status of the Ministry of Environment and Tourism of Mongolia



Source: The Ministry of Environment and Tourism webpage (http://www.mne.mn/) (reviewed and written by the research team)

The Ministry of Environment and Tourism operates nine affiliated agencies dedicated to air, water, forest, and tourism.

[Figure 31] Agencies under the Ministry of Environment and Tourism of Mongolia



Source: The Ministry of Environment and Tourism webpage (http://www.mne.mn/) (reviewed and written by the research team)

<Table 31> Strategic goals of the Ministry of Environment and Tourism of Mongolia

Item	Main contents
Strategic Goal 1	1.1 Approving laws, plans, strategies, and providing policy guidelines for environment, green development, tourism according to the national sustainable development 1.2 Strengthening governance, improving laws, budget planning, finance and asset management in the environmental sector 1.3 Implementing laws, policies, and programs on environmental pollution reduction, desertification prevention, rational use, protection and recovery of environmental resources 1.4 Developing the tourism sector as a major part of the economy, and improving and implementing strategies, programs, and laws in the tourism sector 1.5 Expanding sustainable policies and laws, such as maintaining forest ecosystem, stopping deforestation and devastation, expanding the area of forests, and improving forest quality 1.6 Implementing land management, water supply-related laws and policies, water resource and basin protection, water resource rational use policies and cooperation projects, and strengthening water resource and basin management systems 1.7 Improving and strengthening laws, policies, and programs in special protected area 1.8 Evaluating risks, results, and impacts, and ensuring transparency of evaluation information by monitoring policy execution, evaluating results, and conducting internal financial audits 1.9 Improving and implementing climate change-related laws, policies, and programs, and developing overseas cooperation projects in the environment and tourism sectors
Strategic Goal 2	2.1 Implementing the internal affairs of the Ministry of Environment and Tourism, monitoring and reporting the enforcement of policies and laws, recruiting, and systematizing and promoting laws 2.2 Developing human resources in the relevant areas, improving reporting and responsibility systems, and developing cooperation projects for environmental resources and nature protection partnership activities 2.3 Strengthening electronic governance, introducing information technologies, ensuring transparency and openness of information, and providing information in the environment and tourism sectors 2.4 Developing and monitoring bills, decisions, and negotiation contract projects, and investigating and eliminating overlapping laws, loopholes, and violations of the laws 2.5 Executing budget planning, investment planning, managing, and coordinating finance, and assets in the relevant area, and ensuring budget transparency

Strategic Goal 3	3.1 Laws, policies, and projects related to environmental protection, rational use of natural resources, and expansion and recovery of resources 3.2 Reducing negative impact on the environment through industrial activities, introducing policies to reduce waste and revitalize recycling, and eco-friendly production and environmental protection technologies 3.3 Air pollution prevention, protection, and air pollution reduction policies 3.4 Policies to reduce land devastation, protect and recover soil, and prevent soil pollution and desertification 3.5 Conducting environmental impact assessment of regional industrial development and projects, environmental evaluation, environmental protection education and promotion, and environmental monitoring 3.6 Developing, using and protecting integrated database for forests, water, and special protected area in Mongolia, identifying migration and changing trends, and developing and observing a land registration map
Strategic Goal 4	4.1 Improving and strengthening laws and policies in the tourism sector, and developing and implementing policy-related projects 4.2 Developing eco-friendly tourism services, and improving the tourism industry and its operation 4.3 Collecting and analyzing tourism information, developing an integrated database and providing relevant information, overseas promotion and marketing activities, and policies to expand overseas tourists 4.4 Understanding and consulting on the tourism industry to administrative agencies, specialized agencies, public agencies, and citizens in tourism regions
Strategic Goal 5	5.1 Improving and strengthening forest-related laws, and developing and implementing policies and projects 5.2 Protecting from forest fires, forest pests, and diseases, strengthening illegal logging policies, and implementing policies to prevent deforestation and devastation 5.3 Expanding and recovering the area of forests (foresting, seedling, high-quality tree seeds, etc.), and improving technology 5.4 Sustainable policy of forest resources and expansion of the scope and efficiency of forest products 5.5 Forest sustainability policies and implementation, expansion of support, improvement of science, education, information, promotion, and legal environment of the forest industry, and strengthening "Good Forest Governance"
Strategic Goal 6	6.1 Improving and implementing land management, and water supply-related laws, policies, and projects 6.2 Implementing and monitoring laws and policies related to land management, and land resources 6.3 Protecting water resources and watersheds, rationally using and recovering water resources, and preventing and monitoring water pollution 6.4 Policies to Identify water resources, to increase utilization efficiency of water resources, and to activate sewage recycling 6.5 Strengthening policies for water resources and watersheds
Strategic Goal 7	7.1 Implementing and monitoring laws, policies, and projects related to special protected areas 7.2 Expanding the special protected areas and improving protection policies 7.3 Strengthening the management of networks and protected areas in the special protected areas and providing environment education to the public 7.4 Implementing international agreements and agreements on the special protected areas, and expanding cooperation project development
Strategic Goal 8	8.1 Executing and monitoring laws and policy goals, evaluating results, and ensuring openness and transparency of evaluation information 8.2 Executing and monitoring national programs and overseas investment projects, evaluating results, and ensuring openness and transparency of evaluation information 8.3 Managing statistical data and integrated information database in the area of environment and tourism 8.4 Internal audit and monitoring of budget managers

Source: The Ministry of Environment and Tourism webpage (http://www.mne.mn/) (reviewed and written by the research team)

(2) Ministry of Energy (MOE)

The Ministry of Energy is a national administrative agency with the main goal of executing energy policies for ensuring the socio-economic development of Mongolia and providing productions and services for the healthy and safe environment.

As strategic goals, it is responsible for providing policy guidelines for developing policies, laws, rules, and regulations related to energy and energy fuel, developing overseas cooperation projects, implementing and coordinating energy policies, laws, rules, and regulations, securing the integrated production plans and security in the energy area, forming coal reserves for energy production, implementing and coordinating policies, laws, rules, and regulations on the introduction of fuel and gas, managing national administration and human resources, improving legal environment, securing the implementation of decisions, executing budget expenditures, domestic and international investment programs, and projects, and finance of staff and ministries.

It monitors policies, programs, and projects in the relevant sectors, evaluates the results, conducts inspections, disaster protection activities, integrated management during disater occurence, risk prevention and assessment to reduce risks, and provides information surveys, statistical data, consumer surveys, and information on disciplinary and ethical violations.

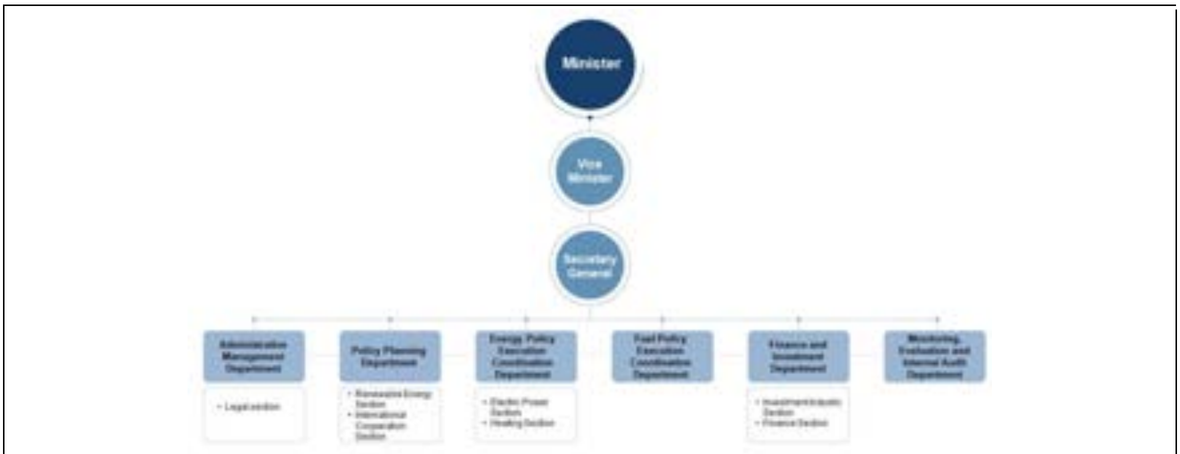
Agencies under the Ministry of Energy of Mongolia include the Energy Regulatory Commission, the National Renewable Energy Center, and the Energy Development Center, which execute policies.

<Table 32> Agencies under the Ministry of Energy of Mongolia

Item	Main contents
Energy Regulatory Commission	• Responsible for the coordination of energy supply, including power generation, power transmission, and power distribution • Approving, issuing, and managing energy supply licenses to create fair competition conditions between energy suppliers such as power generation companies in compliance with the law.
National Renewable Energy Center	• Making efforts to achieve the goals of the national renewable energy program • Conducting research and introducing technologies for developing and using new and renewable energy • Introducing and researching the climate change characteristics of Mongolia and related technologies
Energy Development Center	• Estimating, evaluating, and analyzing information for the establishment of government energy policies • Deliberating the design drawings of energy facilities and equipment • Researching on the feasibility of new energy sources • Supervising projects by national investment and foreign capital investment

Source: The Ministry of Energy webpage (http://energy.gov.mn/) (reviewed and written by the research team)

[Figure 32] Organization status of the Ministry of Energy of Mongolia



Source: The Ministry of Energy webpage (http://energy.gov.mn/) (reviewed and written by the research team)

(3) National Agency for Meteorology and Environmental Monitoring of Mongolia (NAMEM)

Starting with the climate test of the Institute of the Scripture in 1924, the NAMEM continuously, accurately monitors water, weather, and environment and provides preventive information in a timely manner to inform natural disasters and potential risks.

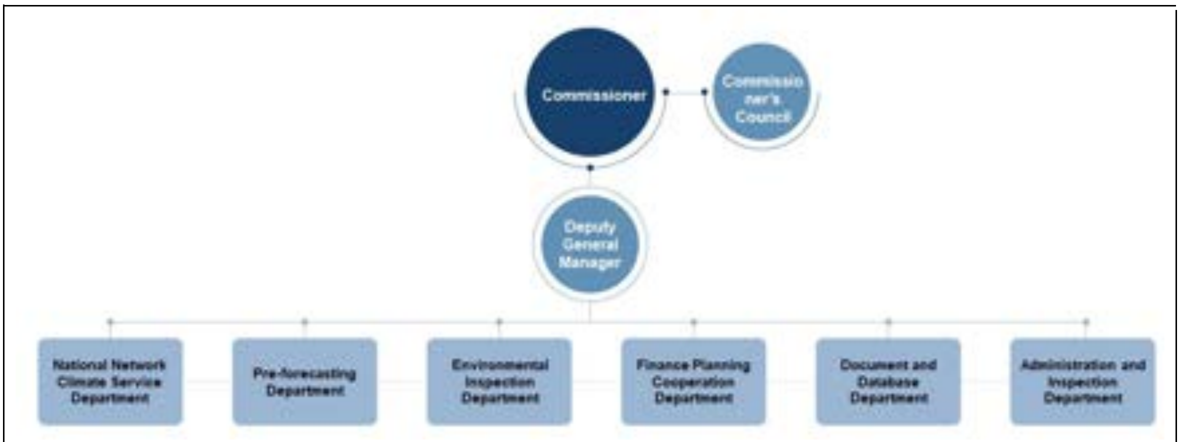
Operational strategies aim to provide fast information on short-term, medium-term, long-term, and risky weather forecasts, to update and expand network technology plans, to construct integrated climate information, to provide integrated management and organization of meteorological and environmental analysis, to improve operational management, and to strengthen capacity. The strategic goals include evaluation of environmental quality, provision of the integrated technology and professional methods for environmental monitoring, setting of guidelines of the integrated environmental information system, provision of data openness, and construction of the security server.

Major functions include weather forecast, disaster alert, monitoring in the area of environment, integrated water resources and climate systems, provision of on and offline data, and preparation of the data system. It is responsible for collecting data from 21 Aimag local offices (laboratories) and centers. The NAMEM signed a memorandum of understanding (MOU) with the Korea Meteorological Administration every two years and maintains a close cooperation relationship.

Strategic Goal 4 is the content corresponding to the Environment Monitoring Department, and the Environmental Monitoring Department conducts environmental quality assessment, provides professional conclusions and professional, methodological, and integrated management for environment monitoring-inspection activities, guarantees measurement and standards, and serves as a professional officer of the ambient air quality.

Specifically, the NAMEM serves to 1. provide professional and methodological integrated management of the monitoring and inspection activities of environment quality, 2. confirm and ensure air, water, soil quality and radioactivity level monitoring activities and the implementation of the program, evaluate and report pollution status, register pollutant emissions and pollution sources, and make a inventory, 3. play the role of the national ambient air quality agency, develop and report databases by collecting ambient air quality and pollution information, notify citizens, businesses, and organizations of ambient air quality, and provide professional and methodological advice and conclusions, 4. support the implementation of the national ozone protection program.

[Figure 33] Organization status of the NAMEM of Mongolia

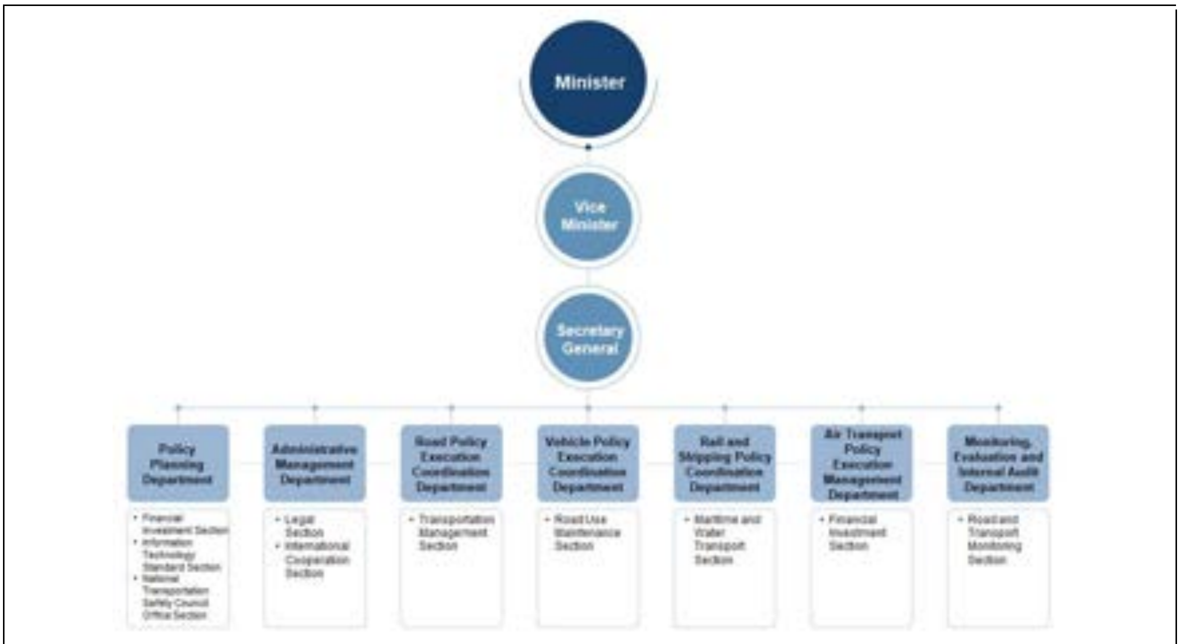


Source: The NAMEM webpage (http://www.NAMEM.gov.mn) (reviewed and written by the research team)

(4) Ministry of Road and Transport Development of Mongolia

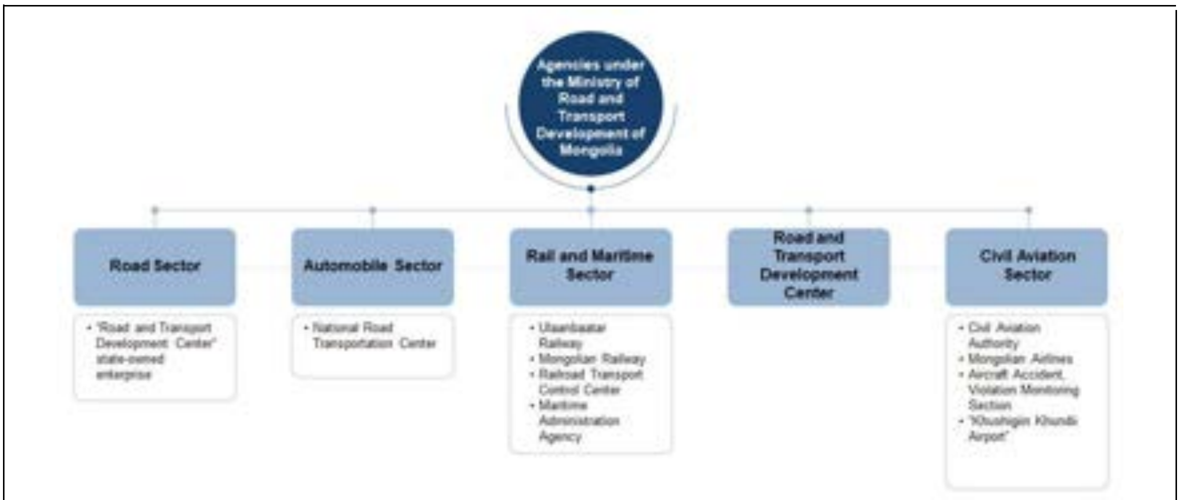
The Ministry of Road and Transport Development of Mongolia is a national central administrative agency in charge of roads, transportation networks, and transportation services in Mongolia, and is responsible for expanding road transport networks by ensuring economic growth and expanding exports. Further, the minitsry aims to expand the road fund investment and convert it into an independent operation by constructing the toll collection and monitoring mechanisms based on a smart transportation system. It is responsible for developing environmental, continuous, efficient, and safe transportation services, maintaining air transportation liberalization, creating a competitive environment, expanding the number of flights and routes, and improving and expanding local airport use.

[Figure 34] Organization status of the Ministry of Road and Transport Development of Mongolia



Source: The Ministry of Road and Transport Development of Mongolia webpage (https://mrtd.gov.mn/) (reviewed and written by the research team)

[Figure 35] Agencies under the Ministry of Road and Transport Development of Mongolia



Source: The Ministry of Road and Transport Development of Mongolia webpage (https://mrtd.gov.mn/) (reviewed and written by the research team)

(5) National Center for Road Transportation

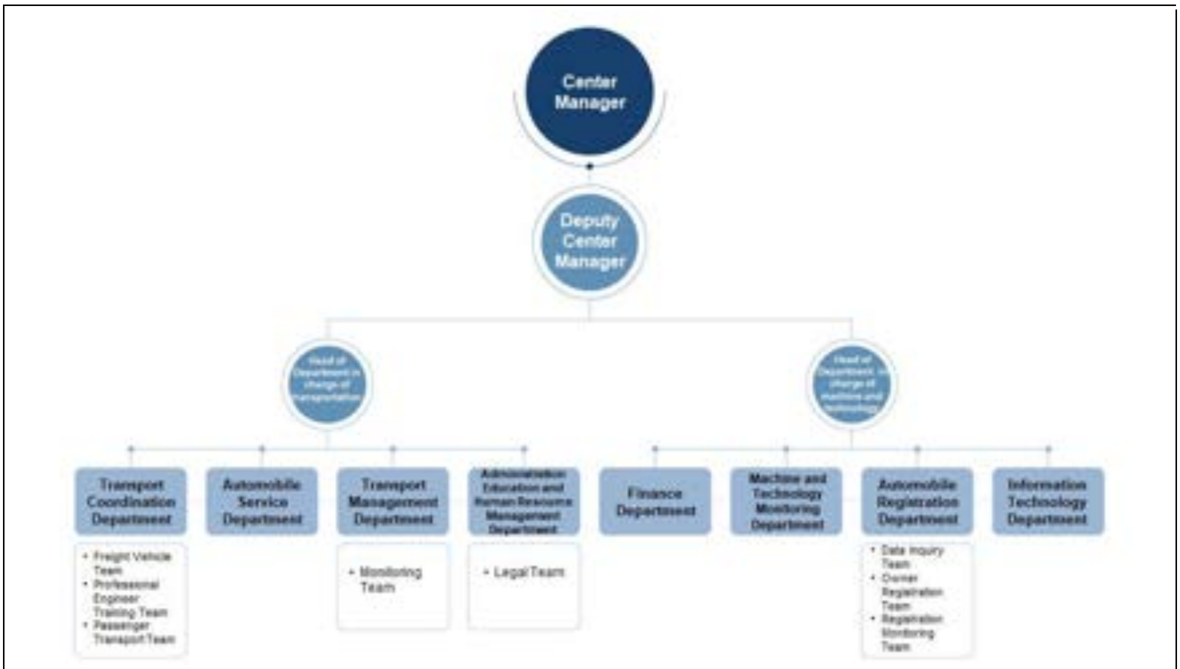
The National Center for Road Transportation is operated nationwide in accordance with the Road Traffic Act, and government resolutions and regulations, and it serves to provide services such as technical inspections of vehicles, registration of vehicles that are being operated in Mongolia, license plate issuance, registration for transfer, registration cancellation, vehicle certificates and license plate reissuance, and building of a vehicle database and registration network and provision of the relevant information.

To coordinate and organize international, urban, regional public transportation and cargo, mail, tourism transportation services nationwide, it is responsible for signing the contracts with public passenger transportation and service companies and organizations and executing it and performing works such as rapid coordination of the operation of vehicles that carry out international, urban, and regional public and cargo transportation.

It executes tests for obtaining a professional driver’s license, issues a driver's license, operates domestic and international passenger transport services, executes classification projects for automobile service organizations, and carries out government consignment tasks and services according to contracts.

It is in charge of checking the recommendations of cargo and passenger transportation businesses and organizations between countries, cities, and regions to review whether to meet the conditions prescribed in the law, and is responsible for reporting the relevant results to the central administrative agency in charge of road and transport or the governor of the Aimag and Sum.

[Figure 36] Organization status of the National Center for Road Transportation of Mongolia

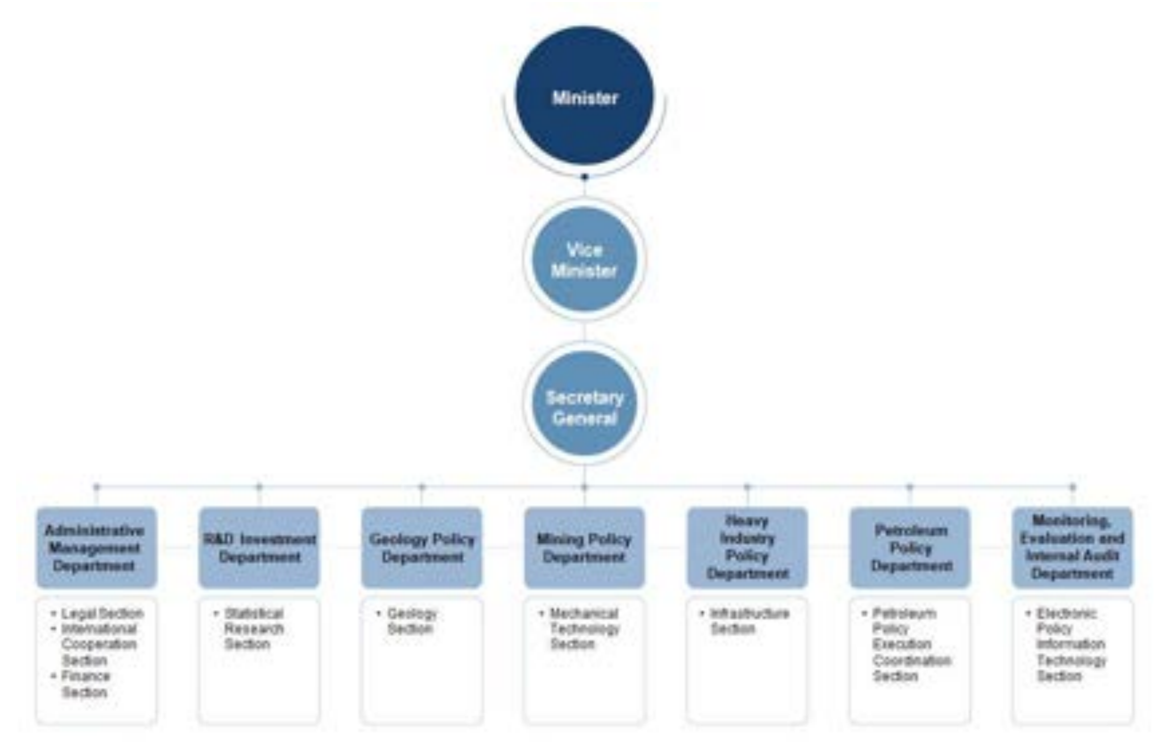


Source: The National Center for Road Transportation webpage (https://www.transdep.mn/) (reviewed and written by the research team)

(6) Ministry of Mining and Heavy Industry

The Ministry of Mining and Heavy Industry develops laws, policies, mid- to long-term strategies, programs and projects development, policy analysis, and policy guidelines related to geological features, mining, fuel, and heavy industry. It is also responsible for administrative and human resource management, legal counsel, expansion of overseas cooperation projects, and supports for developing financial, economic, and investment policies. It executes and coordinates laws, policies, programs, and projects, and serves to carry out the internal monitoring of legal and policy execution, financing budget, financial audits of programs, projects, and investments, internal audits, and crisis management.

[Figure 37] Organization status of the Ministry of Mining and Heavy Industry of Mongolia

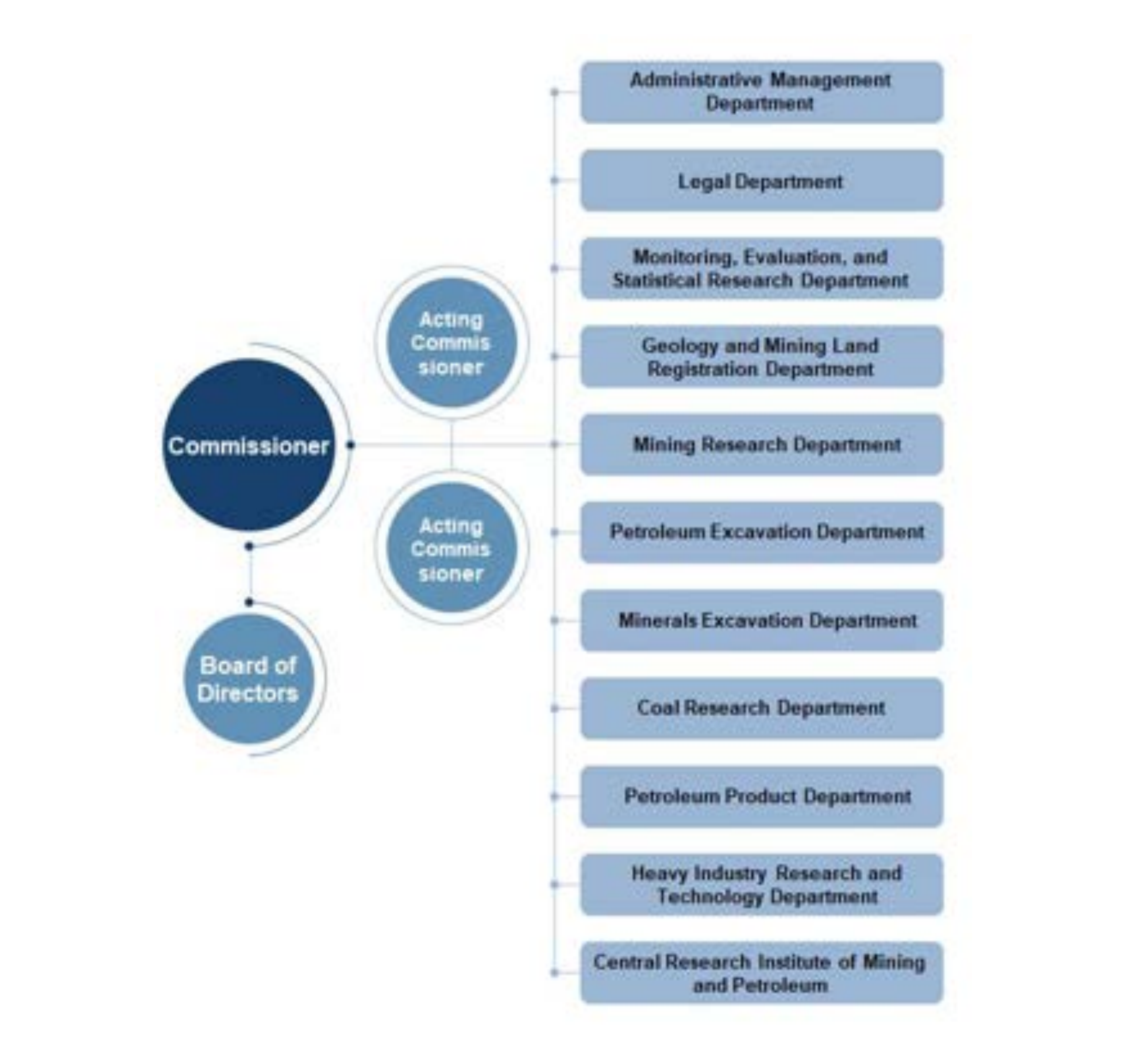


Source: The Ministry of Mining and Heavy Industry webpage (https://www.mmhi.gov.mn/) (reviewed and written by the research team)

(7) Mineral Resources and Petroleum Authority

Mineral Resources and Petroleum Authority supports development policies in geology, mining, and petroleum sectors, and provides rapid and fair services to investors and consumers.

[Figure 38] Organization status of Mineral Resources and Petroleum Authority of Mongolia



Source: The implementing agency of Mongolian Government Mineral Resources and Petroleum Authority webpage (https://mrpam.gov.mn/) (reviewed and written by the research team)

3.1.2 Ambient Air Quality Management Laws of Mongolia

The laws in the ambient air quality management sector include the Law on Air, which is the basic law and the Law on Air Pollution Tax, which was enacted to levy a tax on air pollution activities to control air pollution.

<Table 33> Laws of the ambient air quality management in Mongolia

Enacted year	Name of law	Main contents
2012	Law on Air	• To provide the environment for the current and future generations, it is prescribed to restrict emissions on air pollution, harmful effects, and small changes in air components such as ozone and hydrogen (revised in January 2018). • It is prescribed to endow the leaders of aimags and capital city with the responsibility for organizing and implementing measures to mitigate air pollution in the region • It has been enforced again since 2019 by reestablishing the Anti-Air Pollution Fund. * However, as of 2021, it was surveyed as being not enforced.
2010	Law on Air Pollution Tax	• This law imposes a tax in the event of air pollution (coal combustion, automobile, organic matter, and other resources). • As it was revised in January 2018, taxes was expected to be paid to the Anti-Air Pollution Fund since January 2019. * However, as of 2021, it was surveyed as being not enforced.

(1) Law on Air

The Law on Air is composed of five Chapters, and subdivided into areas such as air quality monitoring, air protection measures, and others.

<Table 34> Details of the Law on Air

Item	Detailed contents	
Chapter 1	Article 1	Purpose of enactment
	Article 2	Legislative enactment
	Article 3	Definition of terms
Chapter 2	Air protection information, authority of local governments, and rights and responsibilities of citizens of business organizations	
	Article 4	Rights of Parliament
	Article 5	Rights of the President in Mongolia
	Article 6	Rights of information
	Article 7	Rights of the national central administrative agency responsible for nature and environment
	Article 8	Rights of local government and local administration
	Article 9	Rights and responsibilities of business, organizations, and citizens
Chapter 3	Air quality monitoring and information	
	Article 10	Monitoring specialized department
	Article 11	Air quality monitoring and inspection
	Article 12	Air quality information

Chapter 4	Air protection measures	
	Article 13	Basic principles of air pollution reduction activities
	Article 14	Citizens' participation and incentives to reduce air pollution
	Article 15	Ambient air quality improvement area
	Article 16	Prohibitions in the ambient air quality improvement area
	Article 17	Air protection-related standards
	Article 18	Permission to use the large stationary sources
	Article 19	Measures to be taken in the event of a significant increase in air pollution and harmful effects
	Article 20	Restrictions on air pollutant emissions and harmful effects
	Article 21	Requirements for air protection when operating construction, industrial production, and service-related companies
	Article 22	Requirements for air protection related to urban construction
	Article 23	Installation of equipment on large stationary sources
	Article 24	Adaptation of climate change and impacts reduction
	Article 25	Protection of the ozone layer
Chapter 5	Others	
	Article 26	Monitoring system
	Article 27	An integrated national inventory of air pollutant emissions, physical side effects, and their causes
	Article 28	Intentional impacts on weather conditions and weather phenomena
	Article 29	Air pollution fee
	Article 29	Anti-Air pollution fund
	Article 30	Clean air fund
	Article 31	Violator's responsibility

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

The provisions related to the stationary sources in the Law on Air are Articles 18, 20, and 23, which prescribe the obligation to permit the use of large stationary sources, to restrict and suspend operations emitting pollutants exceeding emission standards, and to install air pollutant prevention devices, respectively.

[Reference] Provisions related to the stationary sources in Law on Air

Article18. Permission to use the large stationary sources

18.1 Businesses, organizations, and individuals shall seek opinions from specialized offices to obtain permission from the head of the county or the governor of the province when producing and operating large stationary sources.

18.2 Permission specified in Paragraph 18.1 of the Law on Air shall specify measures to be taken to protect the ambient air by designating the standards for allowing air pollutants emissions from the pollutant source and the maximum allowable physical adverse effects, and other requirements specified in the statutes.

18.3 The national central administrative agency shall approve the regulations for determining the allowable concentration of pollutants specified in Paragraph 18.2 of this Law.

Article20. Restrictions on air pollutant emissions and harmful effects

20.1. As soon as businesses, organizations, and individuals receive information from specialized offices that air pollution can increase due to natural causes and weather conditions, measures shall be taken to reduce pollutants emitted from large stationary sources and harmful physical effects pursuant to Paragraph 19.2.

20.2. If pollutants emitted from large stationary sources of businesses, organizations, and individuals and harmful physical impacts exceed prescribed standards and the situation is confirmed to be dangerous to the public's health and the environment, the Environmental and Hygiene Auditor can restrict or temporarily suspend business, organization, or individual activities until violations are corrected.

- This part was added in accordance with the law on May 18, 2017.

20.4 If the Environmental and Hygiene Auditor requests the competent authority to suspend operations of business organizations that repeatedly violate the maximum allowable physical adverse effects, allowable standards and conditions, or restrict changes in business-type thereof, the proposal shall be reviewed and resolved by the competent authority within 30 days.

- This part was invalidated in accordance with the law on May 5, 2017.

Article23. Installation of equipment on large stationary sources

23.1 When conducting productions and services using large stationary sources from businesses, organizations, and individuals, internal control tools that manage each pollutant source and equipment that neutralize and clean air pollutants and mitigate harmful physical effects shall be installed.

23.2 Central administrative agencies, heads of counties, governors of provinces, or environment auditors shall monitor and supervise the use status of facilities and pollutant sources using tools and equipment specified in Article 23.1 of this Law with respect to the large air pollutant sources.

The provisions related to the mobile sources in the Law on Air are Articles 17 and 20, which specify the cooperation and approval obligations of the agencies responsible for developing emission standards and fuel standards, and restriction of the use of hazardous mobile sources that affect ambient air quality.

[Reference] Provisions related to the mobile sources in the Law on Air

Article17. Air protection-related standards

17.2 The national central administrative agency shall develop the following standards in cooperation with the national central administrative agency in charge in the relevant field and obtain approval from the competent authority.

17.2.2 The permissible emission standards and measurement methods of air pollutants from mobile sources are set in cooperation with the national central administrative agency responsible for road transportation.

17.2.4 Standards for fuels such as gasoline, diesel, and liquefied petroleum gas are set in cooperation with the national central administrative agency responsible for road transportation and petroleum.

Article20. Restrictions on air pollutant emissions and harmful effects

20.3 The Environmental Auditors and the police officers having such authority can restrict the use of mobile sources that emit pollutants to the air in excess of the standards and have harmful physical effects, in accordance with the procedures specified in the Law on the investigation and resolution of violations.

20.5. Entry of certain types of vehicles into public streets and squares for the purpose of air protection can be prohibited or restricted depending upon the decision of the head of the county or the governor of the province.

The provisions related to monitoring are Chapter 3, including Articles 10, 11, and 12 of the Law on Air, specifies the operations of specialized departments dedicated to air quality measurements, components of the national monitoring network, and responsibilities of each agency and specialized department for the use of air quality data.

[Reference] Provisions related to the monitoring of the Law on Air

Article10. Monitoring specialized department

10.1. A specialized department (hereinafter referred to as a Specialized Department) that measures and monitors ambient air quality, provides relevant information, and makes conclusions is organized and operated by the national central administrative agency.

10.2 The establishment of a local branch (regional branch) of the Specialized Department is determined by the national central administrative agency in accordance with the environment, climate characteristics, and industrialization level of the relevant region, and the Specialized Department provides professional and methodological guidelines.

10.3 The local branch of the Specialized Department is operated under local governor in accordance with the rules approved by the national central administrative agency.

10.4 The Specialized Department organizes the fulfillment of obligations under international agreements to protect the ozone layer and the implementation of related national programs.

10.5 Staff of the Specialized Department have the right to enter businesses or organizations to perform measurements, inspections, and analyses.

Article11. Air quality monitoring and inspection

11.1 The national central administrative agencies organize and operate the national monitoring network for regular observation, measurement, research, analysis, evaluation and information provision on ambient air quality, harmful physical effects to the ambient air, acid deposition, stratospheric ozone, and changes in greenhouse gas concentrations.

11.2. The national monitoring network is composed of the following parts.

11.2.1 Mongolian branch of the international monitoring network

11.2.2 National monitoring network

11.2.3 Units of region (local) monitoring

11.2.4 Internal control points of businesses or organizations that emit air pollutants and have harmful physical effects

11.3. The networks and units specified in Paragraphs 11.2.1 and 11.2.2 of this Law shall be determined by the national central administrative agency in consideration of the land size, population density, territorial formation, and industrialization level of cities, villages and other settlements to finance their establishment, equipment, and operating costs from the national budget.

Article12. Air quality information

12.1 The Specialized Department of the local branch shall submit reports (information) on ambient air quality to the governor of the province and the Specialized Departments at the relevant level.

12.2 The Specialized Departments shall summarize ambient air quality information and submit the results to the national central administrative agency.

12.3 The Specialized Department shall immediately inform the relevant agency and the public and provide medical advice if the concentrations of air pollutants and harmful physical effects exceed allowable standards.

12.4 Businesses and organizations shall submit reports on internal monitoring and control of activities affecting ambient air quality to the Specified Department within a predetermined period.

12.5 Regulations of establishing ambient air quality data are approved by the national central administrative agency.

(2) Law on Air Pollution Tax

The Law on Air Pollution Tax is a law aimed at regulating the relationship related to the imposition and payment of air pollution charges to those who caused the air pollution. The payers of air pollution charges presented in this law include coal miners, importers of organic solvents, vehicle drivers, possessors of large air pollutants licenses, and citizens, businesses, and organizations that emit air pollutants.

<Table 35> Details of Law on Air Pollution Tax

Item	Contents
Article 1	Purpose of the law
Article 2	Legislation on air pollution charges
Article 3	Definition of terms
Article 4	Payer of air pollution charges and registration
Article 5	Air pollution charges
Article 6	Physical unit for payment
Article 7	Percentage and amount of payment
Article 8	Exemption and discount
Article 9	Payment and reporting
Article 10	Liability for violators

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

Air pollution charges are imposed on the weight of mined raw coal, the weight of produced or imported organic solvents, carbon dioxide emissions of different vehicle types, and emissions from major stationary sources of air pollution.

<Table 36> Method of calculating charges in accordance with the Law on Air Pollution Tax

<table>
<tr><th>Item</th><th>Amount</th></tr>
<tr><td>Raw coal</td><td>The rate and amount of charges on mined raw coal is set at 1 – 2MNT per kg.</td></tr>
<tr><td>Organic solvents</td><td>The rate and amount of produced or imported organic solvents is set at 10 – 30MNT per kg.</td></tr>
<tr><td>Vehicle</td><td>The charge for carbon dioxide emitted by automobiles and self-propelled vehicles is determined according to the following table.
<table>
<tr><th>Type of automobile and self-propelled vehicle</th><th>CO2 emission (g/km)</th><th>Annual payment (MNT)</th></tr>
<tr><td>A (A)</td><td>121-180</td><td>1,800</td></tr>
<tr><td>B (Б)</td><td>181-250</td><td>2,100</td></tr>
<tr><td>C (B)</td><td>251-350</td><td>3,500</td></tr>
<tr><td>D (Г)</td><td>351-500</td><td>5,000</td></tr>
<tr><td>E (Д)</td><td>501-750</td><td>7,500</td></tr>
<tr><td>F (E)</td><td>Over 751</td><td>9,500</td></tr>
</table></td></tr>
<tr><td>Large stationary sources</td><td>The rate and amount of charges on large stationary sources of air pollution is set at 1 – 10MNT per kg.</td></tr>
</table>

3.1.3 Ambient Air Quality Management Policies

Mongolia's ambient air quality management policies include the NPRAEP, which defines the activities of executing policies such as reducing pollution sources to reduce the air and environmental pollution problems in Mongolia, the Zero Night-Time Electricity Payment Policy, and the Banning (Raw) Coal Policy.

<Table 37> Policies of the ambient air quality management of Mongolia

Year	Name of the policy	Main contents
2017	The National Program on Reduction of Air and Environmental Pollution (NPRAEP)	• Period: First phase (2017-2019) / second phase (2020-2025) • Goal: To ensure a healthy and safe living environment for citizens and create a clean environment for future generations in response to the increasing environmental pollution problem in Mongolia. • Specific goal: Compared to the level in 2016, an 80% reduction in air and environmental pollution in 2025 (expenditure is expected to be around $370M.) • Project contents: It includes the announcement of the Zero Night-Time Electricity Payment Policy, spread of clean coal technologies such as semi-coke briquettes and low-carbon emission fuels, and expansion of the district heating networks for stopping steam boilers in small cities.
2017	Zero Night-Time Electricity Payment Policy	• It was established by Articles 6.1.5, 6.1.6, 6.1.7, and 13.1.3 of the Law on Air. • During the winter, the Mongolian government announced its zero night-time electricity payment policy only for some Ger regions, which is to encourage the replacement of fossil fuels with electricity in the Ger region.
2019	Banning (Raw) Coal	• It was established by Article 16.1.5 of the Law on Air. • There is a change under way such as reducing the dependence on coal and shifting to the use of clean and sustainable energy sources. • In May 2019, the Mongolian government decided to prohibit the use of the raw coal only for households (excluding the combined heat and power plants, CHPs).

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

(1) National Program for Reducing Air and Environmental Pollution (NPRAEP)

The NPRAEP was established in 2017 with the aim to reduce air, water and soil pollution in metropolitan areas and ensure appropriate waste control to cope with growing environmental pollution as part of the Five-Year Plan (2016-2020). The NPRAEP has been implemented in two phases: first term (2017-2019) and second term (2020-2025).

The NPRAEP sets five goals: development of the urban and rural areas, reduction of pollutants through restrictions on the use of pollution sources such as coal, reduction of vehicle emissions, the establishment of the incentive system to promote activities for air and environmental pollution reduction, expansion of public participation and responsibility, and capacity building for monitoring. It also sets the action plan corresponding to each goal.

<Table 38> The action plan of the NPRAEP

Goal	Action plan
1	**Goal: Establishment of policies for urban planning, construction and infrastructure development, population dispersion, and improvement of ambient air quality**
2	**Goal: Reduction of pollutant sources through the application of eco-friendly and advanced technology, phased prohibition of coal, and reduction of pollutants emissions**
	① Designation of areas for ambient air quality improvement, and preparation and implementation of the list of the banned objects for heating purposes
	② Phased restriction of raw coal use (except heat generation plants and CHPs)
	③ Provision of high-quality fuel in Ger regions, and support for the production of improved coal to replace raw coal
	④ Discount (50-100%) on electricity price at night for households with electric meters in Ger regions
	⑤ Support for manufacturers of building materials that are eco-friendly and unharmful to humans
	⑥ Implementation of heat loss reduction project by improving insulation in households and Ger regions
	⑦ Expansion of district heating networks, construction of new heat supply sources, introduction of innovative technology for reducing coal use and waste.
	⑧ Introduction of eco-friendly technology for central disposal facilities of Ulaanbaatar and sewage facilities, plants and pretreatment facilities at other cities
	⑨ Improved waste disposal management in Ger regions, increase of the means of transportation, and support for waste recycling industry
	⑩ Construction of infrastructure for temporary storage and disposal of hazardous waste, and prevention of spread of hazardous waste
	⑪ Assignment of responsibility for waste disposal to the businesses that produce, import, and distribute the goods, establishment of incentive for waste recycling
	⑫ Investigation of methane reserves in coal bed, and support for building coal gas plants such as coal thickeners and processing plants
	⑬ Phased shift to electric heating in passenger trains in cities to comply with the Banning Raw Coal policy
	⑭ Introduction of eco-friendly and advanced technology for industrial waste reduction and revision of standards for efficient use of waste
	⑮ Attraction of international funds for technology research to reduce air pollution and greenhouse gas emissions
	⑯ Installation of eco-friendly technology exhibition centers to introduce the technology for air pollution reduction and energy conservation
	⑰ Investigation to establish Green Loan Fund, support for the purchase of eco-friendly and energy-saving products by citizens and private businesses, and support for related loans
3	**Goal: Comprehensive measures to reduce vehicle pollutants emissions**
	① Phased ban on vehicles that cause harmful effects on people and the environment
	② Improvement of fuel quality monitoring system including support import and consumption of Euro 5 fuel (If below the standards, phased ban of imports and consumption)
	③ Study on introducing eco-friendly automobiles such as gas and electric cars, conversion of fuel for mass transit to gas fuel
	④ Expansion of road networks, introduction of smart transportaion control system, and reduction of vehicle emissions
	⑤ Research on the management of road traffic waste and construction of the plants enable to recycle vehicle waste
	⑥ Planning and construction of green accommodation facilities for the convenience of the passengers
	⑦ Planning and implementation of road drainage system, development of technology for road dust control, and eco-friendly treatment of end-of-life vehicles

4	**Goal: Management of air pollution reduction activities, fund raising, and the establishment of an incentive system**
	① Establishment and concentration of funds for air pollution reduction, and the enactment of laws for fund expenditure
	② Clarification of environment-related responsibilities of civil employees, citizens, and organizations and compliance with related laws, for air, water, and soil pollution reduction
	③ Reduction of air pollution with the implementation of regional development policies and development of community center in aimags
	④ Improvement of legal environment related to urban development and green funds
	⑤ Establishment and implementation of a national program for environmental health
	⑥ Establishment and implementation of a national program for energy conservation
	⑦ Offering of tax discounts for domestic manufacturers that hold technology for eco-friendliness and air pollution reduction and treatment
	⑧ Establishment and implementation of master plan for gas supply
	⑨ Phased ban of importation of old vehicles and mobility equipment, expansion of electric and gas-powered vehicles consumption, and enactment of regulations
5	**Goal: Increase of citizens and public participation in efforts to reduce air pollution, and capacity building for environmental monitoring**
	① Provision of air pollution-related information to the public, assignment of responsibilities and participation to citizens for environmental protection, and implementation of education and promotion
	② Increased responsibilities of citizens, businesses, and organizations in case of violation of environmental protection laws and rules
	③ Air pollution monitoring and support for the ban on waste incineration in Ger regions
	④ Presentation of awards to citizens and businesses that support and are actively involved in air pollution reduction efforts
	⑤ Study on the impact of air pollution on the human body
	⑥ Establishment and promotion of manuals for indoor air pollution reduction in Ger, apartment, and houses
	⑦ Provision of equipment that is in accord with international standards to measure hazardous substances to the central environment research institute and local research institutes
	⑧ Increase of ambient air quality monitoring and implementation of capacity building program
	⑨ Installation of air pollution monitoring stations in urban areas and support for their continued operation
	⑩ Revision of the database including preparation of emission inventories of air pollutants and waste

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

The expected effects of implementing the NPRAEP include improvement of quality and accessibility of eco-friendly infrastructure, restriction of the coal-use except for the heat generation purpose, and reduction of air and environmental pollution by 80%. The assessment standard of NPRAEP sets goals for 2019 and 2025 to be achieved and major implementing agencies.

<Table 39> NPRAEP implementation assessment standards

№	Assessment indicators		Unit	Reference level (year) 2016	Target level (year) 2019	Target level (year) 2025	Implementing agencies
1	Pollutant reduction (compared with average concentration as of December 2016)	PM 2.5	μg/m³	256	190	70	MET, Mayor of UB
		PM 10	μg/m³	279	210	100	MET, Mayor of UB
		Sulfur dioxide (SO_2)	μg/m³	89	70	50	MET, Mayor of UB
2	Consumers in Ger regions eligible for electricity price discount at night			110,895	135,000	150,000	MOE, ERC
3	Households with technical capacity to use 2.5 kw electric heater			20,000	110,000	-	MOE
4	Households with technical capacity to use 4 kw electric heater			3,000	20,000	80,000	MOE
5	New households connected to the grid			-	5,800	-	MOE
6	Households that plan to use improved coal after the ban on the use of raw coal			150	23,000	43,000	MOE, Mayor of UB
7	Advanced fuel production volume		ton/year	500	90,000	150,000	MOE, MMHI
8	Quantity of discharged boilers after conversion to district heating system			-	123	228	MOE, Mayor of UB
9	Number of people who moved to suburb and rural area			-	2,000	9,600	Mayor of UB, NSO
10	Number of jobs created in suburb and rural area			-	1,000	10,000	MOFA, MLSP, NSO, Mayor of UB and Aimag
11	Number of households eligible for support			-	13,300	13,000	Mayor of UB MET, MLSP
12	Sub-centers with engineering infrastructure			-	20	100	MCUD, Mayor of UB
13	Number of households that provide technical support to engineering networks			20,000	40,000	70,000	MCUD, MOE, Mayor of UB
14	Supply of housing to Ger regions and the number of households that moved to apartment houses			-	20,000	70,000	MCUD, Mayor of UB
15	Population with improved sanitation facilities (toilets)		%	38	43	50	MCUD, Mayor of UB and Aimag
16	Population of cities and metropolitan area with improved sanitation facilities (toilets)		%	40	60	80	MCUD, Mayor of UB and Aimag
17	Gas-fueled vehicles	Taxi		312	1,000	3,000	MRTD, Mayor of UB
		Automobiles		14,500	17,000	25,000	
18	Share of fuel that meets Euro 5 emissions standards	Gasoline	%	-	50	80	MRTD, MMHI MRPAM
		Diesel	%	-	50	80	
19	Number of passenger trains that are capable of using electric heaters (Total)			16	72	159	MRTD, MOE, Mayor of UB
20	Plants that process waste to produce energy			-	-	1	MOE, Mayor of UB
21	Decrease in patients with respiratory disease (number of hospitalizations per 10,000)		1mil	456	448	433	MOHS
22	Decrease in patients with cardiovascular disease (number of hospitalizations per 10,000)		1mil	399	393	384	MOHS
23	Pneumonia (number of hospitalizations per 10,000)		1mil	239	206	146	MOHS
24	Green garden area added to Ger regions and public places		hectare	110	1,450	3,000	Mayor of UB
25	Share of green area in cities and metropolitan area	UB	%	1	7	25	Mayor of UB
		Aimag	%	1	5	25	Mayor of Aimag

Source: Legal site of Mongolia (www.legalinfo.mn) (reviewed and written by the research team)

The NPRAEP is administered by the National Committee for Reducing Environmental Pollution. The committee is responsible for coordinating between ministries to implement the NPRAEP across the country and monitoring, while in local districts and regions, governors collaborate with the committee to carry out programs and monitor their implementation.

3.1.4 Air Quality Management related Standards

As a result of surveying the ambient air quality management standards, the standards can be largely divided into ① the permissible standards to manage indoor and outdoor air quality overall, ② the permissible emission standards to manage stationary sources such as combined heat & power plants, and heat generation plants and boilers, ③ the permissible standards for the air pollutants emitted from mobile sources such as buses and automobiles, and ④ the standard for fuel such as coal, gasoline, or diesel.

<Table 40> Standards of the air quality management of Mongolia

Item	Target	Standard
Air general	• Outdoor air quality management • Indoor air quality management	• MNS 4585:2016 Air quality. General technical requirements • MNS 5885:2008 Acceptable concentration of air pollutant elements. General technical requirements • MNS 6063:2010 Air quality-Acceptable concentration of pollutant elements for atmospheric air in public area • MNS 6342:2012 Air quality. Maximum permissible level of some air pollutants in flue gas from the hazardous waste incinerator • MNS ISO 4227:2002 Ambient air quality control plan
Stationary source	• Thermal combined heat and power plant • Thermal heat generation plant • Boilers for condominium buildings • Home heating devices	• MNS5919:2008 Maximum acceptable level and measuring method of air pollutants in the exhaust gases from the steam and hot water boilers of TPP and Thermal Stations • MNS6298:2011 Maximum acceptable level and measuring method of air pollutants in flue gas of New thermal power plant and thermal plant • MNS5043:2016 Hot-water boilers with heating capacity up to 4.2MW. General technical requirements • MNS5216:2016 Stove for household. General technical requirements
Mobile source	• Bus • Diesel/gasoline automobiles	• MNS5013:2009 Petrol engine vehicle-Maximum acceptable level and measuring method of exhaust emission • MNS5014:2009 Diesel engine vehicles-Maximum acceptable level and measuring methods of opacity • MNS6757:2019 Installation and use of DPF for diesel engines of road vehicles. General technical requirements
Fuel	• Coal • Gasoline for vehicle • Diesel for vehicle • LPG	• MNS5679:2019 Upgraded solid fuel. Technical requirement • MNS0217:2017 Automotive fuels. Unleaded petrol. Technical requirements • MNS6861:2020 Diesel fuel. Specifications • MNS 5083:2001 Liquefied petroleum gases-Fuel for domestic use-Specifications

Source: Standard and measurement department webpage (https://estandard.gov.mn/) (reviewed and written by the research team)

The standard for air quality in Mongolia is set in two categories: outdoor air quality and indoor air quality, and the current air quality standard (MNS4585:2016) has been applied since July 8, 2016, as an updated version of the existing air quality standard.

The standard for outdoor air quality specifies the chemical impacts contain the permissible emission concentrations of nine chemical substances such as sulfur oxides, carbon monoxide, and permissible levels of workplace noise. The standard for indoor air quality deals with temperature, wind speed, relative humidity, carbon dioxide, and light.

<Table 41> Ambient air quality standard (MNS4585:2016)

Air pollutant	Averaging time	Unit	Permissible concentration
1. Chemical impact			
Sulfur dioxide (SO2)	20 minutes 24 hours One year	㎍/㎥ ㎍/㎥ ㎍/㎥	450 50 20
Carbon monoxide (CO)	20 minutes 1 hours 8 hours	㎍/㎥ ㎍/㎥ ㎍/㎥	60000 30000 10000
Nitrogen dioxide (NO2)	20 minutes 24 hours One year	㎍/㎥ ㎍/㎥ ㎍/㎥	200 50 40
Ozone (O3)	8 hours	㎍/㎥	100
Total suspended solids	20 minutes 24 hours One year	㎍/㎥ ㎍/㎥ ㎍/㎥	500 150 100
PM 10	24 hours One year	㎍/㎥ ㎍/㎥	100 50
PM 2.5	24 hours One year	㎍/㎥ ㎍/㎥	50 25
Lead (Pb)	24 hours One year	㎍/㎥ ㎍/㎥	1 0.25
Benzo[a]pyrene (C20H12)	24 hours	㎍/㎥	0.001
2. Physical impact			
Air pollutant	**Averaging time**	**Unit**	**Permissible level**
Noise Day (07:00-22:00) Night (22:00-07:00)	16 hours 8 hours	dB dB	60 45

<Table 42> Indoor air quality standard (MNS4585:2016)

Air pollutant	Assessment standard	Unit	Permissible level
Temperature	Average	Centigrade °C	18-22
Wind speed	Average	m/s	0.2 – 0.4
Relative humidity	Average	%	30 – 60
Carbon dioxide (CO2)	24 hours	㎍/㎥	1800
Light Places with people Places without people	Average	Lux	150 – 300 50 – 150

Concerning stationary sources of air pollution, different standards are set depending on the capacity of boilers. The standard for the steam and hot water boilers of power plants sets the standard of various air pollutants such as fly ash, carbon monoxide, sulfur dioxide, and nitrogen dioxide.

MNS 5919:2008 (the standard for the boilers in power plants) provides maximum permissible concentration standards and measurement methods of pollutants and has been applied since February 15, 2008. This standard sets maximum permissible levels and measurement methods of air pollutants such as fly ash, carbon monoxide, sulfur dioxide, and nitrogen oxide.

<Table 43> Maximum permissible level of nitrogen oxide (NOx) (MNS 5919:2008)

No.	Boiler capacity D,t/h, (Q, MW)	Combustion type	1 kg standard fuel combustion, g/kg.J.t	Emission per 1 MJ heat, g/MJ	Flue gas concentration, mg/nm³	Waste per unit time, g/s
1. Steam boiler						
1	D=221…420	Dry return system	7.6	0.261	715,0	67
2	D=76...220	Dry return system	15	0.52	1,100	110
3	D=51...75	Dry return system	20.8	0.72	1270	37.9
4	D=51...75	Circulating Fluidized Bed Combustion (CFBC)	4.75	0.2	320	9.8
5	D=26...35	Wet B/A system	14.1	0.482	900	16.03
6	D=26...35	Dry return system	14.7	0.5	710	13.1
7	D=11...25	Combustion grid	15.6	0.54	950	18
8	D=11...25	CFBC	9.3	0.32	660	10.8
9	D ≤ 10	Combustion grid	21	0.8	1,150	14
10	D ≤ 10	CFBC	13	0.48	680	8.4
2. Hot water boiler						
11	12<Q≤23,26	Wet B/A system	30.1	1	1,918	22
12	12<Q≤23,26	Combustion grid	20	0.7	1,028.7	12.2
13	12<Q≤23,26	CFBC	15.5	0.5	1,044.3	7.9
14	4 ≤ Q < 12	Combustion grid	25	0.85	1,500	18
15	4 ≤ Q < 12	CFBC	15	0.54	900	16

<Table 44> Maximum permissible level of sulfur dioxide (SO2) (MNS 5919:2008)

No.	Boiler capacity (Q), MW	Combustion type	Sulfur content from coal (Unit)	1 kg standard fuel combus tion, g/kg.J.t	Emission per 1 MJ heat, g/MJ	Flue gas concentra tion, mg/nm³	Waste per unit time, g/s
1. Steam boiler							
1	D=221…420	Dry return system	Sш=0.02...0.077	13.2	0.45	1,200	12.5
2	D=76...220	Dry return system	Sш =0.02	20.75	0.70	1,485	164.8
3	D=51...75	Dry return system	Sш=0.02...0.083	33.1	1.18	1,931.8	56.8
4	D=51...75	CFBC	Sш=0.02	9.13	0.31	615	18.8
5	D=26...35	Wet B/A system	Sш=0.02...0.035	27.3	0.93	1,740	30.6
6	D=26...35	Dry return system	Sш=0.083	36.6	1.25	1,770	30.8
7	D=11...25	Combustion grid	Sш=0.077	35	1.2	1,690	29
8	D=11...25	CFBC	Sш =0.077	32	1.1	1,560	26
9	D ≤ 10	Combustion grid	Sш=0.02...0.077	33	1.15	1,620	27
10	D ≤ 10	CFBC	Sш=0.02...0.077	30	1.05	1,500	24
2. Hot water boiler							
11	12<Q≤23,26	Wet B/A system	Sш=0.02	42.5	1.45	2,710	29.7
12	12<Q≤23,26	Combustion grid	Sш=0.024	32.6	1.11	1,670	19.8
13	12<Q≤23,26	CFBC	Sш=0.02	26.4	0.90	1,720	13.4
14	4 ≤ Q < 12	Combustion grid	Sш=0.02...0.077	31.0	1.1	1,630	18.5
15	4 ≤ Q < 12	CFBC	Sш =0.02...0.077	28	0.95	1,810	14.2

<Table 45> Maximum permissible level of carbon monoxide (CO) (MNS 5919:2008)

No.	Boiler capacity (Q), MW	Combustion type	1 kg standard fuel combustion, g/kg.J.t	Emission per 1 MJ heat, g/MJ	Flue gas concentration, mg/nm^3	Waste per unit time, g/s
1. Steam boiler						
1	D=221…420	Dry return system	7.6	0.261	715,0	67
2	D=76...220	Dry return system	15	0.52	1,100	110
3	D=51...75	Dry return system	20.8	0.72	1270	37.9
4	D=51...75	CFBC	4.75	0.2	320	9.8
5	D=26...35	Wet B/A system	14.1	0.482	900	16.03
6	D=26...35	Dry return system	14.7	0.5	710	13.1
7	D=11...25	Combustion grid	15.6	0.54	950	18
8	D=11...25	CFBC	9.3	0.32	660	10.8
9	D ≤ 10	Combustion grid	21	0.8	1,150	14
10	D ≤ 10	CFBC	13	0.48	680	8.4
2. Hot water boiler						
11	12<Q≤23,26	Wet B/A system	30.1	1	1,918	22
12	12<Q≤23,26	Combustion grid	20	0.7	1,028.7	12.2
13	12<Q≤23,26	CFBC	15.5	0.5	1,044.3	7.9
14	4 ≤ Q < 12	Combustion grid	25	0.85	1,500	18
15	4 ≤ Q < 12	CFBC	15	0.54	900	16

<Table 46> Maximum permissible level of fly ash (MNS 5919:2008)

№	Boiler capacity (Q), MW	Combustion type	Ash from coal	1 kg standard fuel combus tion, g/kg.J.t	Emission per 1 MJ heat, g/MJ	Flue gas concentra tion, mg/nm^3	Waste per unit time, g/s
1. Steam boiler							
1	D=221…420	Dry return system	Аш=0.84	235	0.08	200	50.8
2	D=76...220	Coal dust	Аш=0.84	151.1	5.15	10,800	420
3	D=51...75	Coal dust	Аш=0.84	304	10.5	21,000	650
4	D=51...75	CFBC	Аш=0.84	17.7	0.6	1,200	36.5
5	D=26...35	Wet B/A system	Аш=0.84 Аш=1.16	187.5	6.3922	11,900	225.00
6	D=26...35	Coal dust	Аш=0.83	218.5	7.45	10,600	194.97
7	D=11...25	Combustion grid	Аш=0.73	225	7.8	10,900	200
8	D=11...25	CFBC	Аш=0.73	150	5.2	7,300	140
9	D ≤ 10	Combustion grid	Аш=0.73...1.63	250	8.7	12,000	220
10	D ≤ 10	CFBC	Аш=0.73...1.63	170	5.8	8,000	150
2. Hot water boiler							
11	12<Q≤23.26	Wet B/A system	Аш=0.84	23	0.788	1,553.5	11.76
12	12<Q≤23.26	Combustion grid	Аш=1.63	945	32.2	48,700	582.5
13	12<Q≤23.26	CFBC	Аш=0.84	9.6	0.326	670	9.49
14	4 ≤ Q < 12	Combustion grid	Аш=0.73…1.63	230	9.5	13,000	240
15	4 ≤ Q < 12	CFBC	Аш=0.73...1.63	190	79	10,500	200

Since 2011, more stringent permissible emission standard for new CHP plants and heat plants (MNS6298:2011) have been applied. The standard is similar to existing standard, MNS 5919:2008, in terms of kinds of substances for regulation. However, among the substances, maximum permissible levels for CO, SO_2, and PM vary depending on the type of region based on population density, such as Region I (population density: 10 people/㎢ to 1,000 people/㎢ , urban areas), and Region II (remote areas with less than 10 people/㎢). Maximum permissible levels for NOx also vary depending on the content of volatile substances in coal.

<Table 47> Maximum permissible level of CO, SO_2, and PM (MNS 6298:2011)

Region (area)	CO (mg/m^3)	SO2 (mg/m^3)	Fly ash (mg/m^3)
Region I (population density: 10 people/km^2–1000 people/km^2, urban areas)	180	400	50
Region II (population density: less than 10 people/km^2, remote areas)	300	600	200

<Table 48> Maximum permissible level of nitrogen oxide (NOx) (MNS6298:2011)

Content of volatile substances in coal	NOx (mg/m^3)
Vdaf<10%	1100
10%≤Vdaf≤20%	650
Vdaf>20%	450

With regard to produced and imported heat-only boilers (HOBs) with a maximum capacity of 4.2 MW that can heat water of 0.7MPa to 115℃, the general technical requirement (MNS5043:2016) specified maximum permissible emission levels of total suspended particles (TSP), particulate matter (PM2.5), CO, SO_2, sulfur oxides, and NOx, depending on boiler capacity and type of fuel.

<Table 49> General technical requirement for HOBs with a maximum capacity of 4.2 MW (MNS 5043:2016)

No.	Air Pollutant	Unit	Boiler capacity (Q), MW				
			Maximum 0.08 MW			0.1<Q<0.8	1.0<Q<4.2
			Fuel type				
			Fluid	Gas	Solid		
1	Total suspended particles (TSP)	mg/Nm^3			225	600	400
		mg/MJ			120	320	215
		mg/kg.e.f			2,840	9,400	6,150
2	Particulate matter (PM2.5)	mg/Nm^3			170	400	300
		mg/MJ			90	215	160
		mg/kg.e.f			1,970	6,270	4,615
3	CO	mg/Nm^3	115	120	9,700	5,000	4,000
		mg/MJ	35	35	6,800	2,870	2,130
		mg/kg.e.f	1,025	1,060	140,000	78,000	62,400
4	SO_2 and sulfur compound	mg/Nm^3			1,000	800	600
		mg/MJ			540	400	300
		mg/kg.e.f			11,880	12,000	900

5	Nitrogen oxides (NOx)	mg/Nm^3	230	240	500	450	400
		mg/MJ	70	75	300	230	200
		mg/kg.e.f	2,050	2,110	6,800	6,750	6,000

The standard for home stoves MNS 5216:2016 replaces existing MNS5216:2011. The latest standard sets the maximum permissible emission level of TSP, PM, carbon monoxide, sulfur dioxide, sulfur compound, and NOx from solid-fueled stoves for heating and cooking used in residences such as Ger.

<Table 50> Emission standard for home stoves (MNS 5216:2016)

No.	Standard	Unit	Permissible level
1	Total suspended particles (TSP)	mg/Nm^3	130
		mg/MJ	90
		mg/kg	1,850
2	Particulate matter emitted from stacks (PM 2.5)	mg/Nm^3	100
		mg/MJ	70
		mg/kg	1,430
3	Carbon monoxide emitted from stacks (CO)	mg/Nm^3	9,800
		mg/MJ	6,800
		mg/kg	140,000
4	SO2 and sulfur compound emitted from stacks	mg/Nm^3	1,200
		mg/MJ	850
		mg/kg	17,400
5	Nitrogen oxides emitted from stacks (NOx)	mg/Nm^3	700
		mg/MJ	480
		mg/kg	9,800

For mobile sources of air pollution, regulated pollutants vary depending on fuel type. For gasoline vehicles, carbon monoxide and hydrocarbon are controlled according to the weight of the vehicle and crankshaft speed, while for diesel vehicles, soot is regulated.

Maximum permissible toxic material standard and measurement method for exhaust from gasoline vehicles (MNS5013:2009) aims to update maximum permissible level of air pollutants in exhaust gas from gasoline vehicles (carbon monoxide, hydrocarbon), to reduce air pollutants from vehicles, to strengthen control on the use of vehicles to mitigate negative effects of air pollution on human health and ecosystem, and to strengthen technology monitoring.

<Table 51> Maximum permissible level of exhaust from gasoline vehicles (MNS5013:2009)

Type of vehicle	Crankshaft speed (min-1)	Carbon monoxide (%)	Hydrocarbon (ppm)
Carburetor engine, vehicle with total weight of more than 3.5 tons	η minimum	2.0	800
	η maximum	1.5	
Carburetor engine, vehicle with total weight of less than 3.5 tons	η minimum	1.5	500
	η maximum	1.0	
Injector engine vehicle with catalytic converter	η minimum	0.5	500
	η maximum	0.3	

η minimum: Crankshaft speed when a vehicle is in idle mode
η maximum: Maximum crankshaft speed

The maximum permissible emission standard and measurement method of soot from diesel evehicles (MNS5014:2009) replaced MNS5014:2003, and it aims to update the maximum permissible emission level of soot from diesel vehicles, to reduce air pollutants from vehicle, to regulate the use of vehicles and controls technology to mitigate negative impact of air pollution on health and the environment. (Soot emitted from the use of vehicles reduces luminous intensity.)

<Table 52> Maximum permissible level of soot from diesel vehicles

Type of vehicle	Maximum permissible level, free acceleration test (%)
Passenger cars and trucks with total weight of less than 3.5 tons	35
Trucks and buses with total weight of more than 3.5 tons	40

As for fuel standards, there are quality standards for improved solid fuel used for stationary sources of air pollution and gasoline and diesel for vehicles. The technical requirement for improved solid fuel (MNS 5679:2019) contains quality standards such as moisture, sulfur, volatile compounds, ash, calories, and durability of three solid fuels: coal briquettes, semi-coke briquettes, and sawdust briquettes.

<Table 53> Quality standard for improved solid fuel (MNS 5679:2019)

No.	Fuel type	Moisture (Wa, %, less than)	Sulfur (Sdt, %, less than) dry condition	Volatile compound (Vd, %, less than)	Ash (Ad, %, less than)	Actual caloric intake (Kkal/kg, over)	Durability (%, over (dropping test))
1	Coal briquettes	≤10.00	≤1.00	≤22.00	≤29.00	≥4200	≥80
2	Semi-coke briquette	≤10.00	≤1.00	≤22.00	≤30.00	≥4500	≥85
3	Sawdust briquette	≤10.00	-	-	≤5.00	≥4000	≥80

The technical requirements for unleaded non-ethanol gasoline (MNS 0217:2017) are applied to gasoline engine vehicles and other vehicles with similar engines. Gasolines in Mongolia are divided into AI-80, AI-92, AI-95 and AI-98, based on an octane rating. Moreover, quality standards such as sulfur, benzene content, hydrocarbon content, and volume percentage of mono methyl aniline differ according to the ecological fuel type classifications of K2, K3, K4, and K5.

<Table 54> Physical and chemical quality standards for unleaded non-ethanol gasoline (MNS 0217:2017)

No.	Standard	Reference equivalent				Analysis method
		AI-80	AI-92	AI-95	AI-98	
1	Octane number - Research Octane Number (RON) - Motor Octane Number (MON)	80 76	92 83	95 85	98 88	MNS GOST R 52946 GOST 32339, GOST 511 GOST 32340, GOST 8226
2	Lead content (mg/dm³)	5				MNS 5845 EN237, GOST 511 GOST 32340, GOST 8226
3	Gum content (mg/100cm³)	50 (5)				MNS 0477 GOST 1567 GOST 32404

4	Oxidation stability (min)	360	GOST 4039
5	Sulfur in accordance with ecological fuel type classification (mg/kg) - K2 - K3 - K4 - K5	500 150 50 10	MNS 470 GOST 32139 ISO 20846 ISO 20448
6	Benzene content in accordance with ecological fuel type classification (%) - K2 - K3, K4, K5	5 1	MNS ASTM D6277 MNS GOST 29040 EN 12177 GOST 32507
7	Hydrocarbon content in accordance with ecological fuel type classification (K3, K4, K5) (%) - olefins - aromatic	18 35 (42-K3 ecological classification	MNS GOST 29040 GOST 32507 GOST 31872
8	Oxygen weight ratio in accordance with ecological fuel type classification (K3, k4, K5) (%)	2,7	EN 13132 EN 1601
9	Volume percentage of oxygen compound (%) - Methanol - Ethanol - Isopropyl alcohol - Tert-butyl alcohol - Isobutylene alcohol - Ether (C5 or maximum) - Other oxygen compound (boil at 210˚C)	1 5 10 7 10 15 10	GOTS EN 13132 GOST 32338 GOST EN 1601
10	Copper strip corrosion (50˚C, 3 hours)	Classification 1	MNS ISO 2160 GOST 6321 GOST 32329
11	Color, appearance	Clean, transparent	Visual inspection
12	Density (15˚C, kg/m³)	725-780	MNS GOST R 51069 MNS ASTM D4052 GOST 31072 GOST 31392
13	Manganese content (mg/dm³)	None	GOST P 51925
14	Iron content (mg/dm³)	None	GOST 32514
15	Volume percentage of Mono methyl aniline in accordance with ecological fuel type classification (%) - K2 - K3, K4 - K5	1.3 1 None	GOST 32515

The technical requirement for diesel fuel (MNS 6861:2020) divides diesel for diesel engines into four types according to season and temperature and specifies physical quality such as cetane number and distillation temperature, as well as chemical quality such as sulfur and hydrogen sulfide content.

<Table 55> Standards on physical, chemical and usability quality of diesel (MNS 6861:2020)

No.	Standards	Permissible emission standard				Analysis method
		Z	ZU	O	A	
1	Cetane number	45				MNS GOST 27768 GOST 32508 ASTM D613
2	Distillation characteristics (50% distillation temperature, ˚C)	280	280	280	255	MNS ISO 3405 ASTM D86
	Distillation characteristics (95% distillation temperature, ˚C)	360	360	360	360	
3	Kinematic viscosity at 20˚C (mm²/c)	3-6	3-6	1.8-5	1.4-0	MNS ASTM D445 MNS GOST 480
4	Flash point (C˚): Diesel and gas turbine engines of locomotives and ships	62	62	40	35	MNS 0333 MNS 0328 ISO 2719
	Flash point (C˚): diesel	40	40	30	30	
5	Sulfur (mg/kg)	2,000				MNS 470 MNS326 MNS 3543 GOST 32139 ISO 20846
		5,000				
6	Mercaptan sulfur weight ratio (%)	0.01				MNS 3627
7	Hydrogen sulfide	None				MNS ISO 8819
8	Copper strip corrosion	Tolerance. Class 1				MNS ISO 2160 MNS ASTM D130
9	Soluble acid and alkali amount	None				MNS 0324
10	Acidity, CON added to 100 cm³ fuel (mg)	5				MNS 334
11	Iodine number, iodine added to 100 g fuel (g)	6				MNS 3500
12	Ash (weight %)	0.01				MNS 3501 GOST 1461
13	Carbon residue in 10% residual oil (weight %)	0.20				MNS 0336 GOST 32392
14	Gross contamination (mg/kg)	24				MNS 3697
15	Moisture (mg/kg)	200				MNS ASTM D1744 MNS 332
16	Density at 15˚C (kg/m³)	863.4	863.4	843.4	833.5	MNS GOST R51069 GOST 31392 MNS 0481 MNS ASTM D4052
17	Density at 20˚C (kg/m³)	840-860				
18	Cold flow plugging point (˚C)	-5	-15	-25	-	MNS 5800 MNS 5799 MNS ASTM D2386
		-	-	-35	-45	

Z: summer, environmental temperature: over -5˚C
ZU: environmental temperature: over -15˚C
O: winter, environmental temperature: -25˚C--35˚C
A: environmental temperature: over -45˚C

3.2 Status of Ambient Air Quality Management in Korea

3.2.1 Histrory of Ambient Air Quality Management System in Korea

After the establishment and implementation of the first Five-year Economic Development Plan in 1962, Korea experienced rapid industrialization and urbanization, which led to the enactment of laws on air pollution control. In November 1963 the Air Pollution Prevention Act was enacted to improve national health by preventing damage to sanitation and to the living environment due to air and water pollution, noise and vibration, but enforcement and supervision to protect the environment was neglected as the nation focused more on economic development. In January 1971, the Air Pollution Prevention Act was revised, and air pollution control efforts centered mostly on carbon monoxide (CO) and sulfur dioxide (SO2).

As the negative consequences of rapid economic development accumulated, various air and environmental pollution issues emerged, and people began to be more aware of the need for environmental protection. In December 1977, the Environmental Conservation Act was enacted to establish a preventive management system with the creation of environmental standards, regulation of total quantity, and environmental impact assessment. The Act also provided for the regulation of fuel use, standards for sulfur content in fuel, vehicle emission standards, regulation of fuel additives, and prohibition of incineration of materials emitting offensive odor. In 1978, Korea created control standards for SO2 for the first time, and in 1983, for CO, NO2, total suspended particles (TSP), and ozone (O3), and has since continued to tighten these standards.

In 1983, it began to apply an emissions charge system that imposes penalties on workplaces that exceed emission standards set for nine air pollutants including suspended particles, sulfur oxides (SOx), ammonia, and hydrogen chloride. In 1990, the Clean Air Conservation Act was enacted by separating provisions on air pollution control from the Environmental Preservation Act, and it took effect in 1991, laying a firm legal foundation for ambient air quality management.

In 1995, PM 10 was added to the types of particles regulated through TSP, and in 1997, a basic emissions charge system was introduced to regulate air pollutants such as suspended pollutants and sulfur oxides regardless of emissions standards. In 2006, the First Comprehensive Plan on Air Quality Improvement was implemented to control PM10, nitrogen oxide, sulfur oxide, and volatile organic compounds at five metropolitan cities and Gwangyang Bay area.

In 2008 and 2010, phases I and II of the Total Air Pollution Load Management System for Seoul metropolitan area were carried out, respectively, marking an expansion in regulatory focus from the control of atmospheric concentrations to control of environmental load factors. In 2015, as the issue of particulate matter emerged, PM 2.5 and ozone were added to ambient air quality standards, and the Second Comprehensive Plan on Air Quality Improvement for nationwide application was unveiled. In 2016, Special Measure on Fine Dust Management the Special Measure for Fine Dust, and in 2017, the Comprehensive Measure on Fine Dust Management were announced to address such issues.

The Comprehensive Measure to Control Fine Dust created emission charges for nitrogen oxides and provided detailed measures for ambient air quality management by zone and the expansion of workplace surveillance to reduce industrial emissions. To provide a legal basis for these particulate matter control measures, the Special Act on the Reduction and Management of Fine Dust took effect in 2019, and the Special Act on the Improvement of Air Control in Air Control Zones in 2020.

Korea enacted the Air Pollution Prevention Act in 1963 as the first law for environmental protection. The Ministry of Environment installed air pollution monitoring networks in 1973 to identify the condition of air pollution and assess the performance of air quality control policies, and since the late 1970s, Korea has actively operated the networks to conduct surveillance of air pollutants that were set in the ambient air quality standards.

With growing threats from secondary pollutants such as acid raid, ozone, and photochemical smog, the Basic Plan on Air Pollution Monitoring Network was established and implemented in 1997 to distinguish the general air pollution monitoring network from the special air pollution monitoring network, and has been updated every five years. With the revision of the Clean Air Conservation Act in 2001, part of the general air pollution monitoring network run by the state was transferred to local governments.

With the acceleration of industrialization in the 1970s, Korea experienced a significant elevation of air pollutants emitted by factories with large smokestacks. To address this concern, the Korean government conducted a pilot project of attaching pollutant measuring devices to large smokestacks. In 1997, the smokestack Tele-monitoring System (TMS) was developed to conduct real-time monitoring of smokestack emissions and managed the large smokestack emission (stationary sources) by dividing the nation into four zones. Since 2002, an administrative service has been conducted based on emissions data from the smokestack TMS. In 1999, the Clean Air Policy Support System (CAPSS) was launched to calculate air pollutant emissions. In 2003, the National Ambient Air Quality Monitoring Information System (NAMIS) was established to monitor real-time air pollution data, and in 2005, AirKorea, a real-time air pollution information disclosure service, was inaugurated. In 2014, a smartphone application for real-time air pollution information service was introduced. In 2020, the NAMIS was improved to convey information on air pollutants from overseas as well as domestic sources.

3.2.2 Ambient Air Quality Management Related Laws and Policies in Korea

The regulations of the ambient air quality in Korea are diversified through the Special Act on the Improvement of Air Quality in Seoul Metropolitan Area for the management of Seoul and the metropolitan area, and the recently enacted Special Act on the Reduction and Management of Fine Dust and the Special Act on the Improvement of Air Control in Air Control Zones based on the Clean Air Conservation Act for meeting the high level of demand in the ambient air quality of the public and solving the fine dust problem that is a recent issue.

<Table 56> Ambient air-related laws, plans and policies in Korea

Laws	Plans/Policies
Clean Air Conservation Act (1991-)	• First Comprehensive Plan on Air Quality Improvement (2006 - 2015) • Second Comprehensive Plan on Air Quality Improvement (2016-2025)
Special Act on the Improvement of Air Quality in Seoul Metropolitan Area (2003)	• First Seoul Metropolitan Air Quality Control Basic Plan (2005-2014) • Second Seoul Metropolitan Air Quality Control Basic Plan (2015-2025)
Special Act on the Reduction and Management of Fine Dust (2019)	• Comprehensive Plan on Fine Dust Management (2020 - 2024) • Special Measure on Fine Dust Management (2016) • Comprehensive Measure on Fine Dust Management (2017)
The Special Act on the Improvement of Air Control in Air Control Zones (2020)	• Basic Plan on Air Quality Management for Each Air Control Zone (2020 - 2024)

Source: Ministry of Environment, 2020 Environmental White Paper (2020), Ministry of Environment website (http://me.go.kr/), etc. (reviewed and written by the research team)

(1) Clean Air Conservation Act (1991)

The Clean Air Conservation Act was enacted in 1990 and went into effect in 1991. This law was enacted to prevent the harm on the public health and environment caused by air pollution, and properly manage or conserve the ambient air quality to ensure that that all people can live in a healthy and comfortable environment.

The First Comprehensive Plan on Air Quality Improvement (2006 - 2015) initially targeted six areas including five metropolitan cities and Gwangyang Bay, and in 2008 extended its scope of targets to cities with a population of more than 500,000. PM10, NOx, VOC, SOx were selected as controlled pollutants in the plan, and target levels were set at 40㎍/㎥ for PM10, and 22ppb for NO2 by 2015. The plan presented 27 measures in six categories and major measures by each category are as follows.

① Measures for workplaces: Introduction of total quantity control in special countermeasure areas, strengthening of emission standards, the imposition of charges for NOx emissions, measures to reduce VOCs, and stronger financial and technical support for workplaces.
② Targeting vehicles: Advancement of emission standards for manufactured vehicles, expanded distribution of low emission vehicles, measures for reducing in-use vehicles (precision testing, emission reduction), management of non-road pollutant sources, and improvement of fuel quality.
③ Measures for land, transportation, and energy: Transportation demand management, creation of a cool city using wind corridors, and integration of ambient air quality management measures with energy policy through energy tax reform.
④ Measures for human health: Strengthening ambient air quality standards with a focus on health risks, establishment of benzene control measure, control of PM2.5 and hazardous air pollutants (HAPs), ambient air quality improvement of cities with population more than 500,000, and assessment of human health risk.
⑤ Measures for air quality information: Expansion of ambient air quality monitoring system, issuance of forecasts and warnings, support for R&D, stronger response to air pollution in Northeast Asia, and the establishment of ambient air quality information system.
⑥ Measures for governance: Building cooperation between national government and local governments, and increased policy consultation between public and private sectors.

<Table 57> Target emissions (six areas)

Item	PM10	NOx	SOx	VOCs
Emissions in 2001 (ton)	22,682	256,137	189,670	207,429
2015 target emission (ton) (reduction rate from 2001)	**16,298** (28%)	**170,062** (34%)	**161,262** (15%)	**157,470** (24%)

Source: Ministry of Environment, the First Comprehensive Plan on Air Quality Improvement (2006-2015)

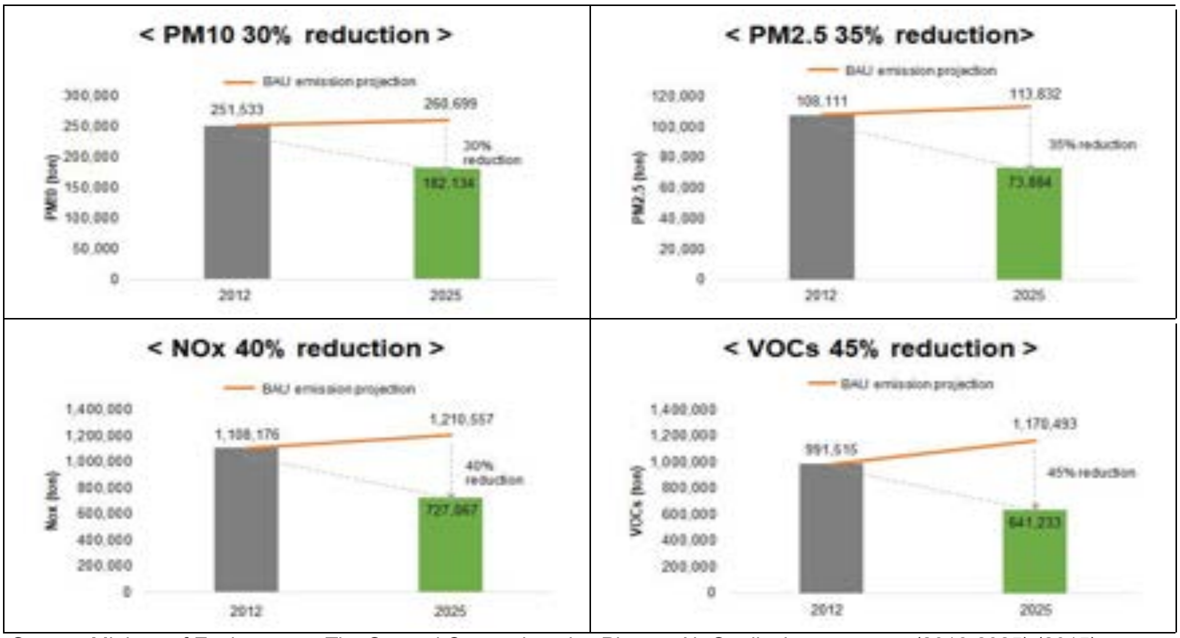
The Second Comprehensive Plan on Air Quality Improvement (2016-2025) aims to control nationwide concentrations of particulate matter (PM10, PM2.5) and ozone (O3), and set target pollutants (PM2.5, PM10, NO2, VOCs, HAPs). With the goal of reducing PM and ozone by more than 50%, projected emissions of each air pollutant in 2025 are expected to be reduced by 35 to 40% with the plan.

<Table 58> Projected emissions by air pollutant

Item	2012 emissions	2025 Projected emissions	2025 Target emissions	Reduction rate	
				Compared to BAU	Compared to 2012
PM10	251,533	260,699	182,134	30%	28%
PM2.5	108,111	113,832	73,884	35%	32%
NOx	1,108,176	1,210,557	727,067	40%	34%
VOCs	991,515	1,170,493	641,233	45%	35%

Source: Ministry of Environment, the Second Comprehensive Plan on Air Quality Improvement (2016-2025) (2015)

[Figure 39] Projected emissions by air pollutant



Source: Ministry of Environment, The Second Comprehensive Plan on Air Quality Improvement (2016-2025) (2015)

As core tasks for ambient air quality improvement, 30 tasks were selected in six categories including the establishment of an integrated ambient air quality management system, diversified workplace emissions management, emission reduction in the use of vehicles in all stages, removal of blind spots for household pollution control, protection of ambient air quality from HAPs, and scientific implementation.

<Table 59> Core Tasks for air quality improvement in the Second Comprehensive Plan on Air Quality Improvement

Six major areas		Major tasks by area (total of 30 tasks)
1	Establishment of an integrated ambient air quality management system (“system-based”)	1. Enhancement of the effectiveness of the ambient air quality standard 2. Innovation in management system of high concentration areas exceeding standards 3. Enhancement of ambient air quality forecast system 4. Laying a groundwork for international conventions on ambient air quality in Northeast Asia 5. Establishment of integrated management system for air pollutants and greenhouse gases 6. Reduction of adverse impact of land-use planning on ambient air quality
2	Diversified workplace emissions management ("workplace measures")	1. Advanced control of workplace emissions (concentration, total quantity) 2. Revision of air pollutant emissions charges 3. Response to integrated licensing system 4. Improvement of efficiency of VOCs emission control 5. Improvement of support system for workplace emissions reduction
3	Emission reduction in the use of vehicles in all stages ("measures for mobile sources of air pollution")	1. Strict control of manufactured vehicle emissions 2. Establishment of a control system for nitrogen oxides of in-use vehicles 3. Expanded distribution of eco-friendly cars 4. Control of emissions from two-wheeled cars and non-road mobile sources of air pollution 5. Transportation demand management
4	Removal of blind spots for household pollution control ("measures for household pollution control")	1. Implementation of emission reduction measures for small commercial facilities 2. Control of VOCs in households 3. Reduction of emissions from biomass burning 4. Reduction of fly ash 5. Implementation of odor management measures

5	Protection of ambient air quality from HAPs ("HAPs control")	1. Reduced emission of HAPs 2. Establishment of integrated HAPs monitoring system 3. Construction of HAPs inventory and modeling basis 4. Advancement of HAPs emission control
6	Scientific implementation ("scientific basis")	1. Improvement of air pollution monitoring network 2. Advancement of ambient air quality policy support system 3. Ambient air quality analysis and forecast using satellites 4. Establishment of national air pollution health risk assessment system 5. R&D for ambient air quality improvement

Source: Ministry of Environment, The Second Comprehensive Plan on Air Quality Improvement (2016-2025) (2015)

(2) Special Act on the Improvement of Air Quality in Seoul Metropolitan Area (2005)

The Special Act on the Improvement of Air Quality in Seoul Metropolitan Area, enacted in 2005, aims to protect the health of local residents and create a comfortable living environment by promoting comprehensive policies and systematically managing the air pollutant source in order to improve the severe air pollution in the metropolitan area, and as the main contents thereof, there are the management of total amount of pollutants emissions at workplaces, the suppression of emissions of vehicles such as low-pollution vehicles and specific diesel vehicles, and suppression of emissions of volatile organic compounds.

The First Seoul Metropolitan Air Quality Control Basic Plan (2005-2014): This plan aimed to cut air pollutant emissions by half by 2014 compared with the level of 2001 with various measures including vehicle emissions reduction, implementation of total air pollution load management system in large workplaces, and eco-friendly energy and urban management, thereby dramatically reducing particulate matter and nitrogen dioxide concentrations to the levels of advanced countries.

The Second Seoul Metropolitan Air Quality Control Basic Plan (2015-2024): With the end of the First Seoul Metropolitan Air Quality Control Basic Plan in 2014, the second basic plan was implemented with a focus on health risk control by 2024. To reflect the government's Special Measure on Fine Dust Management (June 2016), the second basic planwas modified in May 2017. To comply with the Comprehensive Plan on Fine Dust Management (November 2019), the plan was further revised in April 2020. That is, projected air pollutant emissions and reduction targets were reassessed, total amount of permissible emissions of districts were adjusted, and new measures for emission reduction by source of pollution were added and supplemented. The second basic planadded ultra-fine particles (PM2.5) and ozone, which cause significant health risks, to the list of pollutants subject to control, and aimed to carry out measures in five sectors: control of mobile sources of air pollution on roads, control of non-road mobile sources of air pollution, management of emission facilities, household pollution control, development of effective policies, and communication with and participation of residents.

(3) Special Act on the Reduction and Management of Fine Dust (2019)

The Special Act on the Reduction and Management of Fine Dust, which went into effect on February 15, 2019, aims to prevent harm to public health and properly manage and conserve the ambient air quality to create a comfortable living environment by reducing the emissions of fine dust and fine dust-generating substances and continuously managing their generation. The main provisions of this Act include the establishment of a Special Committee on Tackling Fine Dust, a Planning group on Fine Dust improvement, and a Fine Dust information center; the formulation of comprehensive PM control plans every five years; the preparation of a legal basis for emergency measures to reduce high PM concentrations; the designation of PM intensive control areas and performance certification for PM measuring devices; and the adoption of definitions for the terms "particulate matter" (PM10), and "ultra-fine dust" (PM2.5).

the Comprehensive Plan on Fine Dust Management (2020-2024) was deliberated and approved by the Third Special Committee on Tackling Fine Dust on November 1, 2019, in accordance with Article 7 of the Special Act on the Reduction and Management of Fine Dust. This is a legally enforced plan that presents policy directions and tasks for Fine Dust for five years from 2020 to 2024 by succeeding and strengthening existing measures of 2017 and 2018. It is based on policy recommendations of the National Climate and Environment Council, eight newly created and revised laws relating to Find Dust including the "Special Act on the Improvement of Air Control in Air Control Zones" that was approved by the National Assembly in March 2019, and increased fiscal injection supported by a revised supplementary budget. This plan presented 42 tasks and 177 detailed tasks in five categories including ① domestic reduction, ② international cooperation, ③ public health, ④ policies, and ⑤ communication and promotion, and contained a plan to inject a budget of KRW 20.2 trillion to achieve the goal of reducing the annual average concentration of ultra-fine dust by over 35% by 2024 compared with the level of 2016.

(4) The Special Act on the Improvement of Air Control in Air Control Zones (2020)

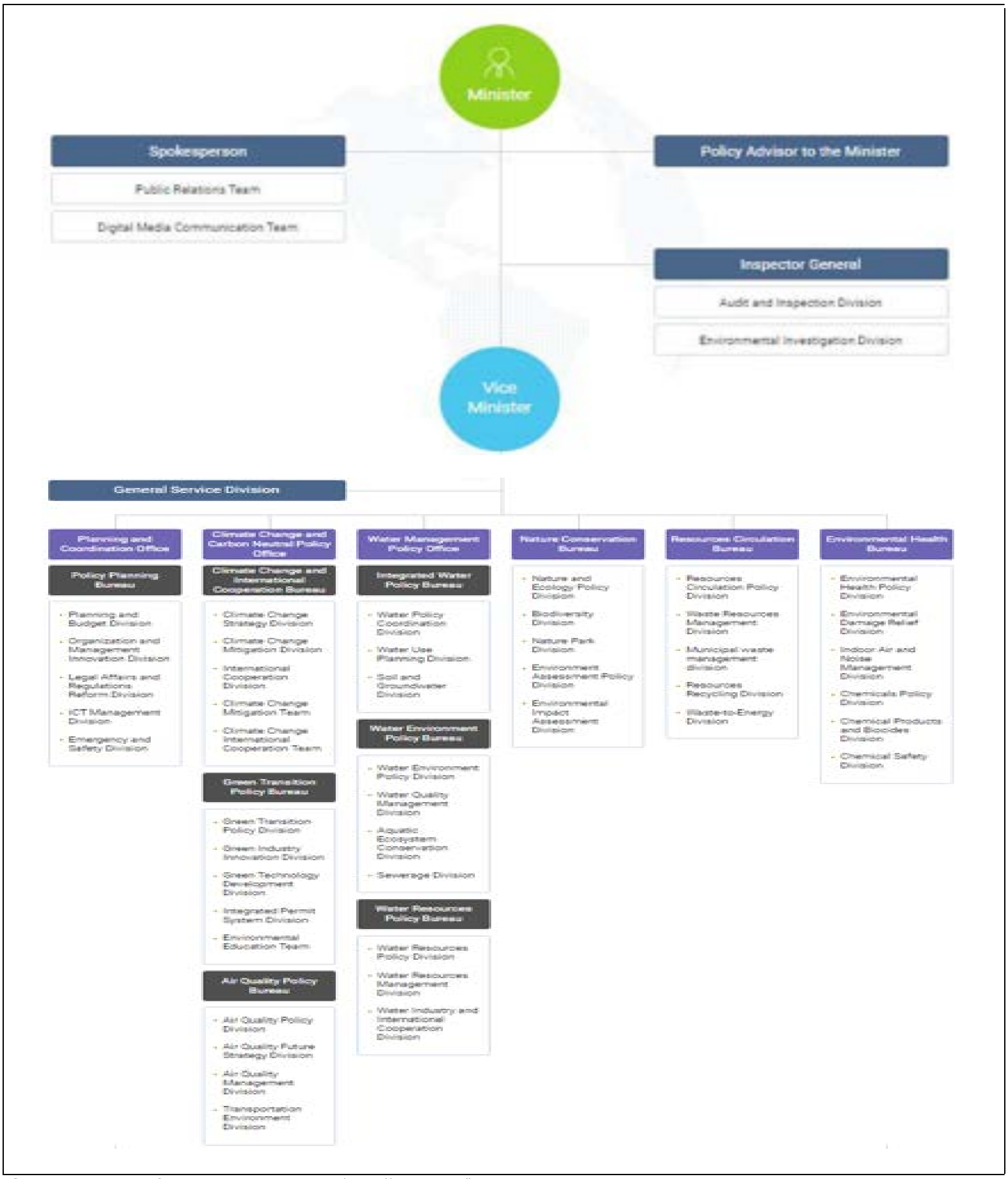
The Special Act on the Improvement of Air Control in Air Control Zones was enacted to protect the health of local residents and create a comfortable living environment by promoting comprehensive policies and systematically and broadly managing the air pollutant sources in order to improve the ambient air quality of the region with severe air pollution. Ambient air quality management by zone that used to be applied only in the Seoul Metropolitan Area was extended to 77 cities and counties in the Seoul metropolitan area, central area, southern area, and southeast area. According to this special act, the "Basic Plan on Air Quality Management (2020-2024)" was drawn up to set ambient air quality targets for each area based on air pollutant emissions in terms of industry, road transportation, non-road transportation, and household pollution, and to establish detailed tasks to achieve these targets. Ambient air quality management by zone is expected to expand as a tailored ambient air quality management system that considers the status of ambient air quality by region, industry size, and share of business types in order to achieve ambient air quality improvement targets on a national level.

Basic Plan on Air Quality Management (2020-2024) was deliberated and approved on April 3, 2020 and is under the Comprehensive Plan on Fine Dust Management (2020-2024) approved by the Special Committee on Tackling Fine Dust in November 2019. It aims to reduce air pollutants by prioritizing various measures listed by the Comprehensive Plan on Fine Dust Management, depending on the characteristics of control zones. The basic plan set ambient air quality targets (target concentration for four pollutants: ultra-fine dust, fine dust, nitrogen oxides, and ozone) considering the amounts of emissions of each zone, future emission estimation, room for emission reduction, and new and additional plant construction plans in areas. Besides, it set the total amount of allowable emissions to achieve the targeted concentration. (Ministry of Environment website)

3.2.3 Status of Governance Related to Ambient Air Quality Management

The Ministry of Environment is in charge of ambient air quality management in Korea. The Ministry of Environment in Korea was established on December 23, 1994 and is the central administrative agency in charge of administrative affairs on conservation of the natural and living environment, prevention of environmental pollution, and conservation, use, and development of water resources.

[Figure 40] Organization status of the Ministry of Environment in Korea



Source: Ministry of Environment website (http://me.go.kr/)

(1) Agencies of the Ministry of Environment

Under the Ministry of Environment, there are agencies such as the Korea Meteorological Administration, the National Institute of Environmental Research, the National Institute of Environmental Human Resources Development, the Greenhouse Gas Inventory and Research Center, the National Environmental Dispute Resolution Commission, the Metropolitan Air Quality Management Office, and the National Institute of Biological Resources. The overview and main tasks of the agencies are as follows.

<Table 60> Overviews and main works of agencies of the Ministry of Environment

Name of agency	Overview	Main work
Korea Meteorological Administration	It is a central administrative agency that oversees and supports national weather matters and is a weather expert agency that not only produces and studies weather and climate information through observation and forecasts, but also protects the lives and property of people from weather disasters and develops the weather and climate industry.	- Three-dimensional observation of the state of the ambient air and ocean form the sky, earth, sea, and space - Production of forecasts by adding the forecaster's professional knowledge and experience to various observational data collected at home and abroad, current weather conditions, and the results of the numerical forecast model - Real-time collection, processing, and distribution of the weather data produced at home and abroad - Production of numerical forecast data by analyzing vast observational data quickly and accurately using the supercomputer - Provision of weather information through various media such as broadcasting, newspapers, and the Internet - Creation of a new value of weather and climate information by opening and sharing weather and climate big data to government agencies, public agencies, research institutes, universities, etc. - Provision of various weather and climate services that have increased usability in public health, life, and industry
National Institute of Environmental Research	It is a specialized research institute in the environmental sector separated from the National Institute of Health in July 1978 to be in charge of the administrative works on the investigation, and research, test and evaluation with regard to environment conservation and prevention of environment pollution	- Research on risk reduction methods for protecting public health - Support the green growth by advancing the climate and air research - Research on securing the safety of drinking water and the health of aquatic ecosystems - Research on the creation of foundation for ecosystem management - Strengthen support for the technology of managing and reducing the transportation environment pollutant source - Research on the construction of scientific foundations for the expansion of the waste recycle and the safe disposal - Research on water of the Four Rivers for systematically managing the basin environment - Environmental quality monitoring and quality control
National Institute of Environmental Human Resources Development	It is a specialized educational agency in the environmental sector separated from the National Institute of Environmental Research in December 2006 to be in	- Expansion of the education and training infrastructure - Planning and operation of educational programs - Enhancement of educational results, performance evaluation, and enhancement of self-capacity

	charge of the matters on the education and training of public officials and civilians engaged in the works in the environmental sector.	
Greenhouse Gas Inventory and Research Center	It is an agency that is in charge of administrative matters on the establishment and coordination of the mid- to long-term greenhouse gas comprehensive information management plan, the establishment and coordination of the comprehensive management plan for greenhouse gas statistics, and the establishment and support of the greenhouse gas reduction goals by country and sector pursuant to the enforcement of the Framework Act on Low Carbon, Green Growth in July 2010.	- Support for setting greenhouse gas reduction goals by country and sector - Operation of the national greenhouse gas comprehensive information management system in accordance with international standards - Support for business cooperation related to greenhouse gas and energy target management and provision of information on related central administrative agencies - Investigation and research for supporting the reduction in domestic and international greenhouse gases - Investigation and research for establishing the basic planfor emission trading system and the plan for allocation of national emission certification - Matters on the calculation and reporting of greenhouse gas emissions, such as verification and management of the national greenhouse gas emission factors, improvement in the emission calculation method, etc. - Review of statements related to the emission trading system and implementation plans related to greenhouse gas and energy target management in the waste sector - Management of the statements related to the emission rights trading system and the construction and operation of the emission rights registration system - Management of the management company's implementation plan and specifications pursuant to Article 42, Paragraph 9 of the Framework Act on Low Carbon, Green Growth
National Environmental Dispute Resolution Commission	It is an agency established for dispute mediation because of environmental pollution induced damage pursuant to Article 4 of the Environmental Dispute Mediation Act.	- In charge of matters on environmental disputes - Operation of the environmental dispute mediation procedure
Metropolitan Air Quality Management Office	It is an agency that establishes a basic planfor the ambient air quality in the metropolitan area to improve the ambient air quality in Seoul, Incheon, and Gyeonggi-do, and implements policies such as managing the total amount of air pollutantstotal air pollutant management, making the vehicles in operation low-polluting oneslow pollution of traveling vehicles, and conducting seasonal managementthe season management system.	- Establishment and execution of detailed implementation plans for the ambient air quality management in the metropolitan area - Basic investigation related to the ambient air quality such as population, automobile industry and air pollutants emissions in the metropolitan area - Operation of the Total permissible emission amount management system for each emission source by region - Supply of low-pollution vehicles and management of specific diesel vehicles

National Institute of Biological Resources	It is a specialized research institute, established in March 2007, that is in charge of investigation and research matters for the efficient conservation and use of national biological resources, and promotion and exhibition of biological resources.	- Securing, keeping, and managing national biological resources - Investigation of and research on biological resources - Construction of and support for materials infrastructure of the biotechnology industry (BT) - Construction of the national biological resource information system and support for policies - Exhibition and education on biological resources and training of professionals
Regional Environmental Management Offices	They are organizations dedicated to improving the ambient air quality in the metropolitan area and include the Metropolitan Air Quality Management Office, and special regional administrative agencies for managing the drainage system of the Four Major Rivers basin (such as Four Major Rivers Environmental management Office and the Regional Environmental management Office in Wonju, Daegu, and Jeonju).	

(2) Agencies under the Ministry of Environment

Agencies under the Ministry of Environment include the Korea Environment Corporation, the Korea Environmental Industry & Technology Institute, the Korea National Park Service, and the SUDOKWON Landfill Site Management Corp. The overviews and main work of the agencies are as follows.

<Table 61> Overviews and main works of agencies under the Ministry of Environment

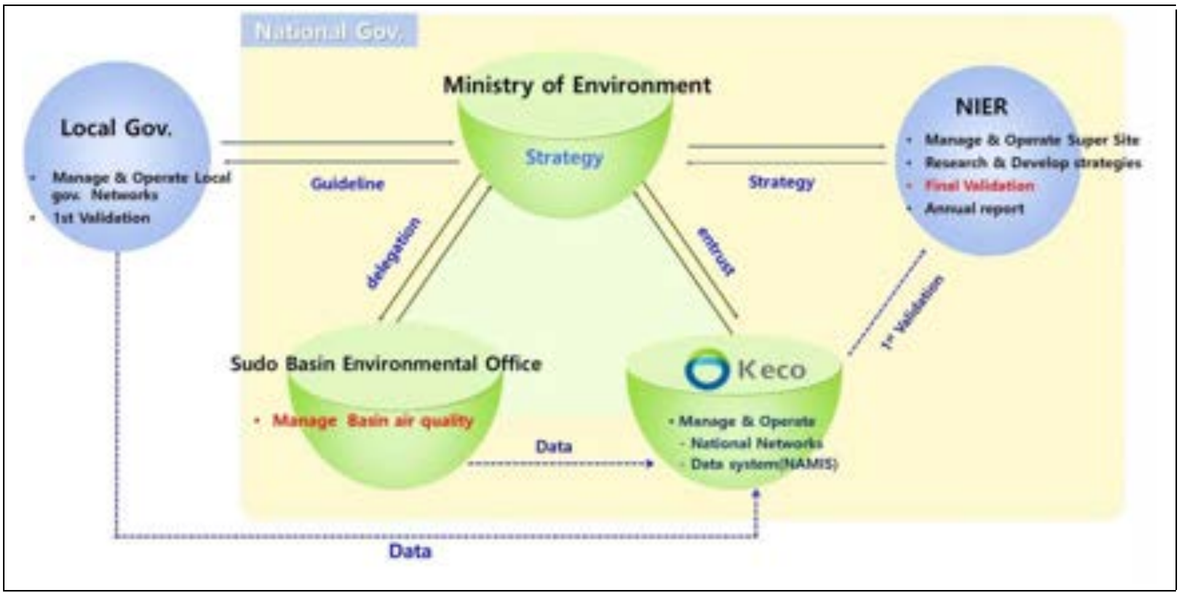
Name of agency	Overview	Main work
Korea Environment Corporation	It is an agency established for contributing to the eco-friendly national development, such as establishing the environmental conservation and resource recycling management system by efficiently promoting projects for preventing environmental pollution, improving the environment, and promoting recycling	- Response to climate change and reduction of greenhouse gases - Improvement in the water quality - Construction of the resource recycling management system - Operation of the environmental monitoring network and health service - Support with policies and support for environmental industry
Korea Environmental Industry & Technology Institute	It is an institute established in 2009 pursuant to Development of and Support for Environmental Technology Act, and is a specialized institute for supporting the development of environmental technology, nurturing the enviroenmental industry, exporting relevant items, and promoting the spread of eco-friendly products.	- Planning, evaluation, and management of environmental technology development projects - Nurturing of environmental industry and supporting for export - Nurturing of the environmental industry and technology professionals, and creation of jobs - Collection and distribution of information on environmental industries and technologies - Environmental new technology certification and technology verification - Operation of the Eco-label system and distribution of eco-friendly products

International Environmental Cooperation Center	It is an agency that works to strengthen Korea's international environmental cooperation capabilities and enhance environmental leadership capabilities in the international society.	- Research, investigation of international environmental trends (including agreements and regulations), and establishment of strategies - Discovery of agendas related to bilateral-multilateral environmental cooperation, exchange of policies and connection of projects - Construction and operation of the international environmental cooperation information system - Operation of the International Environmental Cooperation Council - Planning and operation of environmental diagnosis consulting projects in developing countries, and operation and management of master's degree courses for public officials in the Environmental Cooperation partner contries - Planning and operation of the public relations center of the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) - Cooperation of UNEP sustainable consumption production - Response to OECD environmental information working group
Korea National Park Service	It is an agency established for businesses such as conservation of the national parks, investigation of and research on park resources, installation and maintenance of park facilities, and guidance on and promotion of the use of park pursuant to the provisions of the Natural Park Act for the conservation of park resources, such as the natural ecology, historical culture, and landscape of the national park, and the sustainable use by future generations.	- Investigation, research, and conservation of the natural ecosystem, and natural and cultural landscape - Restoration and proliferation of wild animals and plants for promoting biological diversity - Observation of ecological changes in natural resources - Establishment of a sound exploration culture, such as the development and operation of exploration programs - Prevention of damage to park resources, crackdown on illegal activities, etc.
SUDOKWON Landfill Site Management Corp.	It is an agency established to promote proper disposal and recycle of the waste generated in the metropolitan area, and to contribute to the creation of a comfortable living environment for residents in the surrounding area.	- Disposal of wastes brought into landfills in the metropolitan area - Installation and management of waste disposal facilities and facilities attached thereto - Installation and management of facilities for waste recycling - Creation of the resident support fund and support for the surrounding affected areas

(3) Status of domestic air pollution monitoring governance

Since 2001, the operation and management of the air pollution monitoring network in Korea has been dualized, sharing the roles between the Ministry of Environment and regional governments. The monitoring stations that measure the ambient air quality reference substances, which are relatively easy to manage, are managed by the regional governments, but the measurements of low-concentration background areas or special items that are relatively difficult to evaluate are managed by the Ministry of Environment.

[Figure 41] Stack emission monitoring governance



Source: Korea Environment Corporation

In Korea, the Ministry of Environment is responsible for air pollution monitoring and establishes operation plans, and its affiliated organizations such as the Metropolitan Air Quality Management Office, the National Institute of Environmental Research, and the Korea Environment Corporation perform respective tasks on behalf of the ministry. The Metropolitan Air Quality Management Office is responsible for the installation and operation of an air pollution monitoring network in the Seoul Metropolitan Area, analysis and assessment of collected monitoring data, and operation of mobile air pollution monitoring vehicles. The Korea Environment Corporation is in charge of the installation and operation of a national air pollution monitoring network, measurement and analysis, operation of ambient air quality management systems (NAMIS, Airkorea), and inspection of air pollution monitoring equipment accuracy. The National Institute of Environmental Research is responsible for finalizing and keeping monitoring data, research for improved operation of monitoring networks, analysis and assessment of monitoring data (publication of monthly and annual reports on ambient air quality), and the operation of supersites. Local governments install and operate air pollution monitoring networks, while the Ministry of Environment supports the ambient air quality monitoring network operation of local governments through budgets.

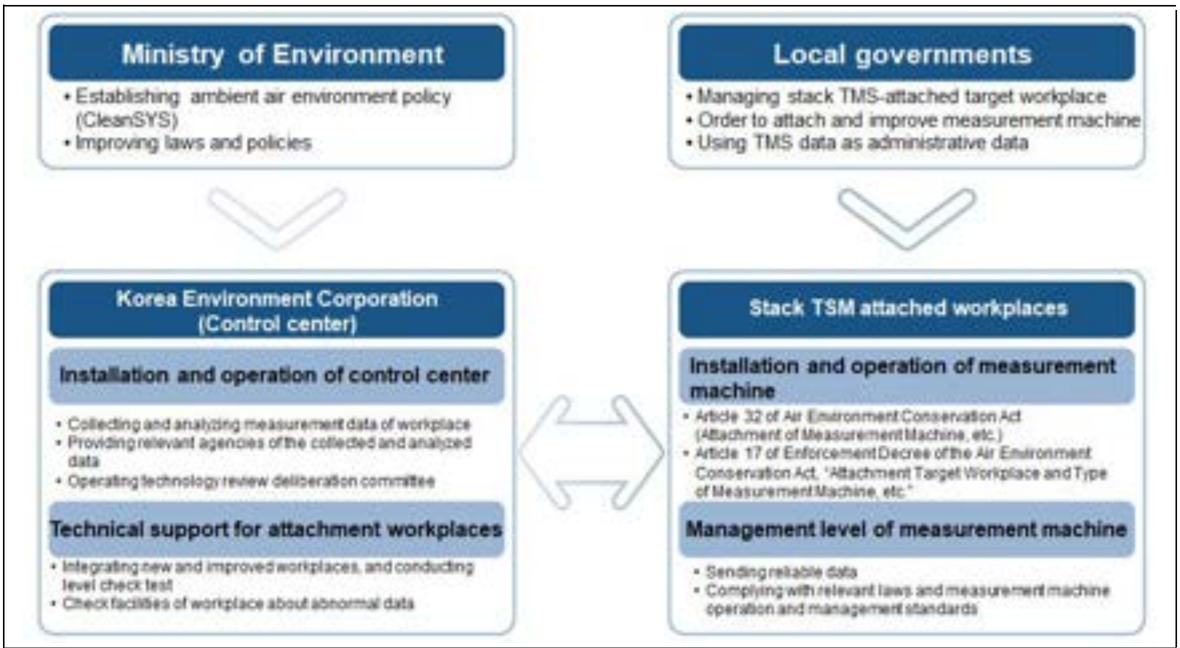
<Table 62> Details of air pollution monitoring governance

Name of agency		Role
National government	Ministry of Environment	• Establishment of air pollution monitoring plan
	Metropolitan Air Quality Management Office	• Installation and operation of air pollution monitoring network in the Seoul Metropolitan Area • Analysis and assessment of air pollution monitoring data in the Seoul Metropolitan Area • Operation of mobile air pollution monitoring vehicles in the Seoul Metropolitan Area
	National Institute of Environmental Research	• Finalization and keeping of monitoring data • Research for improved operation of monitoring networks • Analysis and assessment of monitoring data (publication of monthly and annual ambient air quality reports) • Operation of supersites
	Korea Environment Corporation	• Installation and operation of national air pollution monitoring network • Measuring and analysis of air pollution using national monitoring network • Operation of ambient air quality management systems (NAMIS, Airkorea), • Accuracy inspection of air pollution monitoring system
Local governments		• Installation and operation of air pollution monitoring networks run by local governments

(4) Status of stack emissions monitoring governance

Agencies related to stack emission monitoring are the Ministry of Environment, the Korea Environment Corporation, local governments, and the stack TMS attached workplaces. The work system for each agency is as follows.

[Figure 42] Stack emission monitoring governance



<Table 63> CleanSYS related institutions and roles

Name of agency	Role
Target Workplaces	• Installation and operation of monitoring device • Maintenance and repair of monitoring device • Quality control of monitoring equipment • Transmission of monitoring data and compliance with emission standards
Ministry of Environment and local governments	• Imposition of pollutant emissions charges • Management of workplaces through administrative guidance, etc. • Use of basic materials of ambient air quality policy
Korea Environment Corporation	• Real-time collection of data • Remote control and technical support • Provision of data to competent administrative organizations • Storage and managment of monitoring data

3.2.4 Status of Ambient Air Quality Management in Seoul

In 1978, the Seoul Metropolitan Government established a plan to expand the supply of LPG to 500,000 households, an increase from the existing supply of LPG to about 40,000 homes, among the 800,000 homes that used briquettes at that time. Because of the resulting reduction of the use of briquettes, air pollution was greatly reduced. With the government's expansion of policies such as the supply of low sulfur oil in 1981, restrictions on the use of the solid fuel in 1985, the supply of anthracite gasoline in 1987, and the mandatory use of LNG in 1988, the levels of primary air pollutants such as SO_2, total fine dust, and CO have been reduced noticeably and maintained below environmental standards.

In June 1995, Seoul enacted SEOUL METROPOLITAN GOVERNMENT FRAMEWORK ORDINANCE ON ENVIRONMENT, and in March 1998, created the Air Quality Standard of Seoul, which was tighter than the central government's ambient air quality management standard, and inaugurated the Clean Air Conservation Department to lay the groundwork for ambient air quality management. In addition, the Ministry of Environment designated Seoul, Incheon and some areas of Gyeonggi-do (15 cities) as Seoul metropolitan ambient air quality regulated districts according to the Clean Air Conservation Act in July 1997 (Ministry of Environment Notice no. 97-51), and provided a legal basis for the collaborative efforts of Seoul and related local governments to conserve ambient air quality in the Seoul Metropolitan Area.

In order to improve the ambient air quality of Seoul Metropolitan Area, which was the worst among cities of OECD members, the “Special Act on the Improvement of Air Quality in Seoul Metropolitan Area was enacted in December 2003. The Act included ambient air quality improvement targets, allocation of total amount of permissible emissions by district, establishment of a basic plan for ambient air quality improvement in Seoul Metropolitan Area, Total Air Pollution Load Management System in workplace, distribution of low-emission vehicles, and emission control of in-use vehicles. The special act requires the establishment and updates of the Seoul Metropolitan Air Quality Control Basic Plan every 10 years to reduce nitrogen oxides, sulfur oxides, VOCs, and PMs. The First Seoul Metropolitan Air Quality Control Baster Plan was implemented with a focus on reducing PM10 and NO2 concentrations in the Seoul Metropolitan Area by 2014. As a result of these efforts, the PM concentration of Seoul fell from 71$\mu g/m^3$ in 2001 to 41$\mu g/m^3$ in 2012, showing a clear sign of improvement, but the level of PM, which is one of the major environmental indicators of global competitiveness, still remained at a higher level than other major cities, thus requiring continued efforts.

The First Seoul Metropolitan Air Quality Control Basic Plan that started in 2015 included PM10, PM2.5, NO2, and O3 as target pollutants, and a lowering emission of vehicle project began in the Seoul Metropolitan Area to curb air pollution emissions from vehicles. The lowering emission of vehicle project consists of lowering emission of in-use diesel vehicles, green car distribution, and increase in the number of natural gas stations. To implement the project of lowering emission of in-use diesel vehicles that started in 2003 in the Seoul Metropolitan Area, Seoul began to convert 135 garbage trucks (2.5 tons) used in its districts into LPG engine vehicles. In 2005, Seoul expanded the project to city buses and commercial vehicles and carried out various tasks such as the installation of DPF and DOC for diesel engines, modification of diesel engine vehicles to use LPG, and early scrapping of old cars.

To fundamentally solve the emission problem, the Seoul Metropolitan Government has supplied green cars and has been constructing a charging infrastructure since 2009. This led to the launch of green car demonstration projects such as low-speed electric vehicles, modified electric vehicles, high-speed electric vehicles, electric buses, hydrogen fuel cell vehicles, and online electric vehicles. Charging stations have been constructed in public facilities such as city halls, autonomous district offices, and parks since 2009, and in particular, a “smart charging system” that makes it possible to pay the charging fees was developed in preparation for the general demand for charging demand.

Further, the Seoul Metropolitan Government is operating ambient air quality monitoring stations throughout Seoul to systematically implement ambient air quality management. It introduced the ozone warning system in 1995, followed by the fine dust forecast warning system in 2005 so that citizens can prepare. The Seoul Metropolitan Government set “Seoul, a healthy breathing city,” as one of four major municipal goals, and suggested a goal to reduce ultrafine dust directly related to civic health by 20% by 2018. To this end, the Seoul Metropolitan Government is actively promoting policies to fundamentally prevent vehicle emissions, such as lowering the emission from old diesel vehicles, reducing nitrogen oxides from large vehicles, and expanding the introduction of electric vehicles and CNG hybrid buses. (The Seoul Institute, 2015)

3.3 Proposal of Policies in the Ambient Air Quality Management Sector

The causes of early-stage ambient air pollution in most cities including those in Korea, are population growth, industrialization, urban concentration, an increasing number of vehicles, and deterioration of pollution prevention technologies and facilities.

In Mongolia, more than 60% of its total population lives in cities, and since 1990, the industrial structure has changed from agricultural and livestock farming oriented industries to manufacturing industries, and in particular, the capital Ulaanbaatar is thought to suffer from severe ambient air pollution because of high urbanization rate over a short-term period, coal-fired power plants, factories with insufficient air pollution prevention facilities, and an increasing number of vehicles because of dense population, which has many similarities to Korea’s past.

Looking at the ambient air quality management and ambient air pollution improvement process in Korea, and the efforts that it has made, we can find that ambient air pollution was seriously accelerated because of an increasing use of fossil fuels without consideration of the environment and also because of the expansion of industrial facilities that neglected environmental pollution prevention measures in line with the growth-oriented development logic in 1960s to 1970s, and the increasing number of vehicles further accelerated this situation. For management of such environmental situations, a legal basis began to be established with the enactment of the Air Pollution Prevention Act in 1963, which was developed into the Environment Conservation Act and the Clean Air Conservation Act, providing the legal foundation for ambient air quality management.

Various policy systems and institutional systems have been devised and executed to effectively implement those acts, and some policies have been successfully implemented to contribute greatly to improving the ambient air quality in Korea. Therefore, based on the status data of Mongolia, sine Korean policies that can help solve the ambient air quality problems and other pending issues in Mongolia are here introduced.

3.3.1 List of Proposed Policies in the Ambient Air Quality Management Sector

<Table 64> List of proposed policies in the Ambient Air Quality Management Sector

No.	Area	Proposal of policies	Details
1	Stationary source	Strengthening the implementation of installing air pollution prevention facilities	To achieve and meet the environmental standards for emissions, it is necessary to introduce methods for defining major emission sources and restricted pollutants, and gradually expanding the scope of the emission sources and restricted pollutants to strengthen management of pollution. To this end, it is necessary to make it mandatory to install emission facilities for meeting the standards for relevant restricted pollutants of individual emission sources, and in the long term, it is also necessary to manage the restriction of emissions more strictly by introducing restrictions on the total amount of air pollutants.
2	Stationary source	HOBs fuel replacement for reducing ambient air pollution	For effective fuel replacement, it is necessary to establish policies step by step, such as ①restrictions on the use of existing fuel, ②establishment of standards for introducing new fuel, and ③expansion of supply of new fuel, and it is necessary to consider auxiliary policy measures to ensure that the above policies can be introduced in the market without problems.
3	Mobile source	Introduction of an old vehicle management system	Old diesel vehicles are managed in accordance with the specific diesel vehicle emission standards that are more stringent than the driving vehicle emission standards. Therefore, for the owners of specific diesel vehicles, such measures as ①attachment of an emission reduction device, ② modification to a low-pollution engine, and ③early scrapping of vehicles should be introduced to meet the permissible emission standards for specific diesel vehicles. Consideration can be given for providing government’s partial subsidies to offset related expenses.
4	Mobile source	Introduction of a vehicle fuel quality management system	In the short term, there is a need to identify the status of petroleum providers, introduce a quality inspection system for each fuel distribution stage and construct a specialized laboratory that can test and analyze fuel for vehicles. In the mid- and long-term, it is necessary to introduce a system to actively manage thedistribution of vehicle fuels, identify fake petroleum products, strengthen the ability to analyze vehicle fuels and improve the quality of vehicle fuels.
5	Monitoring	Establishment of a master plan in the sector of air pollution monitoring network	To improve the efficiency of the ambient air monitoring management, the proposal is to establish a plan for identifying the measuring network operation entity and to expand the ambient air pollution measuring network for the areas where measurement has not been conducted. It is also necessary to introduce a precision management system for increasing the reliability of the measured ambient air quality data and to introduce a method for managing hazardous substances in the ambient air by introducing a hazardous ambient air pollutant analysis system.
6	Monitoring	Establishment of an ambient air pollutant inventory system	The proposed method for managing ambient air pollutant emissions is to construct a real-time monitoring system, record and manage the air pollutant inventory in the facilities that generate emission in large scale.
7	Monitoring	Establishment of a hazardous ambient air pollutant analysis system	The proposed method for managing the hazardous ambient air pollutant is to establish a system for analyzing and managing specific hazardous ambient air pollutants more strictly than general ambient air pollutants.

3.3.2 Proposed Policies to Control Stationary Sources of Air Pollution

(1) Strengthening the implementation of installing ambient air pollution prevention facilities

General status

[**Literature research**]

- Major sources of ambient air pollutants in Mongolia include the emissions from combined heat and power plants that use coal as fuel and the emissions from vehicles, and the hazardous gases that are generated not only from the coal that households use as a major energy source but also from factories and the process of waste incineration.
- In particular, the combined heat and power plants in urban areas supply electricity and district heating there, but with poor efficiency of ambient air pollutant control systems, the technical and economic conditions required for optimal operation of the plants are not sufficient.

[Interviews and advisory]

- Large heat only boilers (HOBs) are installed without a license in the first place, and then relevant permits are obtained from the Mayor's Office later, implying that the requirements prescribed under the Law on Air for the issuance of permits for the installation of large HOBs have not been observed.
  (Mr. Munkhbat, Ministry of Environment and Tourism, Mar. 3, 2021)
- Procedures for monitoring and managing permitted boilers have been properly complied with (permit is renewed every five years).
  (Mr. Kherlen, Ulaanbaatar Mayor's Office, Feb. 24, 2021)

Institutional arrangement

[Laws] Law on Air

- Article 18: Permission to use the large stationary sources
- 18.2: To obtain the permission specified in Paragraph 18.1 of the Law on Air, it shall be required to specify measures, as well as other requirements stated in laws, to be taken to protect the ambient air by designating the standards for permissible air pollution emissions from pollution sources and the permissible maximum physical adverse effects
- Article 23. Obligation to install and supervise equipment for managing pollutants from large stationary sources
- 23.1: When businesses, organizations, or individuals conduct productions and provide services by using large stationary sources, they shall install internal control tools to manage individual pollutant sources, and equipment to neutralize and clean air pollutants and mitigate harmful physical effects.
- 23.2: Central administrative agencies, heads of counties, governors of provinces, or environment auditors shall monitor and supervise the use status of facilities and pollution sources by using tools and equipment specified in Paragraph 23.1 of this Act with respect to the large air pollutant sources.

[Policy] NPRAEP

- NPRAEP Goal 2: Reduction of pollution sources by introducing eco-friendly advanced technology, phased prohibition of the use of coal briquettes, and reduction of emission of pollutants

[Standards] MNS5919:2008, MNS6298:2011, MNS5043:2016

- MNS5919:2008: Ambient air pollutant emission standards for steam boilers and hot water boilers of combined heat and power plants and thermal stations.
- MNS6298:2011: Maximum permissible emission standards for the stacks of new thermal power plants and heat generation plants
- MNS5043:2016: Permissible emission standards for ambient air pollutants from hot water boilers with a capacity up to 4.2 MW

[Management entity] Ministry of Energy and Ulaanbaatar City Mayor's Office

- Ministry of Energy: Establishment of laws and policies related to the facilities and fuel of power plants, issuance of permits for installation of boilers, and monitoring and management of their operation
- Ulaanbaatar City Mayor's Office: Responsible for the management, monitoring, and registration of the boilers that are not connected to the central system of Ulaanbaatar City, and for the issuance of permits for the installation of boilers with a capacity of 1.5 MW or higher.

Details	[Policy overview] • Defining the major emission sources and restricted pollutants, and strengthening the management methods - To achieve and meet the environmental standards for emissions in Mongolia, it is necessary to introduce methods for defining the major emission sources and restricted pollutants, and gradually expanding the scope of restricted emission sources and restricted pollutants to strengthen the management of pollution. To this end, it is necessary to make it mandatory to install emission facilities to meet the standards for relevant restricted pollutants of individual emission sources, and in the long term, it is also necessary to manage the restriction of emissions more strictly by introducing restrictions on the total amount of air pollutants. [Details] • First phase: Defining the emission sources first, and then setting permissible emission standards - Defining of the emission sources: In the case of Korea, the scope of emission sources was gradually expanded, starting from large industrial facilities and home heating systems in the 1970s, then including industrial complexes in the 1980s, and then including automobiles and petrochemical plants and incineration facilities in the 1990s. - Setting of the permissible emission standards: After setting the permissible emission standards, it is necessary to install prevention facilities and establish management and monitoring systems to ensure the compliance with the standards. - Introduction of the emission charges: Induce the reduction of pollutants by measuring the level of pollution. If the emission standards are exceeded, it is required to manage the situation by taking measures such as charges for excess emission and administrative depositions. • Second phase: Expanding the scope of restricted ambient air pollutants - In the case of Korea, the permissible concentrations of 19 pollutants such as gas and dust were designated under the Environment Conservation Act in 1977. In 1991, a permissible emission standard advance notice system was introduced under the Clean Air Conservation Act, making it a rule to announce a plan for introducing standards five years ahead. In 2009, permissible emission standards for 26 pollutants such as sulfur oxides were established. In 2017, an integrated environment management system was introduced. * Considering that the permissible emission standards have an impact on the business plans of companies such as improvement and supplementation of prevention facilities at the workplaces, and investment in pollution prevention facilities, the advance notice system makes it possible to prepare for them in advance. • Third phase: Mandate the installation of air pollution prevention facilities in air pollutant-emitting workplaces - It is necessary to make it mandatory for emission facilities larger than a certain size to install a remote automatic stack emission monitoring system, making it possible to perform continuous measurement and monitoring of ambient air pollutants through the automatic stack monitoring system. - In the case of Korea, the monitoring data has been used by administrative institutions since 2002 to decide whether workplaces comply with permissible emission standards. In particular, areas with higher emissions are designated as “areas for special measures” for conducting stricter management. - Process: In the case of Korea in 1977, the Environment Conservation Act added provisions on the installation of air pollution prevention facilities and the issuance of permits for installing emission facilities. In 1983, excess emission charges for nine pollutants including particle matter and sulfur oxides were introduced. In 2020, nitrogen oxides were added to the pollutants subject to excess emission charges. **[Other suggestions] It is necessary to establish a licensing system that considers the introduction of air pollution prevention facilities from the stage of issuing permits for installation of emission facilities.** • Necessary to establish a licensing system that considers the introduction of air pollution prevention facilities at the stage of issuing permits for installation of emission facilities - Although there are provisions in the Law on Air in Mongolia that mandate the installation and supervision of equipment to manage stationary sources of air pollution, it is difficult to guarantee the implementation of the provisions.

	• To ensure effective management and supervision, environmental inspectors need to be trained to maximize the effects of the project. - Because there may be a shortage of environment inspectors capable of understanding and implementing the details of polices, dedicated departments or institutions need to be established, and environmental inspectors need to be cultivated and utilized at the level of the national and public institutions as a means of strengthening the guidance and enforcement system of administrative institutions,

(2) HOBs fuel replacement for reducing air pollution

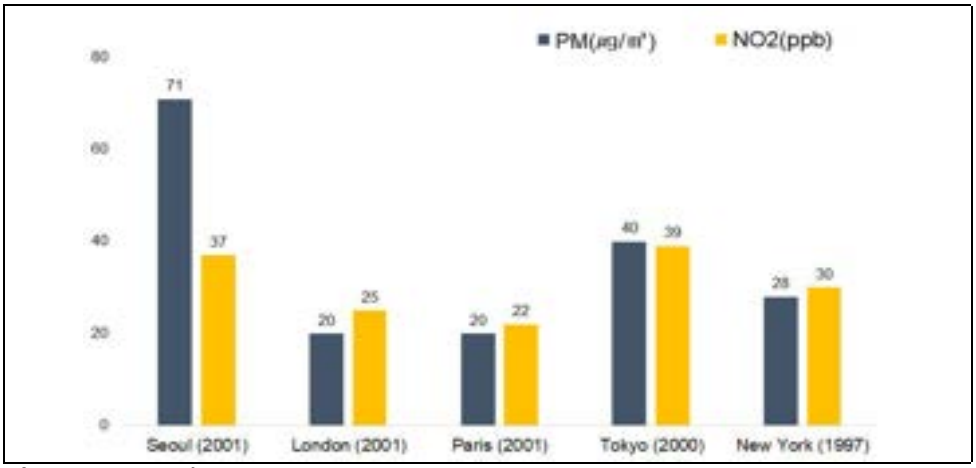
General status	**[Interviews and advisory]** • From May 2021, the use of raw coal for steam boilers is banned, and from Sept. 2022, the use of raw coal for boilers for heating is also banned. However, the use of raw coal at TES-2, TES-3, TES-4, Amgalan power plant, and Selbe power plant is excluded from the banning. • In-depth knowledge for the replacement of fuel and technology is needed to prepare for the ban on raw coal. (Mr. Kherlen, Ulaanbaatar Mayor's Office, Feb. 25 2021) • Ulaanbaatar City Gas Association was established, and gas has been supplied in cooperation with private companies including Unigas LLC. • A provision that allows the temporary use of enriched coal (coal prior to processed coal) at steam production workplaces was added. (Mr. Munkhbat, Ministry of Environment and Tourism, Feb. 23 2021
Institutional arrangement	**[Laws] Law on Air** • Article 9: Rights and obligations of businesses, organizations and individuals - 9.1.8: Prohibition of the incineration of raw coal and other air pollutants in ambient air quality management areas Article 16: "Prohibitions of the ambient air quality improvement region" - 16.1.5: Incineration of raw coal or other air pollutants ※ Mongolian government resolution No.62 (February 28, 2018): Households, businesses and organizations are prohibited from burning raw coal beginning on May 15, 2019, except for thermal power plants that produce electricity and heat in Bayangol, Songinokharkhan, Sukhbaatar, Khan-Uul, and Chingeltei in Ulaanbaatar City. **[Policy] NPRAEP** • NPRAEP Goal 2: Reduction of sources of emissions by introducing eco-friendly technology, phased prohibition of the use of coal briquettes, and pollutant emissions reduction - Action plan 2. Phased ban on raw coal except thermal power plants and CHPs. - Action plan 7. Expansion of district heating network in cities and regions, construction of new heating sources, and development of innovative technology to reduce coal consumption and waste **[Standard] MNS5679:2019** • MNS5679:2019: Technical requirements of improved solid fuel (bituminous coal) **[Management Subject]** • Ministry of Energy: Creation of fuel standard for fuel of HOBs • Ulaanbaatar Mayor's Office: Registration and permit for HOBs installed in Ulaanbaatar • Air pollution Reduction Department (APRD): Sampling and analysis of air pollutants of HOBs
Details	**[Policy overview]** • By regulating the use of existing fuel and creating standards for new fuel, the use of existing fuel is gradually decreased, and the use of new fuel is encouraged by offering subsidies. **[Details]** • 1st phase: Introduction of regulations on consumption of solid fuel to reduce air pollution, and implementation of a policy to encourage clean fuel - For Korea, metropolitan cities and small and medium-sized cities with serious air pollution were designated as "solid fuel control ares" in 1985. In 1993, these ares were expanded to 22 cities and counties and to 13 regions in 1997.

Details	
Details	• 2nd phase: The enactment of a gas safety control law and standards on the safety of gas water boilers - For Korea, some households and restaurants began to use LPG in the early 1970s, and the government enacted the High-pressure Gas Safety Control Act In 1973. With the first oil shock of 1973 and the second oil shock of 1979, the Korean government promoted the supply of gas to diversify sources of energy. As a result, fuel for households changed from petroleum to gas and heaters changed to gas boilers. In October 1984, the Korea Gas Safety Corporation prepared guidelines on precision inspection of gas hot water boilers, and on August 14, 1985, with the creation of the Korean Industrial Standards (KS), a standard specification of gas hot water boilers was made and KS certification was issued to gas boiler manufacturers. • 3rd phase: Establishment of nationwide natural gas supply plan and mandatory use of low sulfur fuel oil - For Korea, LNG was introduced in late 1987. To expand the use of clean fuel in 1990, a nationwide natural gas supply plan was approved, initiating the supply of natural gas across the country. As a result of the mandatory use of natural gas for boilers with a certain capacity in the Seoul metropolitan area in 1991, natural gas use gained traction nationwide.

3.3.3 Proposed Policies to Control Mobile Sources of Air Pollution

(1) Introduction of an old vehicle management system

General status	**[Interviews and advisory]** • Mongolia has an older vehicle control standard to ban the operation of diesel bus models that are more than 12 years old. ('21.2.24, Ministry of Road and Transport Development, Mr. Sh. Khavidolda) • To reduce imports of older vehicle, the government imposed high tariffs on imported older vehicles, and as a result, most of the vehicles in the country are produced after 2012. ('21.2.24, Ministry of Road and Transport Development, Mr. Sh. Khavidolda, '21.2.26, Ministry of Environment and Tourism, Mr. Munkhbat)
Institutional arrangement	**[Laws] Law on Air** • Article 20.3: The Environmental Auditors and the police officers having such authority can restrict emissions of pollutants to the air in excess of the standards and the use of mobile sources that have harmful physical effects in accordance with the procedures specified in the Act on the investigation and resolution of violations. **[Policy] NPRAEP** • NPRAEP Goal 3: Comprehensive measures to reduce pollutant emissions from vehicles - Action plan 3: Change of motor vehicle fuel to gas and electricity, introduction of eco-friendly automobiles and R&D, and phased conversion of public transport fuel to gas **[Management Subject] Ministry of Road and Transport Development, National Road Transport Center, APRD** • Ministry of Road and Transport Development: Emission control of public transportation (bus, etc.) • National Road Transport Center: Vehicle registration and regular emissions testing • Air Pollution Reduction Department (APRD): Vehicle emissions measurement
Details	**[Policy overview]** • Introduction of an old diesel vehicle control system ✓ Attach emission control device to minimize air pollutants emitted by diesel vehicles ✓ Convert existing vehicle engine into low-emission LPG engine ✓ Support costs of scrapping diesel vehicles that are more than seven years old - For Korea, the government supports some of the expenses for the maintenance of older diesel vehicles. **[Details]** • For Korea, owners of vehicles in excess of the permissible emission standard in specific diesel vehicle testing must get retested within the retest period to meet permissible emission standards or attach emission reduction devices (DPF, p-DPF, DOC) within one month from the expiry date of the specific diesel vehicle testing period, or scrap such vehicles. • To support the installation of emissions control devices, the central government and local governments are sharing the cost of low emission measures at a rate of 50/50. **[Reference] Status in Korea** • In the early 2000, the levels of PM and NO2 in Seoul were two or three times as much as those of other OECD countries. According to the statistics of various research institutions, the social costs of vehicle emissions amounted to KRW 10 trillion a year, and related deaths reached 10,000 persons a year in Korea. (Gyeonggi Development Research Institute, 2003). Air pollution fatalities of the world exceed traffic fatalities by 3 to 1. (Earth Policy Institute, USA)

Details	**[Figure 43] Urban air pollution of advanced countries**  Source: Ministry of Environment • The WHO listed PM as the most hazardous carcinogen, and Korea's excess deaths in 2008 were estimated at 24 per 100,000 persons, which is the second highest after China among the 12 countries surveyed. From 2005-2007, PM2.5 in Seoul rose by 10μg/㎥, and the total death rate and death rate for people aged 65 or older rose by 0.8% and 1.1%, respectively, and cardiovascular disease increased by 13%. • In early 2000, pollution loads were concentrated in the Seoul metropolitan area and existing regulations based on the control of emission concentration could not curb the growth of emissions, and as pollution control was implemented by individual local governments, the integrated pollution control of the Seoul metropolitan area consisting of several local governments was not easy. • Therefore, in 2003, the Special Act on Improvement in the Ambient Air Environment in the Metropolitan Area was enacted to improve ambient air quality, and its major tasks included the promotion of low emission vehicles and strengthening of emission control of vehicles in use.

(2) Introduction of a vehicle fuel quality management system

General status	**[Literature research]** • Mongolia mostly imports motor vehicle fuel from China and Russia. • The quality of imported vehicle fuel in Mongolia is relatively low. - In 2018, Mongolia imported 1.45 million tons of gasoline and diesel fuel, 12.8% or 186,000 tons of which met Euro 5 emissions standards. As of 2019, total vehicle fuel imports amounted to 1.61 million tons (212,000 tons or 13.2% met Euro 5 standards), and in 2020 1.62 million tons (253,000 tons or 15.6% met Euro 5 standards), which showed that high quality fuel (Euro 5 standard) was growing, but the share was relatively low. • In Mongolia, there are 85 fuel storage facilities and 1,418 gas stations. (Material from the Ministry of Mining and Heavy Industry) **[Interviews and advisory]** • In 2014, vehicle fuel tests were conducted for 1,167 gas stations, 70% of which had never had their fuel tested, and 30% of which was below standard. • There is no organization that inspects fuel quality, and gas stations themselves were not controlling their fuel quality, suggesting the necessity for improvement. ('21.3.2, Ministry of Environment and Tourism, Mr. Munkhbat)

Institutional arrangement	**[Laws] Law on Air, Petroleum Products Law** • Law on Air - According to Article 17.2.4 of the Law on Air, a state central administrative organization must establish standards for fuels such as gasoline, diesel and LPG by cooperating with other state central administrative organizations in charge of road transportation and petroleum, and said standards are approved by the competent authority. • Petroleum Products Law - Regulations on the import, production, sale and storage of petroleum products consist of five chapters and 15 sections. In 2013, a provision on the registration of petroleum businesses was added. In 2018, a provision on the regulation of petroleum product quality and a provision on the importation, production, distribution, transport, and storage of petroleum products were added. **[Policy] VISION 2050, NPRAEP** • VISION 2050 - Green growth Promotion of eco-friendly growth, ecological balance, and environmental sustainability * The Long-term Development Policy of Mongolia (2015-2040), the predecessor of "Vision 2050," included a policy for technological and innovative adaptation to climate change. • NPRAEP - Goal 3: Overall measure to reduce vehicle emissions - Action plan 2: Support for the import and consumption of fuel that meets Euro 5 standards, phased ban on the importation and consumption of fuel below the standard. Improvement of fuel quality monitoring system • Quality inspection system - Imported products: Mongolian Customs checks the conformity of products with HS Codes. - Products in circulation: Although storage facilities and gas stations are inspected by the Mineral Resources and Petroleum Authority of Mongolia (MRPAM) and related supervisory institutions, the inspection frequency is not determined and the number of inspections are very few. • Quality standard - The Mongolian National Standard (MNS), a petroleum product quality standard, contains standards on ingredients. * Gasoline (MNS 217-2017), Diesel (MNS 216-2017) - Permissible emission standards for sulfur, lead, and benzene are high, and there is no quality standard for alcohol and aromatic compounds. - Plan and goals to enhance fuel quality to Euro 5 standards by 2030 were set and efforts for quality improvement are underway. **[Management Subject]** • Mineral Resources and Petroleum Authority of Mongolia (MRPAM) - MRPAM is an agency under the Ministry of Mining and Heavy Industry responsible for petroleum analysis and quality inspection in Mongolia. It was established under the Ministry of Petroleum and Energy in 1968, and with the merger of the Mineral Resources Authority and Petroleum Authority in 2016, it was renamed the current name.

Details	
Details	**[Policy overview]** • In the short term, there is a need to identify the status of petroleum providers, introduce a quality inspection system for each fuel distribution stage, and construct a specialized laboratory that can test and analyze fuel for vehicles. In mid- and long-term, it is necessary to actively manage the distribution of vehicle fuels, identify fake petroleum products, strengthen the ability to analyze vehicle fuels, and improve the quality of vehicle fuels. • Recommendations for the short term - (Status of petroleum businesses) It is urgent to identify a list of petroleum business operators. - (Quality inspection of petroleum in circulation) Since it is not possible to inspect all imported motor fuel, the quality inspection of fuel in circulation or storage needs to be strengthened (manpower and budget). - (Testing and analysis of motor fuel) In order to clearly understand and maintain the quality of products being imported or in circulation, a testing facility should be installed to ensure that all items of fuel standards can be tested and analyzed (testing conditions, testing equipment and cultivation of professional manpower). • Recommendations for the mid and long term - (Vehicle fuel distribution control) To understand the distribution cycle of all petroleum products produced, imported and distributed in Mongolia, it is necessary to introduce reporting on petroleum demand and supply by petroleum businesses. - (Detection of fake petroleum products) It is necessary to introduce a system* that can detect fake products that contain materials that should not be mixed with motor fuel and to train professional manpower. * Detection system introduction, disclosure of gas stations selling illegal petroleum products, and quality certification program - (Testing and analysis capability) Since it is not possible to inspect all imported motor fuel, the quality inspection of fuel in circulation or storage needs to be strengthened (manpower and budget). - (Testing and analysis of motor fuel) It is necessary to install an experiment center to quickly test conformity with quality standards and to raise professional manpower. - (Revision of vehicle fuel quality standards) It is necessary to revise quality standards to Euro 5 standards by stages. **[Comparison of systems of Korea and Mongolia]** • Quality control system in Korea - (Domestic products) Motor fuel produced domestically must be inspected at production plants by a visiting inspection institution once a month or anytime if necessary. - (Imported products) All imported motor fuel must be inspected at a customs bonded area, and only those that pass can be distributed. - (Distribution) Petroleum businesses that distribute motor fuel (agents, filling stations, stores, etc.) must inspect and control fuel quality by themselves, and if products are not normal, an administrative measure will be imposed. • Difference in quality standards between Korea and Mongolia - (Gasoline) The standard on the sulfur content in Mongolia is higher (Mongolia: less than 500, Korea: less than 10) - (Diesel) The standard on the sulfur content in Mongolia is higher (Mongolia: less than 2,000, Korea: less than 10), and Mongolia does not have a standard for aromatic compound content (Korea: less than 5 vol%) • Specialized organizations related to motor fuel - (Korea Petroleum Quality & Distribution Authority) Uses a motor fuel distribution inspection system from production to end user consumption and operates an ISO certification center. - (Central Experiment Office of Mineral Resources and Petroleum Authority of Mongolia) There is personnel for quality control, but inspections have not been made properly and the experiment office does not have experiment equipment and manpower to check conformity with the quality standard, requiring improvement.

3.3.5 Introduction of Monitoring Management System

(1) Establishment of a master plan in the sector of air pollution monitoring network

General status	**[Literature research]** • Automatic monitoring stations installed in Ulaanbaatar are not insufficient considering the population of the capital city, but because most of them are installed in the inner city, monitoring results do not represent the ambient air quality of the entire city. • Although there is a system that discloses monitored air pollution data to the general public on a real-time basis, an improved system is needed for more efficient data management and use.
Institutional arrangement	• Most of the air pollution monitoring stations installed in Mongolia were installed with the support of ODA, and they did not follow Mongolian laws or regulations when installed. • The government has recently adopted regulations regarding the installation of air pollution monitoring stations, but regulations on operating them have not been enacted, and thus monitoring data is not fully reliable.
Details	**[Policy overview]** • Ambient air quality management begins with the identification of current ambient air quality. Mongolia needs a system to efficiently collect, store and apply data from existing monitoring stations and add new stations in Ger regions, thereby providing correct data to policymakers. • To increase the reliability of monitoring data, the consistent operation of monitoring stations is necessary, and laws and regulations need to be brought in. It is also necessary to strengthen quality control and quality assurance, and to train inspectors. Ambient air quality improvement requires an efficient management of sources of emissions, and to do this, an inventory system that calculates the amount of emissions by source is necessary. **[Details]** • For efficient ambient air quality monitoring, operators of the monitoring network must be listed, and a plan to install monitoring stations in areas not currently covered needs to be established. • To increase the reliability of monitoring data, it may be necessary to introduce an accuracy inspection and air pollutant analysis system. • The proposed method for managing air pollutant emissions calls for constructing a real-time monitoring system in large-scale emission facilities, and recording and managing the air pollutant inventory. **[Other recommendations]** • Air pollution monitoring network operation methods - It is suggested that monitoring stations should be classified by purpose of installation, and that stations whose operation is easy should be entrusted to local governments, while those whose operation is difficult should be managed by the Ministry of Environment and Tourism. - The Ministry of Environment and Tourism is responsible for the overall management of ambient air quality monitoring by enacting laws, regulations and guidelines regarding air pollution the monitoring network, and by developing ways of utilizing monitoring data. • It is suggested that to produce scientific and reliable ambient air quality monitoring data, an accuracy inspection system should be introduced. - Through regulations on the operation of the monitoring network, monitoring stations should be operated in a unified and consistent way, and to maintain the performance of monitoring devices, the accuracy of the equipment needs to be tested regularly. - To ensure that only monitoring equipment that passes Mongolian standards can be imported or manufactured, a performance inspection system needs to be introduced.

Details	• It is advisable to develop a hazardous air pollutant analysis system. - To deal with hazards caused by specific pollutants other than general air pollutants, a precision experiment facility is needed. • It is suggested that a real-time monitoring system (TMS) should be set up for large emission facilities. - By attaching a monitoring device to the stacks of coal-fired power plants, emissions can be measured on a real-time basis. • It is necessary to make an air pollutants inventory (including greenhouse gas emission inventory) - By establishing an emission inventory system, a list of sources of emission that require regulation can be prepared and used for developing related policies. • It is necessary to expand the ambient air quality monitoring network. - With modeling based on emissions and weather data of Ulaanbaatar, locations for installing more stations can be found.

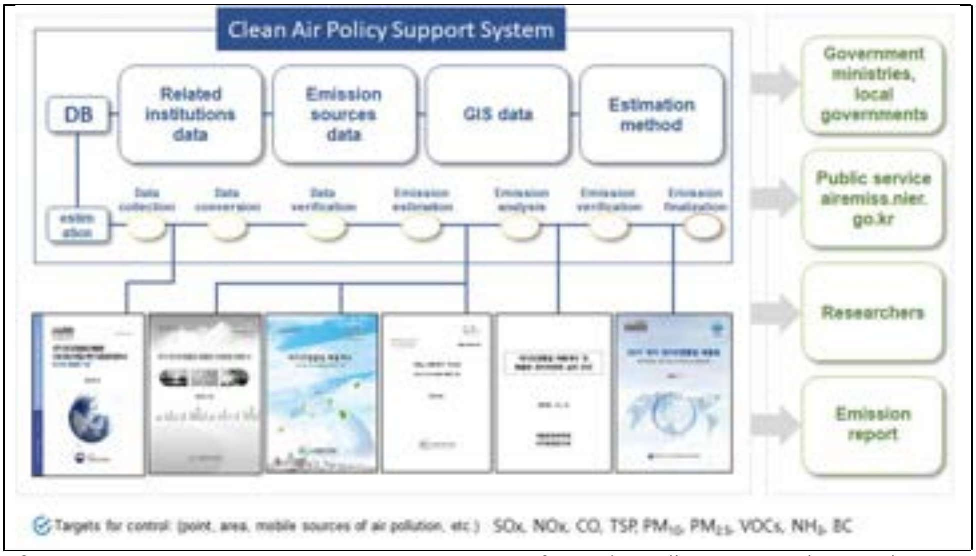
(2) Establishment of an air pollutant inventory system

General status	**[Literature research]** • Mongolia measured air pollutant emissions with the JICA project, but it seems that it has not continued to measure them each year. • To estimate emissions inventory, securing statistical data and emissions factors is important.
Institutional arrangement	• Most of the air pollution monitoring stations installed in Mongolia were installed with the support of ODA, and they did not follow Mongolian laws or regulations when installed. • The government has recently adopted regulations regarding the installation of air pollution monitoring stations, but regulations on operating them have not been enacted, and thus monitoring data is not fully reliable.

Details

[Policy overview]
- Introduction of the Clean Air Policy Support System (CAPSS) to control sources of air pollutants, which are a direct cause of air pollution.
- Korea uses CAPSS to estimate emissions from all sources of air pollution based on activity data and emissions factors.

[Figure 44] Overview of the CAPSS of Korea



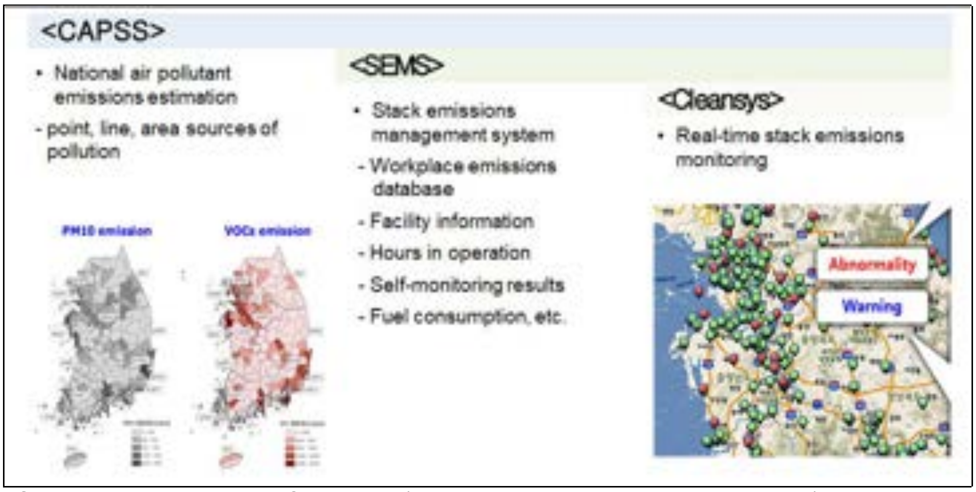
Source: National Air Emission Inventory and Research Center (https://www.air.go.kr/index.do)

Details

[Reference] Overview of CAPSS (CAPSS ⊃ SEMS ⊃ CleanSYS)

- To control stack emissions at workplaces, which account for a large amount of air pollutants, the Stack Emission Management System (SEMS) was installed and operated.
- CleanSYS was operated at the stacks at large workplaces among SEMS to measure emissions from the stacks of large workplaces on a real-time basis.

[Figure 45] Korea's emissions estimation system



Source: Korea Environment Corporation (reviewed and written by the research team)

- Use of emissions data: Used for establishing the government's air pollution control policy or assessment of policy results
- Measurement method: A stack tele-monitoring system is used, based on emissions factors.
* Emissions calculation formula: ∑[Emission factor × activity (fuel usage rate)×(1-control efficiency)]

- Essential elements for emissions estimation
  ① Classification of sources of emissions: Generally, sources of emissions include energy industry combustion, non-industry combustion, manufacturing industry combustion, production processes, energy transport and storage, use of organic solvents, on-road mobile sources of air pollution, off-road mobile sources of air pollution, waste disposal, natural sources of pollution, and agriculture. Each source can be subdivided. Therefore, the government needs to develop a classification system by considering realistic feasibility.

<Table 65>Examples of classification of sources of emission

Large category	Combustion of energy industry	Production process	On-road mobile sources of air pollution
Medium category	• Public power generation facilities • District heating facilities • Oil refining facilities • Private power plants	• Petroleum products • Steel products • Chemical products • Lumber, pulp products	• Passenger cars • Buses • Cargo trucks • Two-wheeled vehicles

Source: National Institute of Environmental Research, 2017 Air pollution Emissions (2019)

Details

② Selection of emission calculation method: Emission is calculated using the formula above. In the case of point pollutants with clear emission sources, since activity data is easily obtained, a bottom-up approach (the sum of emissions of individual workplaces) is used. For area sources of air pollution such as residential places, since activity data is not easy to collect, a top-down approach that relies on the activity data of the entire region is used.

③ Activity data: Because it is important to obtain data by source of emission, a emissions classification system needs to be based on the possibility of obtaining activity data. Activity data includes coal consumption, product production, raw material inputs, number of registered vehicles, distance of travel, efficiency of emission prevention facilities, and the number of fires.

④ Emissions factor: Emissions factor refers to the amount of emissions generated per unit of activity, and for calculation of the precise emission amount, it is recommended to develop an emissions factor for the country, but emission factors of advanced countries can be used as well.

- Considerations for establishment of an air pollutant inventory system
  The guidelines for the calculation of greenhouse gas emissions consist of five principles, which can also be applied to calculate air pollutant emissions.

<Table 66> Principles of air pollutant emissions inventory

Principles	Main contents
Transparency	Assumptions and methods to develop emissions inventory should be clearly explained so that users of the reported inventory can easily apply or assess it.
Consistency	The emissions inventory should be internally consistent in all of its components for a long period of time.
Comparability	The estimated emission quantity of inventory of a country needs to be able to be compared with those of other countries.
Completeness	The emissions inventory should be reported for all sources of emissions, and if there are omissions, reasons for it should be clearly provided.
Accuracy	The emissions inventory should not be overestimated or underestimated.

[Other recommendations]

- To estimate air pollutant emission quantity on a country level, principles that are prioritized need to be set and applied preferentially. Transparency, completeness and accuracy are recommended as the most important principles.

① The emission source survey should be provided for under laws.
- Correct data submission by workplaces is essential. Laws and regulations mandating workplaces to submit correct emission quantity data by a certain reporting frequency, and the imposition of penalties for violators is necessary.
- Major emission source information includes activity data provided by the government, businesses, specialists, and citizens, statistical data, GIS data for the production of regional emissions maps, and grid maps. They can be linked to statistical systems of Mongolia (statistics on automobiles, city gas consumption, coals, etc.).

② The classification system of major emission sources should be detailed, complete, and standardized.
- If any source of emission is omitted, the reliability of data is reduced. All sources of emissions under the classification system should be included in an inventory system.

③ Upon completion of classification of emission sources, it is necessary to determine emission factors for each source.
- Emissions factors may be developed, or the emissions factors of advanced countries can be modified to reflect the reality of the country.

④ Use of consistent and sustainable methods
- Since emission quantity estimation is not a short-term project but a continuous one made every year, a consistent and sustainable method should be applied. All activities of emission quantity calculation need to be documented so that officials in charge can easily access them, and since the calculation method may be modified, the emission quantity calculation procedure should be transparent.

Details	⑤ Enhancement of inventory reliability through systematic management - The emission quantity estimation process is relatively simple, but securing and verifying activity data and emissions factors requires a lot of labor, budget and time. Therefore, it is necessary to designate a dedicated department and systematize the emission calculation process to increase inventory reliability.

(3) Establishment of a hazardous air pollutant analysis system

General status

[Literature research]

- With regard to hazardous air pollutants (HAPs) monitoring in Mongolia, data on polycyclic aromatic hydrocarbons (PAHs) cannot be collected continuously due to the lack of a monitoring network. Therefore, an investigation based on the literature found that the level of HAPs in Mongolia was serious.

> **Reference: Hazardous Air Pollutants (HAPs)**
> - Definition: HAPs that pose significant risks to human health and the growth of animals and plants directly or indirectly include PAHs and VOCs, and their major emission sources are exhaust gas from motor vehicles and thermal power plants.
> - PAHs: PAHs are composed of multiple aromatic rings and emitted in all combustion processes, and even a small amount of PAHs can cause cancer. PAHs induce mutations and are emitted in all combustion processes.
> - VOCs refer to organic compounds in fluids or gases that are easily evaporated due to a low boiling point. VOCs are industrial solvents or organic gases emitted from chemical and pharmaceutical or plastic drying processes, such as liquid fuel, paraffin, olefin and aromatic compounds.
> - A small amount of HAPs causes a fatal health risk, and their emission sources should be clearly identified and proper control measures are necessary. To identify the sources of HAPs, an analysis system needs to be set up to examine their ingredients.

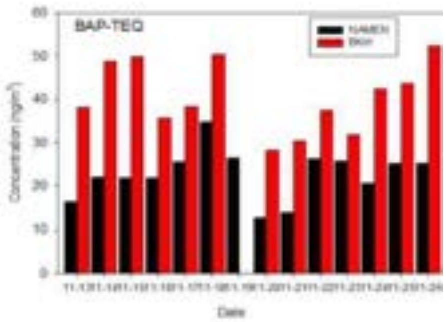
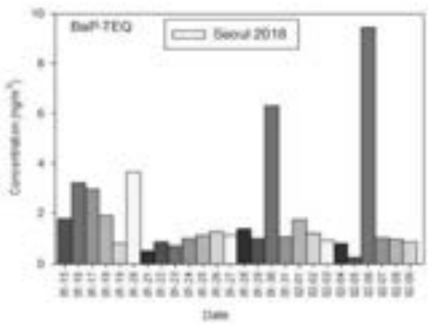
- The average PAHs measured by the National Agency Meteorology and the Environmental Monitoring (NAMEM) and Bayankhoshuu (BKH) stood at 280±110 ng/㎥ and 484±179 ng/㎥ respectively, which are very high levels. Compared with the level of Seoul (16.1±10 ng/㎥), the PAHs concentration in Mongolia is serious.

<Table 67> BaP-TEQ comparison between Mongolia and Seoul

	PM2.5 concentration (mg/)	PAHs concentrations (ng/m^3)	BaP-TEQ (ng/m^3)	Normalized toxicity by PM2.5 concentration (ng/ug)
NAMEM	81.4±34.7	280±110	22.7±5.74	0.33±0.15
BKH	147±75.1(210±107)	484±179	40.5±8.06	0.41±0.49(0.29±0.35)
Seoul	30.1±20.9	16.1±10.0	1.86±1.99	0.04±0.05

※ BaP-TEQ, expressed in toxic equivalency quotient (TEQ) is shown in the figures below.

General status

[Figure 46] BaP-TEQ of Mongolia	[Figure 47] BaP-TEQ of Seoul
	

※ Monitoring location of Mongolia
- Bayankhoshuu (BKh): subcenter of Ulaanbaatar city, residential Ger region using stoves
- NAMEM: Center of Ulaanbaatar city

• The figures above show that PAHs in Mongolia were 17 to 30 times as much as that of Seoul, and BaP-TEQ in Mongolia was 10 times as much as that of Seoul.
* Sampling for monitoring was made at the same time in November 2017.

Institutional arrangement

[Laws] None

• Currently, the ambient air quality related laws of Mongolia do not provide for regulations on the control of HAPs.

[Standards] MNS5885:2008, MNS6063:2010

• Permissible air pollution emission level (MNS5885:2008)
• Permissible air pollution emission level in urban areas (MNS 6063:2010)

Details

[Policy overview]

• It is a system that analyzes hazardous air pollutants for its management. For Korea, Article 38 (2) of the Ambient Clean Air Conservation Act, defines HAPs, which are controlled with more intensity than other air pollutants.

[Details]

■ PAHs (Polycyclic Aromatic Hydrocarbons)

• Major emission sources: PAHs are emitted in all combustion processes, mostly from artificial sources. PAHs are generated from the incomplete combustion of organic materials such as coal, oil, gas, and waste, and can easily be found in all human living environments.
• Sampling method: A quartz filter is used for PAHs in particles, while polyurethane form (PUF) or XAD-2 resin is used for PAHs in gases. For analysis, Gas Chromatography (GC) and Mass Spectrometry (MS) are used. A list of PAHs that can be analyzed is as follows.

Acenaphthene	Benzo(e)pyrene	Coronene	Naphthalene
Acenaphthylene	Benzo(b)fluoranthene	Dibenz(a,h)anthracene	Phenanthrene
Anthracene	Benzo(k)fluoranthene	Fluoranthene	Pyrene
Benz(a)anthracene	Benzo(g,h,i)perylene	Fluorene	Perylene
Benzo(a)pyrene	Chrysene	Indeno(1,2,3-c,d)pyrene	

• Equipment: GC/MS detectors, thickener, extractor, oven, and hood for preprocessing of sample

Details

■ **VOCs (Volatile Organic Compounds)**

- Definition: VOCs produce photochemical oxidants such as ozone through photochemical reaction with NOx in the air, causing photochemical smog. VOCs also generate benzene, a carcinogen that poses a significant health hazard.
- Sampling method: Samples are put into absorbent tubes filled with an absorbent. After thermal desorption, it is thickened and goes through two-stage thermal desorption in a low-temperature thickening tube. Substances for analysis are separated by gas chromatography using high-resolution capillary column and measured by MSD or FID. Sixteen kinds of VOCs are as follows.

Benzene	Styrene	TriChloroethylene	1,3-Butadiene
Toluene	o-Xylene	Tetrachloroethylene	Methylenechloride
Ethylbenzene	Chloroform	1,1-Dichloroethane	Vinylchloride
m,p-Xylene	MethylChloroform	Carbon tetrachloride	1,2-Dichloroethane

■ **Acid precipitation**

- Definition: Acid precipitation is an item considered important in Mongolia and one of the monitoring items of the Mongolian Central Laboratory for Environmental Monitoring (CLEM). Here are elements necessary to organize an acid precipitation monitoring network.
- Monitoring method: Based on EPA method 1631, Revision E (2002), regarding mercury monitoring in precipitation, mercury in rainfall can be measured using a cold vapor atomic fluorescence spectrometer (CVAFS) through oxidation, oxidation, absorption, and thermal desorption processes.
- Negative ions (SO42-, NO3-, Cl-) contained in acid precipitation are analyzed using ion chromatography.
- Positive ions (NH4+, Na+, Ca2+, Mg2+) contained in acid precipitation are analyzed using atomic absorption spectrochemical analysis or ion chromatography.

<Table 68> Components of acid precipitation monitoring network

<table>
<tr><th colspan="4">Item</th><th>Monitoring items</th></tr>
<tr><td rowspan="3">Pollutants</td><td rowspan="2">Dry</td><td>Gaseous</td><td>Manual</td><td>HNO3, NH3</td></tr>
<tr><td>Particulate</td><td>Manual</td><td>Mass concentration of ultra-fine PM (PM-2.5), ion in ultra-fine PM (PM-2.5)
(SO42-, NO3-, Cl-, K+, NH4+, Na+, Ca2+, Mg2+)</td></tr>
<tr><td>Wet</td><td>Liquefied</td><td>Manual</td><td>pH, conductivity, ionic concentration of rainfall or snow
(SO42-, NO3-, Cl-, K+, NH4+, Na+, Ca2+, Mg2+)</td></tr>
<tr><td colspan="2" rowspan="2">Mercury</td><td colspan="2">Automatic</td><td>Total gaseous mercury, atmospheric mercury species</td></tr>
<tr><td colspan="2">Manual</td><td>Wet deposition of mercury</td></tr>
</table>

Details

■ **Analysis of PM ingredients**

- Ultra-fine PM is directly emitted from various sources (primary aerosols), or through chemical reactions where gases in ambient air are converted into particles (secondary aerosols).
- Ultra fine PM consists of ion, organic carbon, elemental carbon, and various minerals (element components).

<Table 69> Analysis items in ultra-fine PM and analysis devices

Analysis item	Target material	Analysis method
PM weight	Weight	Weight concentration using microbalance
Carbon ingredients	Organic carbon (OC) compounds and elemental carbon (EC)	OC, EC analyzers
Negative ions	SO42-, NO3-, Cl-	IC
Positive ions	K+, NH4+, Na+, Ca2+, Mg2+	IC, ICP-OES
Metal ingredients	Element components	XRF, ICP-OES

Part 1 Establishment of the Environmental Improvement Plan

Chapter 4 Status of the Project Target Area

Chapter 4 Status of the Project Target Area

4.1 General Status of Ulaanbaatar City

4.1.1 General Status

Ulaanbaatar City is the capital of Mongolia, and its area is 4704.1km^2, and located at 47 degrees 55 minutes north latitude and 106 degrees 53 minutes east longitude. The topography is a meadow plateau with an average height of 1,350m and has a continental climate with a large annual temperature difference between summer and winter.

<Table 70> Status of Ulaanbaatar

Item	Details
Area	• 4,704.1㎢ (about 4.7 times that of Incheon), located 47 degrees 55 minutes north latitude and 106 degrees 53 minutes east longitude • Formed a 3,485km border with Russia to the north and a 4,676.9km border with China to the south
Altitude	• 1,350m (the meadow plateau, TsetseeGun Mountain 2,257m)
Climate	• Continental climate with a wide annual temperature range of 35℃ in summer and -39.5℃ in winter
Monthly average temperature	• -24.3℃ (recorded minimum temperature -48℃) in January and 16.6℃ (recorded maximum temperature 39℃) in July, and the coldest area among the world's capital cities • Severe changes in weather in May and June and sometimes, severe gusts • Summer is short and hot, and the temperature rises to 36℃, but the humidity is not high, and therefore, the sensory temperature is low and ultraviolet rays are very strong. 257 days of the year without clouds
Annual precipitation	• Low at 350mm

Source: Blog of the Korea Meteorological Administration, Incheon Metropolitan City webpage (https://www.incheon.go.kr/IC040513) (reviewed and written by the research team)

4.1.2 Status of Administrative Districts

Ulaanbaatar City is divided into nine administrative districts, each of which consists of a minimum of two khoroo to a maximum of 43 khoroo. Regions with the largest population by administrative district are Bayanzurkh and Songinokharkhan, and the former is 367,679 and the 335,703 (as of January 1, 2021), and it was found that the gender ratio of each district is almost even.

<Table 71> Status of Ulaanbaatar administrative districts

Name of district	Status of district		Population (as of January 1, 2021)		
	khoroo (number) *Equivalent to Korea's Dong	Area (ha)	Total population (person)	Male (person)	Female (person)
BAGANUUR	5	60,355	29,342	14,399	14,943
BAGAKHANGAI	2	15,497	4,463	2,278	2,185
BAYANGOL	25	2,506	231,517	109,083	122,434
BAYANZURKH	28	122,665	367,679	177,701	189,978
NALAIKH	8	69,126	38,690	19,104	19,586
SONGINOKHARKHAN	43	120,370	335,703	165,542	170,161
SUKHBAATAR	20	21,559	144,616	69,567	75,049
KHAN-UUL	21	50,352	195,927	93,486	102,441
CHINGELTEI	19	9,143	151,203	73,570	77,633

Source: Ulaanbaatar City webpage (www.ulaanbaatar.mn) (reviewed and written by the research team)

4.1.3 Status of Industry

The market volume of Ulaanbaatar City steadily increased at a rate of 10.5% over the past five years (from 2015 to 2019). As of 2019, the agricultural sector accounted for 0.3% of the gross domestic product (GDP) in Ulaanbaatar City, the industrial sector accounted for 41%, and the service sector accounted for 58%. Mining accounts for more than half of the industrial sector with manufacturing also accounting for a large proportion.

<Table 72> Status of main industries in Ulaanbaatar (unit: MNT)

Industry sector	2015	2016	2017	2018	2019
Gross Domestic Product (Market price)	14,964,718.7	15,703,079.4	18,105,283.4	21,509,825.1	24,683,663.7
Agriculture	**96,930.4**	**82,868.6**	**56,845.1**	**78,733.4**	**66,825.04**
Crops	22,983.2	11,175.7	9,299.3	14,364	15,247.25
Livestock	40,585.7	36,567.7	29,939.5	46,510.3	48,135.97
Other agricultures	33,361.4	35,125.2	17,606.3	17,859	3,441.82
Industrial	**5,066,531.7**	**5,654,367.3**	**7,195,663.5**	**8,981,754.1**	**10,199,132.18**
Mining	2,501,823.7	3,108,830.7	3,864,855.4	5,126,566.4	5,725,040.66
Manufacturing	1,234,999.3	1,163,711.2	1,786,918.4	2,069,946.5	2,483,238.98
Electricity, gas, and water business	378,106.7	465,347.1	492,582	567,488.5	653,651.6
Construction industry	951,602	916,478.2	1,051,307.6	1,217,752.7	1,337,200.94
Service industry	**9,801,256.6**	**9,965,843.5**	**10,852,774.8**	**12,449,337.6**	**14,417,706.48**
Wholesale and retail and lodging food business	3,538,042.4	3,666,205.1	4,183,006.9	5,121,820.2	5,953,754.19
Transportation and information and communication business	1,560,866.7	1,585,291.9	1,710,676.3	1,898,169.7	2,069,783.19
Financial and business service industries	3,073,857.5	3,048,661.6	3,180,913.9	3,519,158.9	4,057,478.16
Other service industries	1,628,490	1,665,684.9	1,778,177.8	1,910,188.7	2,336,690.94

Source: The National Statistical Office of Mongolia (www.1212.mn) (reviewed and written by the research team)

4.1.4 Economic Status

The economic status of the past five years from 2015 to 2019 in Ulaanbaatar, Mongolia, was investigated through economic indicators such as gross domestic product (GDP), GDP per capita, and average household income.

<Table 73> Five-year economic indicators in Ulaanbaatar

Item	2015	2016	2017	2018	2019
Gross Domestic Product (GDP) (unit: hundred million MNT)	14,965	15,703	18,105.3	21,510	24,684
GDP per capita (gross domestic product) (unit: thousand MNT)	11,252	11,520	12,940.7	15,031	16,960
Changes in the annual consumer price index (unit: %)	1.1	0.5	7.2	9.7	5.0
USD average exchange rate of MNT (unit: MNT)	1,970	2,146	2,440	2,472	2,664
Budget in Ulaanbaatar City (unit: hundred million MNT)	846.7	870.6	1,070.2	1,249.5	1,381.5
Budget usage status in Ulaanbaatar City (unit: hundred million MNT)	883.8	1,025.8	1,075.1	1,282.4	1,447.5
Average monthly household income (unit: MNT)	1,169,820	1,073,118	1,188,933	1,368,251	1,510,926
Average monthly household expenditure (unit: MNT)	1,097,901	1,034,986	1,188,837	1,377,888	1,525,282

Source: Ulaanbaatar City webpage (www.ulaanbaatar.mn) (reviewed and written by the research team)

4.1.5 Social Status

<Table 74> Five-year social indicators in Ulaanbaatar

Item	Unit	2015	2016	2017	2018	2019
Resident population	thousand persons	1,345.5	1,380.8	1,417.4	1,444.7	1,466.1
0-15 year old population	thousand persons	417.2	423.2	440.9	470.0	492.6
16-35 year old population	thousand persons	458.8	464.1	460.6	444.8	457.1
Number of deaths	thousand persons	7.2	7.3	7.6	7.6	7.8
Numbers of births	thousand persons	42.8	39.1	34.4	35.3	35.5
Moving-in population	thousand persons	30.3	25.2	10.3	6.6	12.6
Moving-out population	thousand persons	11.7	14.3	11.4	6.3	6.6
Number of marriages	number	8,263	8,288	10,399	10,890	10,721
Number of divorces	number	2,515	2,630	2,448	2528	2,713
Total number of households	thousand (household)	376.4	380.8	386.2	387.5	411.4
Working-age population	thousand persons	494.1	511.5	553.6	555.3	529.5
Unemployment	thousand persons	12.6	12.0	7.0	8.3	6.7
Poverty range	%	-	24.8	-	25.9	-
Average life span	year	71.79	71.47	71.51	71.65	71.8
People with infectious diseases	number	40,461	40,178	26,555	24,056	26,447
Maternal deaths	person	12	17	12	12	10
Number of infant deaths	number	613	611	489	555	531
Number of crimes	case	17,939	17,909	21,947	25,652	20,261

Source: Ulaanbaatar City webpage (www.ulaanbaatar.mn) (reviewed and written by the research team)

(1) Population density

The population density in Ulaanbaatar steadily increased from 2015 to 2019, and the compound annual growth rate (CAGR) was 2% and the population density in 2019 was 327.6 people/㎢. It was found that there is about a 300 times difference between the population density in Ulaanbaatar and that of other regions.

<Table 75> Population density of Ulaanbaatar and other regions (unit: people/km^2)

Region	2015	2016	2017	2018	2019
Western region	0.9	0.9	1.0	1.0	1.0
Khangai region	1.5	1.5	1.5	1.6	1.6
Central region	1.0	1.0	1.1	1.1	1.1
Eastern region	0.7	0.7	0.8	0.8	0.8
Ulaanbaatar	297.1	306.5	311.3	317.3	327.6

Source: The National Statistical Office of Mongolia (www.1212.mn) (reviewed and written by the research team)

(2) Education

As of 2020, among the population in Ulaanbaatar aged 10 or older, the uneducated population accounted for 4.1%, while the rate of high school students was 32.7% and the rate of those attending university was 36.3%.

<Table 76> Education level of population in Ulaanbaatar aged 10 or older (as of 2020) (unit: number)

Item	Population in Ulaanbaatar aged 10 or older	Uneducated population	Elementary school	Middle school	High school	Technical school	Special school	University
Population	1,094,470	45,176	100,198	102,607	357,647	32,574	58,523	397,745

Source: The National Statistical Office of Mongolia (www.1212.mn) (reviewed and written by the research team)

4.1.6 Status of Infrastructure Construction

(1) Power plant

In the UB City, it was investigated that there are six locations—three combined heat and power plants (CHPs) and three thermal heat generation plants, and the power generation capacity of the TES-4 power plant is the largest at 700 MW.

<Table 77> Status of the combined heat and power plants and the heat generation plant of Mongolia

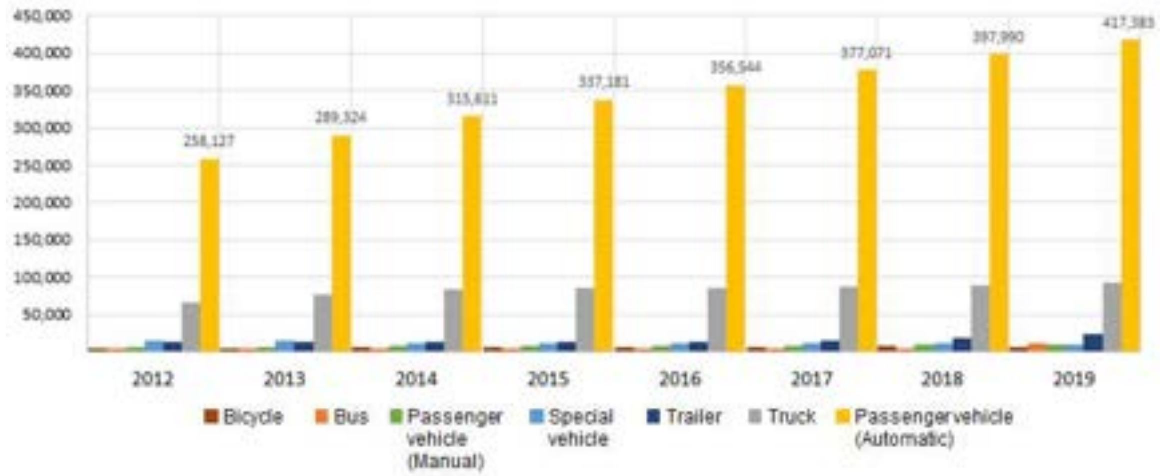
No	Item	Power plant	Established year	Location	Capacity (MW)
1	**Thermal combined heat and power plant (CHP)**	**UB TES-2 (Second power plant)**	**1961**	**Ulaanbaatar**	**21.5**
2	**Thermal combined heat and power plant (CHP)**	**UB TES-3 (Third power plant)**	**1968**	**Ulaanbaatar**	**198**
3	**Thermal combined heat and power plant (CHP)**	**UB TES-4 (Fourth power plant)**	**1983**	**Ulaanbaatar**	**700**
4	Thermal combined heat and power plant (CHP)	DARKHAN (Darkhan Power Plant)	1965	Darkhan	48
5	Thermal combined heat and power plant (CHP)	ERDENET (Erdenet Power Plant)	1987	Erdenet	28,8
6	Thermal combined heat and power plant (CHP)	DORNOD TPP (CHOIBALSAN) (Dornod Power Plant)	1970	Dornod	36
7	Thermal combined heat and power plant (CHP)	DALANZADGAD (Dalanzadgad Power Plant)	2000	Umnugovi, Dalanzadgad	6
8	Thermal combined heat and power plant (CHP)	ERDENET MINING CORPORATION (Erdenet Power Plant)	1976	Erdenet	53
9	Power plant (PP)	UKHAA KHUDAG (MCS-Coal Mine) (Power Plant)	2011	Umnugovi, Tsogttsetsii	18
10	**Thermal heat generation plant**	**BAGANUUR**	**1980**	**Ulaanbaatar, Baganuurduureg**	**-**
11	**Thermal heat generation plant**	**AMGALAN**	**2016**	**Ulaanbaatar, Bayanzurkhduureg**	**348**
12	**Thermal heat generation plant**	**NALAIKH**	**1976**	**Ulaanbaatar, Nalaikhduureg**	**-**
13	Thermal heat generation plant	DULAAN SHARIINGOL	1964	Darkhan, Shariingol	-
14	Thermal heat generation plant	Khuvsgul	-	-	-
15	Thermal heat generation plant	Khovd	-	-	-

Source: Ministry of Energy of Mongolia (https://energy.gov.mn) (as of November 2020, reviewed and written by the Research team)

(2) Status of vehicles

The number of registered vehicles in Ulaanbaatar continues to increase from about 360,000 in 2012 to about 570,000 in 2019 (Compound Annual Growth Rate (CAGR): 5.6%), and the number of passenger cars is the highest.

[Figure 48] Registration status by vehicle type in Ulaanbaatar from 2012 to 2019 (unit: ea)



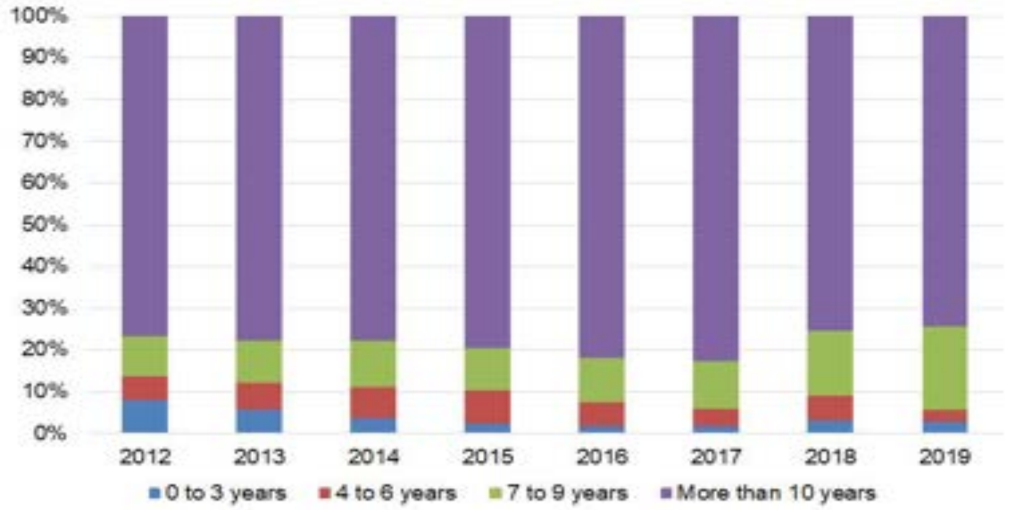
<Table 78> Registration status by vehicle type in Ulaanbaatar from 2012 to 2019 (unit: ea)

Type	2012	2013	2014	2015	2016	2017	2018	2019
Bus	4,297	4,570	4,784	4,928	5,055	4,942	4,482	11,021
Truck	66,792	76,319	84,388	85,208	85,481	87,098	88,710	91,670
Passenger vehicle (Automatic)	258,127	289,324	315,611	337,181	356,544	377,071	397,990	417,383
Special vehicle	15,295	14,877	12,084	11,812	11,952	11,903	10,752	9,984
Passenger vehicle (Manual)	6,007	6,878	7,418	7,748	8,200	8,599	9,410	10,120
Trailer	13,374	13,783	14,093	13,835	13,947	15,459	18,734	22,959
Motorcycle	3,922	4,765	5,415	5,971	6,349	6,935	7,594	5,729
Total	367,814	410,516	443,793	466,683	487,528	512,007	537,672	568,866

Source: The National Statistical Office of Mongolia (http://www.1212.mn/) (reviewed and written by the research team)

Among registered vehicles, it was found that vehicles more than 10 years old accounted for 74.4% and vehicles between 7 to 9 years old accounted for 19.8%. Therefore, most of the vehicles operating in Ulaanbaatar are more than 7 years old.

[Figure 49] Proportion by vehicle age in Ulaanbaatar from 2012 to 2019 (unit: ea)



<Table 79> Vehicle age status in Ulaanbaatar from 2012 to 2019 (unit: ea)

Vehicle age	2012	2013	2014	2015	2016	2017	2018	2019
0 to 3 years	29,701	23,838	15,836	10,933	8,459	8,882	16,082	16,408
4 to 6 years	20,873	26,213	33,246	37,212	28,303	21,991	32,717	16,507
7 to 9 years	35,659	41,837	49,351	47,798	52,030	57,566	83,910	112,788
More than 10 years	281,581	318,628	345,360	370,740	398,736	423,568	404,963	423,169

Source: The National Statistical Office of Mongolia (http://www.1212.mn/) (reviewed and written by the research team)

According to a transportation report published in 2018, a fuel inspection was conducted on about 400,000 vehicles of registered ones in Ulaanbaatar in 2018. The results showed that gasoline vehicles accounted for 42.7%, diesel vehicles 25.2%, flex fuel vehicles 28.6%, and gas vehicles 3.5%.

<Table 80> The number of registered vehicles in Ulaanbaatar by fuel from 2017 to 2018 (unit: ea)

Classification	Passenger vehicle		Truck		Bus		Special vehicle		Total number	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Gasoline	157,049	163,647	4,503	5,463	1,677	1,923	380	392	163,609	171,525
Diesel	17,946	17,993	61,998	69,237	7,984	8,098	5,520	5,938	93,448	101,266
Flex fuel	93,730	114,656	405	232	135	101	63	15	94,333	115,004
Gas	13,457	13,516	793	324	128	179	51	11	14,429	14,030
Total	282,182	309,812	67,699	75,256	9,924	10,301	6,014	6,356	365,819	401,725

Source: Statistics Department of Ulaanbaatar, 2018 traffic report, 2019(reviewed and written by the research team)

(3) Status of road

The length of roads in Ulaanbaatar has increased yearly, and it was 1,135 kilometers as of 2019.

<Table 81> Length of roads in Ulaanbaatar by year (unit: km)

Year	2015	2016	2017	2018	2019
Length of roads	644.1	1,080.0	1,093.7	1,102.4	1,135.6

Source: Ulaanbaatar City webpage (www.ulaanbaatar.mn) (reviewed and written by the research team)

4.2 Status of Ambient Air Quality Management

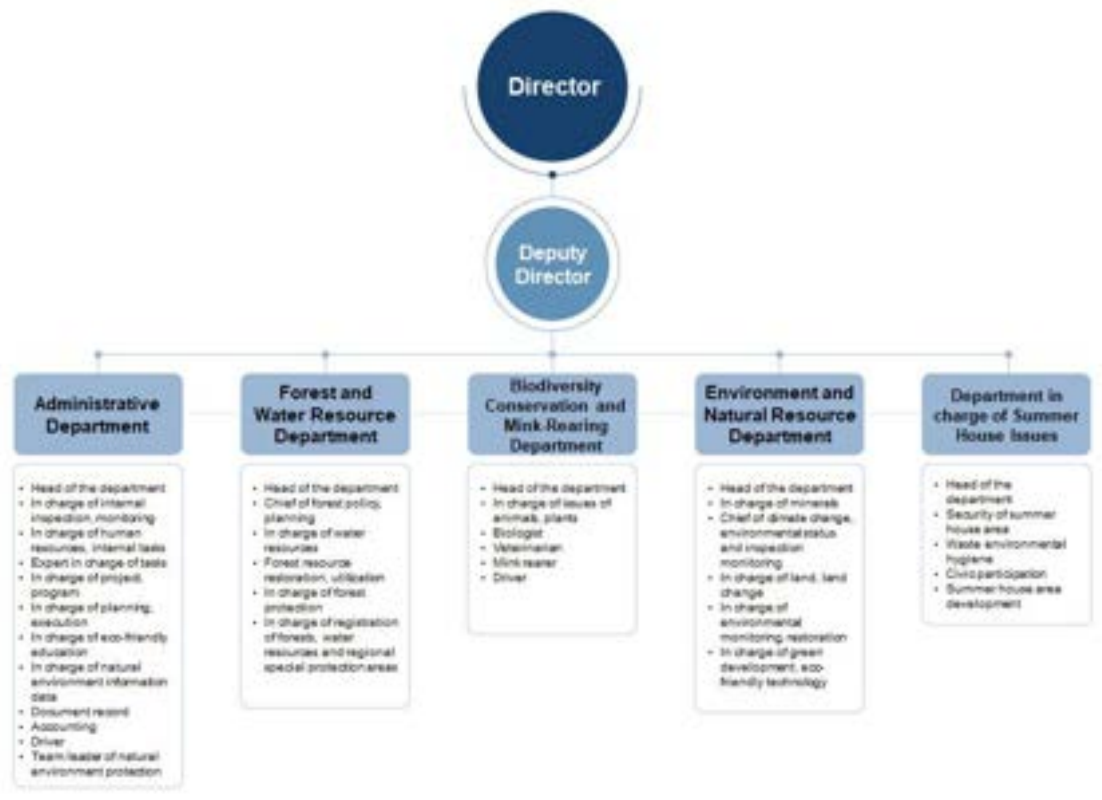
4.2.1 Air Quality Management Governance

(1) Ulaanbaatar City Environmental Department

The Ulaanbaatar City Environmental Department is an agency that is in charge of the management of agencies under the Department, environmental projects, and pollution. In 1924, it was established as the forest agency in Ulaanbaatar City, and was renamed to the Ulaanbaatar City Environmental Department from 2016. Currently, it is in charge of the environment of the Ulaanbaatar City, green development policies and projects, rational use of natural resources, and management of green area summer houses.

Now, the Ulaanbaatar City Environmental Department consists of the Administrative Department, Forest and Water Resource Department, Biodiversity Conservation and Mink-Rearing Department, Environment and Natural Resource Department, Department in charge of Summer House Issues, and so on. The department conducts work such as business and project management, eco-friendly education, forest policy, biodiversity conservation, climate change, monitoring and restoring of the environment, and water resource management.

[Figure 50] Organization chart of Ulaanbaatar City Environmental Department

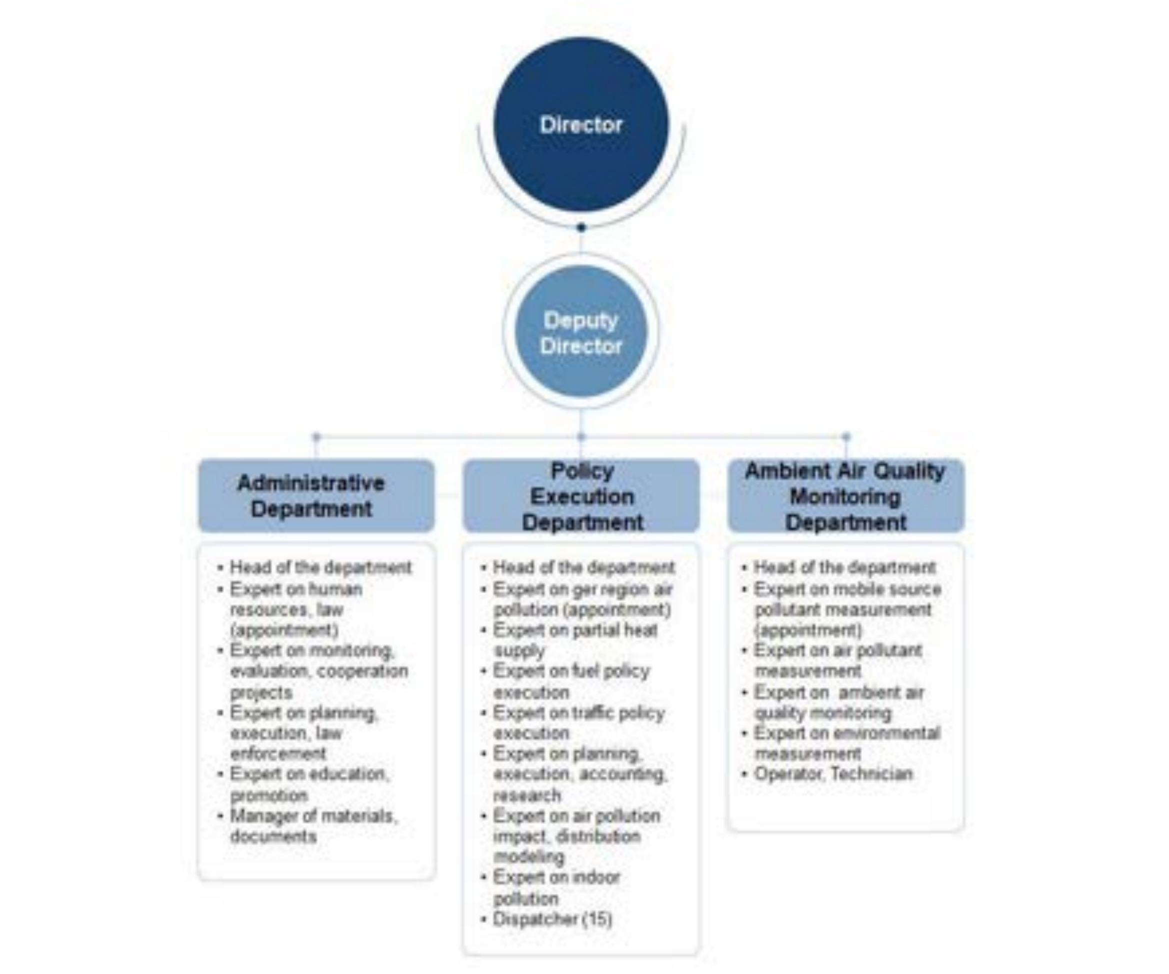


Source: Ulaanbaatar City Environmental Department webpage (www.environment.ub.gov.mn) (reviewed and written by the research team)

(2) Ulaanbaatar City Air Pollution Reduction Department (APRD)

The Ulaanbaatar City Air Pollution Reduction Department was established in 2006 as the ambient air quality agency of the Ulaanbaatar City Environmental Protection Department and renamed to the Ulaanbaatar City Air Pollution Reduction Department, that is, APRD, in 2019. The APRD consists of the Administrative Department, Policy Execution Department, and Ambient Air Quality Monitoring Department, and is carrying out the works such as ambient air quality measurement, monitoring, analysis, ambient air quality information provision, execution of policies approved for reducing the air pollution, and air protection-related regulations, rules, programs, and standards development.

[Figure 51] Organization chart of APRD



Source: APRD webpage (http://APRD.ub.gov.mn/) (reviewed and written by the research team)

(3) Ulaanbaatar Mayor's Office

The Ulaanbaatar Mayor's Office consists of six departments, of which the urban engineering facility department is in charge of the establishment of policies and plans in road and bridge construction, heat supply, water supply and sewage, and drainage facilities in Ulaanbaatar City. Further, it is in charge of the works such as HOBs, heaters, generators, and heat supply.

[Figure 52] Organization chart of Ulaanbaatar Mayor’s Office

Source: Ulaanbaatar Mayor’s Office webpage (http://www.ubservice.mn/) (reviewed and written by the research team)

(4) Inspection Agency of the Capital City (IACC)

The Inspection Agency of the Capital City (IACC) is a specialized inspection agency for law, environment, and sustainable development in the UB City. The IACC has 10 goals, of which Goal 3 focuses on environmental pollution such as air, water, and soil.

<Table 82> 10 goals of IACC

Item	Contents
Goal 1	Reduce accidents related to infrastructure and mines
Goal 2	Promote the mining industry to advance again
Goal 3	Decrease (environmental) pollution of air, water, and soil
Goal 4	Guarantee quality and security of construction, energy, and road traffic service
Goal 5	Guarantee hygiene, quality, and safety of food ingredients and products
Goal 6	Ensure the safety of children
Goal 7	Guarantee quality and safety of medical supplies
Goal 8	Guarantee quality and safety of medical care and service
Goal 9	Prevent radiation exposure
Goal 10	Guarantee the safety of export and import products and prevent epidemics through the border

Source: IACC webpage (http://inspection.gov.mn/new/ulaanbaatar/) (reviewed and written by the research team)

The Inspection Agency of the Capital City consists of a total of eight departments, and among them, there is the Ambient Air Quality Inspection Department, which solely examines ambient air quality.

[Figure 53] Organization chart of IACC

Source: IACC webpage (http://inspection.gov.mn/) (reviewed and written by the research team)

The Ambient Air Quality Inspection Department in IACC is believed to conduct the following tasks: examining whether agents (individuals, companies, vehicles, etc.) that discharge air pollutants follow regulations, and checking overall things such as heater operation, fuel quality, and activities to reduce the pollutants that vehicles emit.

[Figure 54] Organization chart of the Ambient Air Quality Inspection Department in IACC

Source: IACC webpage (http://inspection.gov.mn/) (reviewed and written by the research team)

4.2.2 Status of the Ambient Air Quality Management Strategy Goals and Implementations

(1) Status of establishment of Ulaanbaatar City's master plan to reduce air pollution

On June 28, 2018, the Ulaanbaatar City's master plan to reduce air pollution was passed through a resolution by the Ulaanbaatar City Council. The mayor of Ulaanbaatar City is in charge of the implementation of the master plan, and the chairperson of the Ulaanbaatar City Council is in charge of implementation monitoring.

The implementation phase of Ulaanbaatar City's master plan to reduce air pollution is divided into two phases, first is from 2018 to 2019, and the second is from 2020 to 2025. The master plan specifies policy directions, specific policy content, performance, standards and implementing agencies, and joint enforcement agencies at each stage to achieve 5 goals that are identical with the NPRAEP.

<Table 83> Goals of the first phase (2018-2019) of Ulaanbaatar City's master plan to reduce air pollution

Goal	Policy direction
1	**Goal: Establishment of policies for urban planning, construction and infrastructure development, population dispersion, and improvement of ambient air quality**
	① Minimize the increase of population in the Ger regions by controlling population movement to the capital city and prevent the rise in the number of stacks
	② Establish a legal environment for population movement and redevelopment
	③ Demolish HOBs and connect consumers to central or local engineering systems in stages
	④ Prepare an environment that helps consumers in the Ger regions to use electric heaters
	⑤ Establish infrastructure for building houses in the Ger regions with the "inexpensive apartment" project, revitalize apartment purchases, support long-term loans at low interest rates for young people and low-income groups
	⑥ Connect consumers who cannot use central infrastructure systems to local engineering systems, set up sub-centers, develop renewable energy technology
	⑦ Construct green environment for redevelopment areas and establish small parks in the Ger regions, comply with the standard of the Ulaanbaatar City plan by expanding green area per person
	⑧ Connect the land use plan through measures for activating redevelopment in the Ger regions, and build engineering infrastructure and systems by establishing small sub-centers
2	**Goal: Reduction of pollutant sources through the application of eco-friendly and advanced technology, phased prohibition of coal briquettes, and reduction of pollutants emissions**
	① Provide households in the Ger regions with improved fuel and minimize raw coal use by supporting improved fuel manufacturers
	② Prepare and implement legal regulations to support the production of building materials with the most advanced technology that is highly efficient, eco-friendly, and harmless to the human body
	③ Pursue projects and programs related to heating and insulation of Gers, houses, old apartments, etc.
	④ Expand finance and support connections with global funds for research and development of technology to reduce air pollution and greenhouse gases
	⑤ Support the purchase of eco-friendly and energy-saving products by citizens and private companies, and develop long-term and low-interest loan products by establishing a "Green Loan Fund"
	⑥ Establish eco-friendly technology exhibition centers to promote technology for air pollution reduction and energy conservation
3	**Goal: Comprehensive measures to reduce pollutant emissions from vehicles**
	① Support fuel supply and consumption to meet Euro 4 or Euro 5 standard, phased prohibition of importing, supplying, and consuming fuel that does not meet the standard, and improve fuel quality management systems
	② Replace vehicle fuel with gas and electricity, conduct research to introduce technology and vehicles with low environmental impact, and gradually replace transportation vehicle fuel with gas

4	**Goal: Management of air pollution reduction activities, fund raising, and the establishment of an incentive system**
	① Establish an "Air Pollution Prevention Foundation," secure funds for air pollution reduction policy, and set up a legal environment to efficiently use funds
	② Specify liability system of officials, citizens, private companies, public institutions to reduce air pollution and regenerate the environment, and obey environmental laws
	③ Reduce air and environmental pollution by executing regional development policy and improving it
	④ Limit the import and supply of old vehicles and motors step by step, and prepare a legal environment to increase the use of electric and gas vehicles
	⑤ Prepare conditions to provide citizens with low-interest loans when building houses, installing insulation, and connecting distribution lines for a living, and establish tax reduction systems for energy-saving or low-energy household items
5	**Goal: Increased participation of citizens in efforts to reduce air pollution, and capacity building for environmental monitoring**
	① Provide the public with information about sources, impacts, and damages of air pollution, establish a healthy lifestyle, and conduct education and promotion on a sense of civic responsibility for environmental protection
	② Implement air pollution monitoring in the Ger regions, prohibit incineration of waste matter such as trash, etc., and support low-income groups for the prohibition
	③ Prepare benefits and support for citizens, companies, and institutions that actively participate or cooperate to reduce air pollution, and introduce and promote them
	④ Decrease disease caused by air pollution by researching short- and long-term impacts that air pollution has on the human body and finding prevention plans
	⑤ Prepare guidelines to reduce and prevent indoor air pollution occurring in Gers, apartments, and houses, and introduce and promote the guidelines to the public
	⑥ Build a database based on research and statistics on air pollution causes and waste
	⑦ Expand ambient air quality monitoring management systems, and strengthen the capacities of professionals working in related fields
	⑧ Promote and extensively share the latest research on Ulaanbaatar City's air pollution and the results of the project by holding an academic conference to explain the research and results

<Table 84> Goals of the second phase (2020-2025) of Ulaanbaatar City's master plan to reduce air pollution's

Goal	Policy direction
1	**Goal: Establishment of policies for urban planning, construction and infrastructure development, population dispersion, and improvement of ambient air qulaity**
	① Establish a legal environment for population movement and redevelopment, and pursue projects for rail freight and highway construction
	② Establish a technical foundation to help residents in the Ger regions get private houses to continue the "inexpensive apartment" project, activate support program for apartment residence, and pursue long-term and low-interest loan policy for young people and low-income groups
	③ Connect consumers who cannot use central infrastructure systems to local engineering systems, establish sub-centers, introduce renewable energy technology
	④ Demolish HOBs for heating in Ulaanbaatar, and connect consumers to central or local engineering systems in stages
	⑤ Improve and update toilet facilities in the Ger regions
	⑥ Move plants processing hide, fur, and cashmere to the provinces in stages, develop overall industries using nanotechnology through technological innovation, improve operation of vehicle sales and building material markets, and establish measures for land use policy
	⑦ Prohibit industries mining sand and gravel around Ulaanbaatar City step by step, and manage work to regenerate land
	⑧ Construct green environment for redevelopment areas in the Ger regions and create parks, comply with the standard of the Ulaanbaatar City plan by expanding green area per person, and so on
	⑨ Connect the land use plan through measures for activating redevelopment projects in the Ger regions, and build engineering infrastructure and systems by establishing small sub-centers
	⑩ Prepare an environment that helps consumers in the Ger regions to use electric heaters

2	**Goal: Reduction of pollutant sources through the application of eco-friendly and advanced technology, phased prohibition of coal briquettes, and reduction of pollutants**
	① Redefine “ambient air quality improvement area” in Ulaanbaatar City, make and comply with the lists of banned incineration materials for heating
	② Prohibit raw coal use except for heat supplying power plants step by step
	③ Provide households in the Ger regions with improved fuel and replace raw coal use by supporting improved fuel manufacturers
	④ Discount night electricity bill of households in the Ulaanbaatar Ger regions, create an environment to use electric heaters, and use saved electricity efficiently
	⑤ Expand storage to stockpile ashes and waste from households in the Ger regions, increase vehicles for waste disposal and facilities, improve waste management and disposal systems, and recycle waste and support the recycling industry
	⑥ Support the purchase of eco-friendly and energy-saving products by citizens and private companies, and develop long-term and low-interest loan products through establishing of a “Green Loan Fund”
3	**Goal: Comprehensive measures to reduce pollutant emissions from vehicles**
	① Gradually prohibit vehicles that adversely affect the human body and environment or do not meet the standards
	② Support fuel supply and consumption to meet Euro 4 or Euro 5 standard, phased prohibition of importing, supplying, and consuming fuel that does not meet the standard, and improve fuel quality management systems
	③ Replace vehicle fuel with gas and electricity, conduct research to introduce technology and vehicles with low environmental impact, and gradually replace transportation vehicle fuel with gas
	④ Expand Ulaanbaatar’s road traffic network and introduce smart systems, improve public transportation service quality and accessibility, and reduce vehicle emissions
4	**Goal: Management of air pollution reduction activities, fund raising, and the establishment of an incentive system**
	① Prepare conditions to provide citizens with low-interest loans when building houses, installing insulation, and connecting distribution lines for a living, and establish tax reduction systems for energy-saving or low-energy household items
5	**Goal: Increased participation of citizens in efforts to reduce air pollution, and capacity building for environmental monitoring**
	① Provide the public with information about sources, impacts, and damages of air pollution, establish a healthy lifestyle, and conduct education and promotion on a sense of civic responsibility for environmental protection
	② Reinforce legal responsibility for citizens and companies that violate environmental laws
	Decrease disease caused by air pollution by researching short- and long-term impacts that air pollution has on the human body and finding prevention plans
	④ Expand ambient air quality monitoring systems and strengthen the capacities of professionals working in related fields
	⑤ Establish and expand automatic monitoring stations for monitoring air pollution in Ulaanbaatar, and create an environment for regular operation and management
	⑥ Build a database based on research and statistics on air pollution causes and waste
	⑦ Promote and extensively share the latest research on Ulaanbaatar City’s air pollution and the results of the project by holding an academic conference to explain the research and results

(1) Ambient Air Quality Management Strategy Goals of Ulaanbaatar City's master plan to reduce air pollution's first phase (2018-2019)

The first goal is to carry out rational policies for city plans and construction and infrastructure development, to decentralize the population through regional development, and to improve ambient air quality in urban areas. There are four activity plans to reach this goal.

<Table 85> Ambient Air Quality Management Strategy Goals of APRD (1)

Item	Activity plan	Necessary criteria for activities	Department in charge	Period
1.1	Change ambient air quality improvement areas and implement the system according to the law on ambient air quality	Change ambient air quality improvement areas and implement the system	Policy Execution Department	Every year
1.2	Demolish 228 heat only boilers (HOBs) operated in the capital city in stages and connect to the central heating supply system	Demolish 228 heat only boilers (HOBs), and plan to connect 445 buildings to the central heating supply system	Policy Execution Department	2018-2020
1.3	Make a list of hot water boiler facilities connectable to the central heating supply system around the Amgalan thermal power plant and connect to the system	Make a list by researching hot water boiler facilities connectable to the central heating supply system around the Amgalan thermal power plant and connect to the system	Policy Execution Department	2018-2020
1.4	Supply electric heaters to low-income households	Supply electric heaters with high technology free of charge to more than 290 households	Policy Execution Department	2019-2020

The second goal is to reduce pollutants by introducing eco-friendly high technology, to gradually prohibit briquette use, and to decrease the discharge of contaminants. There are eight activity plans to reach this goal.

<Table 86> Ambient Air Quality Management Strategy Goals of APRD (2)

Item	Activity plan	Necessary criteria for activities	Department in charge	Period
2.1	Provide households in the Ger regions, companies, and organizations in the capital city with improved high-quality fuel that meets the standards, and support high-quality fuel production	Produce more than 80,000 tons of improved high-quality fuel each year	Policy Execution Department	2018-2020
2.2	Establish storage, distribution, and sales points for improved high-quality fuel	Establish distribution and sales points	Policy Execution Department	2019-2020
2.3	Develop ecological requirements, standards, and methods for improved high-quality fuel	Develop ecological requirements, standards, and methods for improved high-quality fuel	Policy Execution Department	2018-2020
2.4	Provide improved high-quality fuel to households in areas where ambient air quality improvement is required	Provide improved high-quality fuel to target households	Policy Execution Department	2019-2020
2.5	Investigate and research electric heaters available to discount night electricity bill	Draw a conclusion by testing devices able to store heat in target areas	Policy Execution Department	2018-2020
2.6	If government agencies are not connected to the central heating supply system, resolve the problem with other useful technology such as renewable energy heating systems, etc.	Convert heating systems for buildings in 10 khoroo (Equivalent to Korea's Dong) to renewable energy or other useful technology	Policy Execution Department	2018-2020
2.7	Prepare a legal environment to establish a "Green Loan Fund" in the capital city	Prepare a legal environment to establish a "Green Loan Fund" in the capital city	Policy Execution Department	2018-2020

2.8	Establish an "Eco-friendly Technology Exihibition Center" to inform the public of high technology for reducing air pollution	Establish one or more Eco-friendly Technology Exhibition Centers in the capital city	Policy Execution Department	2018-2020

The third goal is comprehensive measures to reduce pollutants emitted by vehicles, and there are two activity plans for this goal.

<Table 87> Ambient Air Quality Management Strategy Goals of APRD (3)

Item	Activity plan	Necessary criteria for activities	Department in charge	Period
3.1	Import buses that use fuel that meets or exceeds Euro-4 standard	Prepare a legal environment for importing and using buses that use fuel that meets or exceeds Euro-4 standard	Ambient Air Quality Monitoring Department	2018-2020
3.2	Install diesel particulate filters (DPF) that filter out hazardous substances emitted by diesel buses in the capital city and cleaning devices for the filter, and manage them consistently	Install diesel particulate filters (DPF) that filter out hazardous substances emitted by diesel buses in the capital city and cleaning devices for the filter, and secure stable operation	Ambient Air Quality Monitoring Department	2018-2020

The fourth goal is to manage and adjust the project for air pollution reduction, to clearly prepare financing methods, and to build an incentive system for air and environmental pollution reduction projects. There are four activity plans to reach this goal.

<Table 88> Ambient Air Quality Management Strategy Goals of APRD (4)

Item	Activity plan	Necessary criteria for activities	Department in charge	Period
4.1	Establish a department in charge of air pollution reduction in every area and create jobs for ambient air quality inspectors responsible for khoroo (Equivalent to Korea's Dong) in the department	Create jobs that are in charge of ambient air quality in each khoroo (Equivalent to Korea's Dong) of the nine districts in the capital city	Policy Execution Department	2019-2020
4.2	Reflect air pollution reduction and prevention activities in the duties of the head of each khoroo (district)	Include air pollution reduction and prevention activities in the work of the head of each khoroo (Equivalent to Korea's Dong) and evaluate them	Policy Execution Department	2019-2020
4.3	Empower a supervisor in each khoroo (Equivalent to Korea's Dong) to temporarily monitor air pollution reduction activities	Empower a supervisor in each khoroo (Equivalent to Korea's Dong) to temporarily monitor air pollution reduction activities	Policy Execution Department	2019-2020
4.4	Prepare long-term, low-interest loan products for purchasing energy-saving appliances, renewable energy devices, etc.	Prepare long-term ,low-interest loan products for customers to purchase energy-saving appliances, renewable energy devices, etc.	Policy Execution Department	2018-2020

The fifth goal is to raise civic participation and responsibility for air pollution reduction, to form a healthy lifestyle, to enhance the capacity of environmental quality monitoring, and to expand research and analysis. There are 11 activity plans to reach this goal.

<Table 89> Ambient Air Quality Management Strategy Goals of APRD (5)

Item	Activity plan	Necessary criteria for activities	Department in charge	Period
5.1	Carry out “Air pollution reduction civic participation” campaign	Promote the campaign to citizens and the public by the media	Administrative Department	2018-2020
5.2	Inform about air pollution and negative impacts caused by air pollution and promote how to prevent health damage, a healthy lifestyle, etc. over public radio and television	Proceed with contracts with public media organizations to make regular programs (at the appointed hour) related to air pollution and its reduction, how to prevent negative impacts caused by air pollution, etc., develop 20- to 30-minute programs at two to three broadcasting stations, FM radio stations, etc.	Policy Execution Department	2018-2020
5.3	Obey international standards of ambient air quality index provided to citizens	Provide ambient air quality index in compliance with international standards to citizens and the public	Ambient Air Quality Monitoring Department	2018-2020
5.4	Monitor the incineration of wastes such as tires, oil through the ambient air quality monitoring project in the Ger regions, and investigate target households in cooperation with civil society organizations	Monitor with 21 vehicles and inspectors in cooperation with civil society organizations, implement a system of ambient air quality improvement areas, and conduct the corresponding research and provide citizens with information	Ambient Air Quality Monitoring Department	2018-2020
5.5	Establish incentive systems for citizens and companies that do business related to air pollution reduction, heat loss decrease, and energy conservation	Develop rules related to incentive systems for citizens and companies that do business related to air pollution reduction, heat loss decrease, and energy conservation, and implement them step by step	Policy Execution Department	2018-2020
5.6	Educate and promote methods related to the prevention of hazards and harmful effects of air pollution on human health	Continue education and promotion on how air pollution has harmful effects on human health and how to prevent damage	Policy Execution Department	2018-2020
5.7	Take measures and proceed programs about civic health damage caused by air pollution	When pollution is bad, take measures such as wearing masks, installing air cleaners in schools, kindergartens, hospitals, etc., ventilating, and so on	Policy Execution Department	2018-2020
5.8	Develop, test, and introduce a methodology to establish an inventory of air pollutants	Use the methodology to establish an inventory of air pollutants and derive results	Ambient Air Quality Monitoring Department	2018-2020
5.9	Improve the “National integrated air pollutant statistical performance rules”	Submit the improvement of the “National integrated air pollutant statistical performance rules”		
5.10	Continuously monitor ambient air quality and develop human resources	Build the capability of organizations in charge of air and environmental quality monitoring in the capital city and continuously monitor ambient air quality	Ambient Air Quality Monitoring Department	2018-2020
5.11	Hold regular conferences to publish the latest research on capital city air pollution and results of the project	Prepare conditions to hold a regular conference once or twice a year to publish the results of research and projects on capital city air pollution reduction and innovative technology	Ambient Air Quality Monitoring Department	2018-2020

(2) Status of implementation for the air pollution prevention activities in Ulaanbaatar City

The Ulaanbaatar City Air Pollution Reduction Department (APRD) organizes and discloses the implementation status of air pollution prevention activities conducted in the UB city every year. Among the air pollution prevention activity reports released in 2020, the air pollution reduction activities are reported in detail in Goals 2, 3, and 5.

First, the contents of Goal 2 are as follows: pollutan reduction through eco-friendly and advanced technology, phased prohibition of briquette use, and reduction of pollutant emissions. The following are sub-targets and details of activities related to Goal 2.

<Table 90> Performed activities for Goal 2 of APRD

No.	Activity	Specific goal	Contents
Activity Direction-1. Upgrade “ambient air quality improvement areas” in the city, make lists of banned incineration materials for heating and comply with the lists			
2.1.1	Renew ambient air quality improvement areas and implement rules according to the Law on Air	Make a resolution to renew the area, establish rules and procedures for the corresponding areas	• A total of five khoroo (Equivalent to Korea’s Dong) are included in the ambient air improvement areas. For 98 people in the khoroo, activities such as checking whether the emission measuring instrument is operating, improving the strength of stoves, and education related to measures when smoke is leaking are implemented. • The “ambient air quality improvement areas, rules” in 2020 are promoted on the webpage to inform citizens and the public.
Activity Direction-2: Gradually prohibit briquette use except for power plants and thermal power plants			
2.2.1	Gradually prohibit briquette use except for power plants and thermal power plants in all areas of Ulaanbaatar	Implement the rules in improvement areas where briquette use is banned	• From 21 October 2020 to 1 May 2021, individuals and companies who operate industries and factories by using boilers and household stoves in the ambient air quality improvement areas are being monitored for prevention such as stable operation of stoves, ash trap filter operation, waste contracts of individuals and factories, transportation, soil pollution status, fuel use, raw coal use, etc.
Activity Direction-3: Provide households in the Ger regions with high-quality fuel that meets the requirements of the standards, and replace briquette consumption by supporting improved coal production			
2.3.1	Establish storage, distribution, and sales points for improved high-quality fuel	Establish improved coal storage places and sales networks	• According to a project for winter preparation, warehouses for high-quality fuel were investigated from 2020 to 2021 so that households in the Ulaanbaatar Ger regions could use the fuel, 120 warehouses that met the standards were contracted, and 95,000 tons of high-quality coal was stored. • As of December 10, 2020, the following contracts were completed: 686 stores in six central districts and the capital for 28 supplies, 22 companies in charge of transporting high-quality fuel.
Activity Direction-4: In the Ger regions, households that installed two tariff meters (type of gas meter charging different fees depending on time) received night electricity bill discounts of 50 to 100%.			
2.4.1	Discount on night electricity bill of Ulaanbaatar households	Discount on night electricity bill	• Thanks to the night electricity bill discount system for households in the Ger regions, 1,802,511 consumers (including duplicates) got a fee discount of 2.7 billion MNT for 33,680 kWh for 3 years from 2017 to 2019, and 451,593 consumers got a fee discount of 1.14 billion MNT for 10,500 kWh from January to April 2020. • From 1 November 2020 to 1 April 2021, households that installed 2 tariff meters (type of gas meter charging different fees depending on time) in the Ger regions were to get discounts

			up to 100% for the night electricity bill and the renewable energy support charge.
2.4.2	Provide improved stoves, high-quality fuel, and electric heaters to households in areas where ambient air quality improvement is required	Stoves provided for the target households	• From 7 to 10 April 2020, 1,330 electric heaters were handed to the staff in charge of the corresponding area.
		High-quality fuel provided to target households	• According to the "high-quality fuel provision to the target households," project, 9,786 households in Ulaanbaatar ambient air quality improvement areas received a total of 6,277 tons of high-quality fuel (925 kg per household).
Activity Direction-15: Expand finance to support innovative research and technology for reducing air and environmental pollution and greenhouse gases, and continue to endeavor for support of the international fund			
2.15.1	If government agencies are not connected to the central heating supply system, resolve the problem with other useful technology such as renewable energy heating systems, etc.	Resolve heating supply systems of 53 khoroo (Equivalent to Korea's Dong) buildings	• A budget of 400 million MNT was approved so that coal-fired boilers supported by the 2018 budget of the capital city could be connected to engineering networks. As a result, the project for connecting 33 stoves of 56 buildings to the central heating supply system is underway.
Activity Direction-16: Establish an "Eco-friendly Technology Exhibition Center" that publicizes advanced technology for reducing air and environmental pollution, and saving energy			
2.16.1	In the capital city, establish three "Eco-friendly Technology Exhibition Centers" that publicize advanced technology for reducing air and environmental pollution and saving energy	Establish "Eco-friendly Technology Exhibition Center"	• There are three "Eco-friendly Information Innovation Centers" in Ulaanbaatar.

Goal 3 is comprehensive measures to reduce pollutants emitted by vehicles. The following are sub-targets and details of activities.

<Table 91> Performed activities for Goal 3 of APRD

No.	Activity	Specific goal	Contents
Activity Direction-3: Replace vehicle fuel with gas and electricity, do research and experiments related to introducing eco-friendly technology and vehicles, and gradually replace public transportation vehicle fuel with gas			
3.3.3	Install diesel particulate filters (DPF) and cleaning devices for the filters on diesel buses in Ulaanbaatar's public transportation, and manage them consistently	Install diesel particulate filters (DPF) that filter out hazardous substances emitted by diesel buses in the capital city and cleaning devices for the filter, and manage them consistently	• E-NOM devices of the Korean company Item Cheongook Co., Ltd were installed and tested in 400 public transportation buses. - As a result of the experiment, it was confirmed on May 12, 2020 that less hazardous substances were discharged when a DPF was attached. • Ten public transportation companies run 75 buses with compressed natural gas (CNG) engines, 11 large electric buses, 45 trolleybuses, 59 diesel engine vehicles of Euro-5 standard, and 249 taxies with liquefied petroleum gas (LPG) engines.

3.3.4	Install an “eco driving” control system on Ulaanbaatar’s public transportation buses, and introduce and promote the system	Test 10 buses with the “eco driving” control system installed and write a research report. Educate, promote, and introduce it	• In project-3 of JICA, “Capacity Development Project for Air Pollution Controlling Ulaanbaatar City,” the “eco driving” control system will be installed on 80 government vehicles in Ulaanbaatar from 2019 to 2021. A document requesting a list of registered vehicles was submitted to the corresponding government agencies on June 4, 2019.
3.4.4	A remote sensing device (RSD) was installed in front of the immigration agency to monitor vehicles passing through Ulaanbaatar to measure greenhouse gas emissions from vehicles	A remote sensing device (RSD) installed in front of the immigration agency to monitor vehicles passing through Ulaanbaatar	• In cooperation with JICA, pollutants emitted by vehicles were measured by the RSD device. Development of measurement data-based standards to use in Mongolia has been delayed until 2021.

Goal 5 is to raise civic participation and responsibility for air pollution reduction, to form a healthy lifestyle, to enhance the capacity of environmental quality monitoring, and to expand research and analysis. Accordingly, activity direction 10 is set to build an integrated information database by categorizing air and environmental pollutants, etc.

<Table 92> Performed activities for Goal 5 of APRD

No.	Activity	Specific goal	Contents
Activity Direction-10: Register the air and environmental pollutant lists, and the waste list, and build an integrated information database			
5.10.1	Register air pollutants and build the lists, and an integrated information database	Register air pollutants and households, and build database	A project for registering air pollutants and making the lists is underway in nine districts of Ulaanbaatar. This project is expected to be conducted from 20 December 2020 to 5 February 2021, and an “environmental pollutant and waste registration database” will be built and managed.

Part 1 Establishment of the Environmental Improvement Plan

Chapter 5 Identification of Environmental Cooperation Projects and Establishment of Basic Plans

Chapter 5 Identification of Environmental Cooperation Projects and Establishment of Basic Plans

5.1 Approach to the Environmental Cooperation Project

We identified main status and problems of each pollutant source in Ulaanbaatar City by conducting video conferences with Mongolia's government officials in the ambient air quality management sector and visiting the site through local outsourced service agencies. We reviewed the literature and identified the relevant laws, policies, standards, and subjects who execute and supervise the implementation of regulations that regulate Mongolia's ambient air quality management to identify 12 cases for the environmental cooperation projects to contribute to solving problems in the ambient air quality management sector in Mongolia.

5.2 List of the Environmental Cooperation Projects by Sector

<Table 93> List of the Environmental Cooperation Projects by Sector

No.	Sector	Improvement proposal	Details
1	Stationary source	Improvement and installation of electrostatic precipitators in the combined heat and power plants in Ulaanbaatar city	A project to install replacements for old electrostatic precipitators for TES-4 (supplying power to over 60% of the UB City), which has the largest power generation capacity of 700 MW, to fundamentally reduce the emission amount of air pollutants in Ulaanbaatar City. After that, it may be required to consider the installation of the prevention facilities in preparation not only for the management of coal ash and for the strengthening of regulation on sulfur oxides and nitrogen oxides in future.
2	Stationary source	Introduction of desulfurization facilities in the combined heat and power plants in Ulaanbaatar city	
3	Stationary source	Pilot installation of the workplace air pollutant management system (CleanSYS)	Introduce a system that can identify the emission concentration and emission amount at the stacks of large stationary sources. Such a system will provide a basis for the Ministry of Environment and Tourism or the APRD, both of which are the main management and supervision entities, to check the emission status and issue an order for taking actions. It is almost similar to the air pollution monitoring network and management system, but because there is a need for a special management method to ensure that the monitoring equipment can withstand the high moisture level and temperature at the workplace as far as the operation environment is concerned, more advanced competence enhancement program should be implemented in parallel.

4	Stationary source	Introduction of gas fired HOBs	To improve the ambient air quality, it is necessary to introduce gas boilers that can replace coal boilers conventionally used in Mongolia. Further, there is a need for laws related to the installation of gas boilers and regulations for the management of emissions.
5	Mobile source	Introduction of measuring devices for implementing the emission inspection system	Currently, there are permissible standards for discharged air pollutants by vehicle type in Mongolia, but there is a lack of equipment to measure these pollutants. Therefore, by introducing vehicle emission inspection measurement equipment to strengthen the vehicle exhaust gas inspection system, air pollutants generated by mobile sources can be managed, thereby contributing to the improvement of ambient air quality in Ulaanbaatar City.
6	Mobile source	Pilot installation of a DPF for reducing emissions from old diesel vehicles in Mongolia	Air pollutants are discharged from old diesel vehicles traveling in Ulaanbaatar City, adversely affecting its ambient air quality. We propose a project of introducing a DPF device that can reduce the discharged air pollutants, targeting the old diesel vehicles in Ulaanbaatar City.
7	Mobile source	Expansion of LPG stations	To spread the use of LPG vehicles with less air pollutants than gasoline and diesel vehicles, the LPG filling infrastructure capable of supplying LPG to users is essential. Because a project for building an infrastructure requires large-scale capital, it is possible to devise a method for expanding charging stations utilizing concessional loans, etc. In the long term, it is also necessary to consider projects to expand electric charging stations through the introduction of policies to encourage the introduction of electric vehicles at the government level.
8	Mobile source	Expansion of electric vehicle charging stations	
9	Monitoring	Establishment of a national ambient air quality monitoring information system (NAMIS)	Prepare a basis to produce reliable ambient air quality data by building a real-time ambient air quality monitoring system and strengthening the ambient air management competence, which will enable the policymakers to prepare ambient air quality improvement policies based on such scientific basis.
10	Monitoring	Improvement of an air quality monitoring system of Mongolia (Agaar)	
11	Monitoring	Expansion of air pollution monitoring stations	
12	Monitoring	Introduction of mobile air pollution monitoring stations (vehicles)	

5.2.1 Environmental Cooperation Projects in the sector of Stationary Sources

Through interviews with the Energy Department in charge of combined heat & power plants, a stationary source, the Ulaanbaatar Mayor's Office responsible for registration/management of steam and hot water boilers in Ulaanbaatar, the Ulaanbaatar City Air Pollution Reduction Department, and the Ministry of Environment and Tourism administering overall Mongolian environmental matters, a total of four cooperation projects were identified: ①Improvement and installation of electrostatic precipitators in the combined heat and power plants in Ulaanbaatar city, ② Introduction of desulfurization facilities in the combined heat and power plants, ③Pilot installation of the workplace air pollutant management system (CleanSYS), ④Introduction of gas fired HOBs

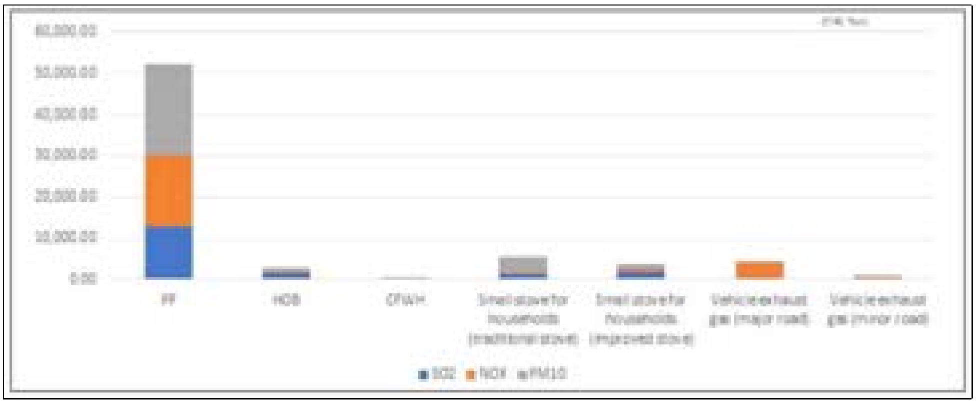
(1) Improvement and installation of electrostatic precipitators in the combined heat and power plants in Ulaanbaatar city / Introduction of desulfurization facilities in the combined heat and power plants

General status

[Literature research]

- In Mongolia, environmental pollution problems such as air pollution are on the rise because of the high rate of industrialization and rapid economic growth over the past decade.
- According to an investigation, thermal power plants (PP) were found to be the major pollutant source in Mongolia that emits a large amount of air pollutants such as SO_2, NOX, PM10, etc. (source: JICA, 2017)

[Figure 55] SO_2, NOX, and PM10 emissions of each pollutant source (as of 2015)



Source: JICA, Capacity Development Project for Air Pollution Control in UB City Phase 2 in Mongolia Final Report (2017)

- Fly ash collected at TES-4 power plant in Ulaanbaatar, Mongolia is less than 15% of the total amount of generated fly ash, while 85% of the discharged fly ash that was not collected acts as one of the causes of air pollution (Mine Reclamation Corporation, 2019).

[Interviews and advisory]

- Chinese prevention equipment installed in Mongolia in 2019 cannot process pollutants properly because of quality issues.
  (Mr. Kherlen, Ulaanbaatar Mayor's Office, Feb. 24, 2021)
- The Mongolian government wanted to be supported with electrostatic precipitators (ESP) to improve the efficiency in collecting and recovering fly ash emitted by TES-4.
  (Interviews with the Mine Reclamation Corporation and the Ministry of Environment and Tourism of Mongolia, and with Ms. Burenjargal B, TES-4, Jul. 20, 2021)

Institutional arrangement	**[Laws] Law on Air** • Article 18: Permission for the use of large-scale stationary sources • Article 23: Obligations to install and supervise equipment at large-scale stationary sources **[Policy] NPRAEP** • NPRAEP Goal 2: Reduction of sources of emissions by introducing eco-friendly advanced technology, phased prohibition of the use of coal briquettes, and reduction of emission of air pollutants **[Standards] MNS5919:2008, MNS6298:2011, MNS5043:2016** • Air pollutant permissible emission standards for steam boilers and hot water boilers in combined heat & power plants and thermal stations (MNS5919:2008) • Air pollutant permissible emission standards for new thermal and heat-producing plants (MNS6298:2011) • Air pollutant permissible emission standards for hot water boilers with capacity up to 4.2 MW (MNS5043:2016)
Details	**[Contents of the project]** • **Improvement and installation of the prevention equipment in the combined heat & power plant** - To fundamentally reduce the emission amount of air pollutants in Ulaanbaatar City, a project to install prevention equipment in the combined heat & power plants was proposed. TES-4, with the largest generation capacity in Ulaanbaatar (700 MW), supplies the city with more than 60% of its electricity. Considering this power plant as a target, the following projects were proposed: introducing desulfurization systems and electrostatic precipitators sequentially, improving performance by replacing power supplies and expanding dust collection areas, and introducing the dry treatment and take-out treatments of fly ash. **[Proposal]** • **Proposal 1. Introduce prevention equipment with the appropriate technology in Mongolia** - Need to apply, not the conceptually optimal prevention equipment, but appropriate technology considering the social and economic level of Ulaanbaatar, the level of the people's technical skill, and the possibility of sharing the costs. - If the conceptually optimal prevention equipment, which is used by developed countries, expensive and can secure the maximum efficiency, is applied, the equipment may not be operated normally because of the problems with proficiency required for professional management and operation, the problem of cost, and lack of skills for installation and operation. Accordingly, it is desirable to apply 'appropriate technology' rather than advanced or utmost technology so that the equipment can be operated normally under acceptable technical levels and available human and material resources for each country. In other words, it will be more efficient to apply 'the best technology within a range that the entities responsible for installing and operating the equipment can bear.' This means applying technology considering the extent of social and economic development and available infrastructure, etc. in Ulaanbaatar, Mongolia. • **Proposal 2. Strengthen optimal operation capacity of installed facilities** - Power generation facilities, which are normally built in the entire unit through turnkey methods are designed and installed on the assumption that the level of the operational technology of the production and emission facilities is similar to the level of the operation technology of prevention equipment. However, in most cases, prevention equipment tends to be given low priority and is regarded as less important than production facilities because each country has a different degree of environmental awareness, the level of affordable operating costs is different, and skilled technical human resources are insufficient. To overcome these difficulties, activities such as educating personnel who operate the facilities and optimizing the operation procedures in manuals or checklists to be compatible with national conditions are needed. Also, it is necessary to prepare regulations for the technical levels and qualifications of the personnel operating facilities and also for the strengthening of penalties for illegal and abnormal operation, and to draw up plans for enhancing the ability of enforcement to apply the regulations at sites.

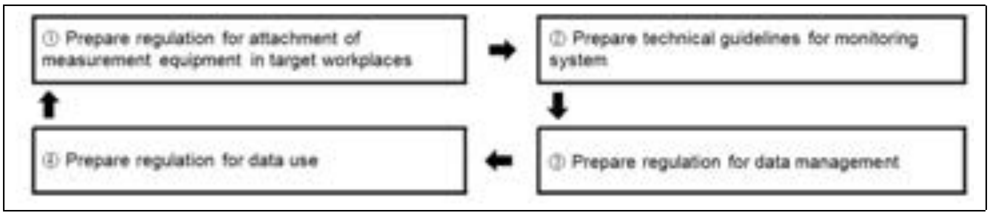
(2) Pilot installation of the workplace air pollutant management system (CleanSYS)

General status	**[Literature research]** • There are permissible standards for pollutants emitted by the power plants and boilers in Mongolia, but the laws and standards for the mandatory installation of prevention equipment are inadequate. **[Interviews and advisory]** • Chinese prevention equipment installed in Mongolia in 2019 cannot process pollutants properly because of quality issues. (Mr. Kherlen, Ulaanbaatar Mayor's Office, Feb. 24, 2021) • Items of the permission requirements for the operation of large-scale stationary sources specified in the Law on Air are not complied with. • It is difficult to control pollutant sources because of a lack of remote real-time air pollutant measuring systems in Mongolia, so it is hoped that items for improvement will be reflected in the MP report. (Mr. Munkhbat, Ministry of Environment and Tourism, Mar. 3, 2021)
Institutional arrangement	**[Laws] Law on Air** • Article 18: Permission for the use of large-scale stationary sources • Article 23: Obligations to install and supervise equipment at large-scale stationary sources **[Policy] NPRAEP** • NPRAEP Goal 2: Reduction of sources of emissions by introducing eco-friendly advanced technology, phased prohibition of the use of coal briquettes, and reduction of emission of air pollutants **[Standards] MNS5919:2008, MNS6298:2011, MNS5043:2016** • Air pollutant permissible emission standards for steam boilers and hot water boilers in combined heat & power plants and thermal stations (MNS5919:2008) • Air pollutant permissible emission standards for new thermal and heat producing plants (MNS6298:2011) • Air pollutant permissible emission standards for hot water boilers with capacity up to 4.2 MW (MNS5043:2016)
Details	**[Contents of the project]** • **Introduce real-time emission amount identification system for large-scale stationary sources** - Introduce a system that can identify the concentration and amount of the emissions discharged from the stacks of large stationary sources. Such a system will provide a basis for the Ministry of Environment and Tourism or the APRD, both of which are the main management and supervision entities, to check the emission status and issue an order for taking actions. - It is almost similar to the air pollution monitoring network and management system, but because there is a need for a special management method to ensure that the monitoring equipment can withstand the high moisture level and temperature at the workplace as far as the operation environment is concerned, more advanced competence enhancement program should be implemented in parallel. **[Details]** • **Set up a real-time monitoring system (TMS) for large emission facilities** - Coal power plants are major air pollutant emission facilities and should be managed essentially to reduce air pollution. TMS is a real-time monitoring system that makes it possible to monitor stack emissions without visiting the stack via telecommunication. - By establishing TMS, the government can enhance inspection efficiency of targeted workplaces and use the data as evidence for the administrative process when emission concentrations are exceeded, and workplaces can prevent air pollution by introducing and improving air pollution emission prevention equipment. - TMS can monitor emissions from a stack 24 hours a day, making it possible to perform management and supervision at night, while raining, or during holidays.

Details	**[Proposal]** • **Proposal 1. Prepare institutional and technical systems to identify whether prevention equipment operates properly** - Measure emitted pollutants at all times: When prevention equipment does not operate properly or emission facilities are managed abnormally, the first phenomenon is a change in the quantity and concentration of emitted pollutants. Therefore, the best method to identify whether prevention equipment is operating properly is to measure the quantity and concentration of pollutants emitted by the outlets at all times. In the case of Korea, it is made mandatory to install a continuous emission monitoring system (CEMS) on the stacks of workplaces, and the competent supervisory institutions conduct monitoring at all times. This is a very scientific and strict monitoring system that can be applied to large workplaces or the workplaces that emit high concentrations of pollutants. However, this method has the disadvantage of high installation and operation costs. - The second method is to install sensors in the prevention equipment that can measure representative signals (displacement signals) related to the operation of prevention equipment such as temperature, pressure, electrical current, etc., and an administrative agency conducts monitoring through the Internet of Things (IoT). Though less accurate, this method can be applied to small and medium-sized facilities and is relatively cheap. - The third method is to let workplaces periodically submit self-measured data, and an administrative agency confirms the data. But it is possible for the workplaces to manipulate the data. Low efficiency is also a disadvantage because of the difference between the time of measurement and the time of confirmation by the administrative institution. - If workplaces are large and have many emission facilities, the first method would be efficient. If workplaces are small or medium and do not have many emission facilities, the second method can be applied together with frequent site inspections and crackdowns by the administrative agency would be quite effective. In the long term, It is desirable to build a regular monitoring system by applying the stack TSM and IoT. • **Proposal 2. Plan to apply an air pollutant management system to Mongolian workplaces** - Introduction procedure (plan) ① Prepare regulations for attachment of measurement equipment in target workplaces ✓ Regulations are needed to define target workplaces for attaching measurement equipment for real-time monitoring and based on the annual emission amounts of regulated pollutants, it is possible to introduce attachment of equipment firstly for high emission workplaces and then gradually for low emission workplaces. ✓ Considering that resistance is expected at the workplaces, there is a need to continuously persuade the workplaces of the reasons and justification for measuring emission amounts. ② Prepare technical guidelines for the inspection system ✓ It is very important to secure data reliability because the data will be used as evidence for administrative processing. Therefore, the government should prepare and apply common technical guidelines to secure the accuracy and transparency of data. The technical guidelines should include the specifications of measurement equipment, measurement methods, maintenance methods, etc. ③ Prepare regulations for data management ✓ As with technical guidelines, a unified method to sort out and use data is needed. Prepare selection standards to use data for policies and confirm the procedure for each step for use the data as final data. ④ Prepare regulations for data use ✓ The produced data will include concentration, temperature, flow, etc., and emission amounts can be calculated by using the data. The government should use scientific and reliable data for administrative restriction and establish regulations on which data to use for administrative processing.

Details

[Figure 56] Procedure plan for introducing air pollutant management system to workplaces



- Division of roles among the participating organizations (plan)

<Table 94> Procedure plan for introducing an air pollutant management system to workplaces

<Ministry of Environment and Tourism> • Establishes related policies • Improves laws, regulations, etc.	<Ulaanbaatar City (Aimag, in the future)> • Manages the workplaces that have stacks within its jurisdiction • Main agency for attachment of measurement equipment and for giving an order for improvement • Administrative processing (penalities, guidance)
<Central Laboratory of Environmental Monitoring, CLEM> • Technically supports the inspection of measurement equipment at target workplaces • Collects and analyzes TMS data • Provides the government with analyzed data • Checks TMS data in real time and takes action in case of abnormalities	<Workplaces with stacks> • Attach measurement equipment • Maintain measurement equipment

[Figure 57] TMS operation cases in Korea

(3) Introduction of gas fired HOBs

General status	**[Interviews and advisory]** • Mongolia is gradually prohibiting the use of raw coal, and the Ministry of Environment of Mongolia is exploring the possibility of replacing heat-only boilers (HOBs), which mainly use raw coal as the main fuel, with gas boilers. • In Ulaanbaatar, there are about 294 large-scale boilers with 1.5 MW capacity (2 for industry and 212 for heating), and it is found that half of the heating boilers belong to public institutions. Up to now, about 50 boilers of public institutions such as schools, kindergartens, etc., have been replaced with gas boilers. • From May 2021, the use of raw coal for steam boilers is banned, and from September 2022, the use of raw coal for boilers for heating purposes is also banned. However, the use of raw coal at TES-2, TES-3, TES-4, Amgalan power plant, and Selbe power plant is excluded from the banning. • In-depth knowledge related to the replacement of fuel and technology is needed to prepare for the ban on raw coal. (Mr. Kherlen, Ulaanbaatar Mayor's Office, Feb. 24, 2021) • Ulaanbaatar City Gas Association was established, and gas has been supplied in cooperation with private companies including Unigas LLC. • A provision that allows the temporary use of enriched coal at steam production workplaces was added. (Mr. Munkhbat, Ministry of Environment and Tourism, Feb. 23, 2021) **[Reference] Status of gas boiler introduction in Mongolia** • Since Mongolia does not yet have a gas supply system, the gas boilers that are currently used are operated using the gas fuel provided by Russia. • There is no liquefied natural gas (LNG) supply system in Mongolia, and the main type of gas is liquefied petroleum gas (LPG:BUTAN) supplied from Russia. • The number of gas boilers installed in Mongolia is very limited, and the latest case is the installation of a gas boiler for generating steam in a Coca-Cola factory in Ulaanbaatar, which was promoted as part of the Mongolian government's policy for ambient air quality protection. **[Reference] Difference between the gas boilers recently introduced in Mongolia and the coal-fired boilers** • A coal-fired boiler has low efficiency and emits a large amount of air pollutants. In contrast, the LPG gas boilers introduced in Mongolia recently are at least 10% more efficient and emit less hazardous air pollutants such as CO_2, NO_x than the coal-fired boilers. The LPG gas boilers also do not emit SO_x and dust. So, the LPG gas boilers are excellent in preventing air pollution. • Mongolia's plan to secure the gas fuel in Mongolia: Because gas is not produced in Mongolia, the government is forced to import it from Russia. This problem should be resolved at the country level.
Institutional arrangement	**[Laws] Law on Air** • Article 9: Rights and obligations of businesses, organizations, and individuals (9.1.8 Prohibition of the incineration of raw coal and other air pollutants in the ambient air quality improvement areas) • Article 16: "Prohibitions in ambient air quality improvement areas" (16.1.5 Incineration of raw coal or other air pollutants) **[Policy] NPRAEP, Policy to prohibit the use of raw coal** • NPRAEP Goal 2: Reduction of sources of emissions by introducing eco-friendly advanced technology, phased prohibition of the use of coal briquettes, and reduction of emission of air pollutants - Activity Plan 2: Phased ban on raw coal in other locations except for thermal power plants and CHPs. - Activity Plan 7: Expansion of the heating supply and network in cities and regions, phased construction of new heating sources, and development of innovative technology to reduce coal consumption and coal waste

	• Ban on the use of raw coal (Mongolian government resolution No.62, Feb. 28, 2018): Households, businesses and organizations are prohibited from using raw coal from May 15, 2019, except for the businesses that are generating energies such as electricity and heat in Bayangol, Songinokharkhan, Sukhbaatar, Khan-Uul, and Chingeltei in Ulaanbaatar City. **[Standard] MNS5679:2019** • Technical requirements for improved solid fuel (bituminous coal) (MNS5679:2019) **[Management entity] Ministry of Energy, Ulaanbaatar City Mayor's Office, and APRD** • Ministry of Energy: Creation of fuel standard for the fuel of HOBs • Ulaanbaatar Mayor's Office: Registration and permission for HOBs installed in Ulaanbaatar • Air Pollution Reduction Department (APRD): Sampling and analysis of air pollutants emitted from HOBs **[Mongolian laws related to gas boilers]** • Mongolia has no permits or laws to consider when installing gas boilers.
Details	**[Contents of the project]** • **Project to introduce gas boilers in Ulaanbaatar** - Because the ban on the use of coal makes it difficult to operate existing coal-fired boilers in Mongolia, gas boilers should be introduced. - Currently, it has been confirmed that Mongolian import companies are bringing in gas fuel from Russia and other countries and are supplying the fuel to gas boilers of schools or public offices. - In line with the background of the policy and the gas supply and demand situation, a project to introduce gas boilers in Ulaanbaatar and establish related standards was proposed. • **Proposal 1. Contribute to greenhouse gas reduction by introducing gas boilers** - According to the policy that bans the use of raw coal, executed in 2018, the use of raw coal was prohibited, except for the case of producing energy, from May 15, 2019. - It has been confirmed that there are about 294 large-scale boilers with 1.5 MW capacity in Ulaanbaatar, and about 50 HOBs of public institutions such as schools, kindergartens, etc., were replaced with gas-fired boilers. This means that the remaining 244 coal-fired boilers in Ulaanbaatar should also be gradually replaced with gas-fired boilers. - Compared with a coal-fired boiler, a gas boiler has several advantages as follows: high level of space utilization, high efficiency leading to low energy loss, and low emissions of hazardous pollutants. • **Proposal 2. Establish standards for installing and maintaining gas boilers** - It has been confirmed that Mongolia has no regulations or standards for installing gas boilers, so there are no legal limitations on the installation of gas boiler. This is likely to cause safety issues such as poor installation and improper operation when gas boilers are extensively distributed in the future. To prevent this in advance, appropriate standards should be established in Mongolia. • **Proposal 3. The emergence of the need to prepare fundamental solutions, such as changing the heating systems through a change of the housing types** - When the housing in Mongolia changes from Ger type to apartment type in the future, gas-fired district heating systems are expected to be introduced, thus fundamentally improving the ambient air quality. **[Reference] Background on how Korea reduced coal-fired boiler use and introduced gas boilers** • In the 1970s, Korea used coal as a fuel to provide heating for buildings and classrooms and produce hot water, but social issues were raised because coal polluted the air and emitted hazardous pollutants, and handling the ash left over was difficult. Accordingly, a ban on the use of coal-fired boilers started with the area within the four gates of Seoul and then spread across the country later.

- In the beginning, oil boilers were suggested as an alternative, but these also emitted a large of amount air pollutants. In the 1980s, gas boilers began to be distributed, and now, more than 95% of major cities in Korea use gas boilers.
- As Korea strengthened Article 5 of the Ambient Clean Air Conservation Act, emissions of NOx, which is the main cause of generating fine dust, should be less than 40 PPM from 2020, and less than 20 PPM from 2022. Also, major public offices are recommended to use eco-friendly high-efficiency boilers according to the Energy Use Rationalization Act.

[Reference] Advantages of introducing gas boilers compared with coal-fired boilers

① Reduction of air pollutant emissions: A gas boiler emits less hazardous pollutants than a coal-fired boiler. It also emits less CO2 and NOx, and does not emit SOx and dust, which helps to reduce air pollution. Ash is not generated either, so a clean environment is maintained.

② Prevention of loss and waste of energy because of high efficiency: It can be possible to manufacture gas boilers that has an efficiency of more than 90% and loses less energy

③ No need for storage space and boiler facility space: Coal cannot be transported naturally, so transportation devices and storage spaces such as conveyors are required for coal-fired boilers, and large spaces and costs are required for installation of precipitators, but gas boilers do not require large spaces, making them easy to handle.

5.2.2 Environmental Cooperation Projects in the sector of Mobile Sources

Through interviews about mobile sources with the Ministry of Road and Transport Development in charge of the road, transportation network, and transport service, and the Ministry of Environment and Tourism, a total of four cooperation projects were identified: ① Introduction of measuring devices for implementing the emission inspection system, ② Pilot installation of a DPF for reducing emissions from old diesel vehicles in Mongolia, ③ Expansion of LPG stations, and ④ Expansion of electric vehicle charging stations.

(1) Introduction of measuring devices for implementing the emission inspection system

General status	**[Interviews and advisory]** • Of the total number of vehicles registered in Mongolia, about 80% is the vehicles that are more than 10 years old, and more than 50% of all the registered vehicles in Mongolia are travelling in Ulaanbaatar. Now, Mongolia's CO_2 emissions per kilometer are much higher compared to other countries. • Although there are permissible standards for emitted air pollutants by vehicle type such as public transportation, diesel and gasoline vehicles, there is a lack of equipment for measuring exhaust, leading to insufficient supervision of whether the standards are followed. (Mr. Munkhbat, Ministry of Environment and Tourism, Feb. 26, 2021) • The National Center for Road Transportation conducts regular vehicle inspections once a year. When vehicles are inspected, pollutant emission amounts are also measured, but it is impossible to estimate all types of pollutants because of technical issues. This project is expected to draw proposals for the improvement of the vehicle inspection system. • Mongolia's Law on Air Pollution Tax specifies the standard for CO_2 emitted from vehicles. However, because there is no CO_2 measuring device in Mongolia, the law is enforced based on engine capacity. • There is a vehicle exhaust gas management system in 21 aimags of Ulaanbaatar, and the Ministry of Road and Transport Development is researching telemetry devices and conducting the project for RSD introduction in cooperation with JICA. (Mr. Sh. Khavidolda, Ministry of Road and Transport Development, Feb. 24, 2021)
Institutional arrangement	**[Act] Law on Air, Law on Motor Vehicles** • Section 3, Article 20 of the Law on Air: For the mobile sources that emit pollutants into the air exceeding the standard and cause harmful physical effects, the police officers having the environment audit authority can apply restrictions in accordance with the procedures specified in the Act on the investigation and resolution of violations. • The "Vehicle Technical Inspection Procedure Regulation" of the Law on Motor Vehicles: Public transportation vehicles are inspected once every 6 months, and other general vehicles are inspected once a year, and technical inspections are conducted. (See below for inspection standards) **[Standard] MNS5011: 2003, MNS5012:2011, MNS5014:2009, MNS5013:2009, MNS4598:2011** • Vehicle Technical Inspection Guidelines. General requirements (MNS5011: 2003) • Public transportation service. General requirements for classification and service (MNS5012:2011) • Emission standards for diesel vehicles (MNS5014:2009) • Emission standards for gasoline vehicles (MNS5013:2009) • General requirements for the technical condition of motor vehicles (MNS4598:2011)

Details	
Details	**[Contents of the project]** • Introduction of measuring equipment for implementing the vehicle emission inspection system - Although there are permissible standards for emitted air pollutants by vehicle type currently in Mongolia, there is a lack of equipment to measure these pollutants. - Introduction of vehicle emission measuring equipment can strengthen the implementation of the vehicle emission inspection system and make it possible to manage air pollutants caused by mobile sources, consequently contributing to ambient air quality improvement in Ulaanbaatar. **[Proposal] Strengthen the capabilities of operating the vehicle emission measuring equipment** • To Introduce vehicle emission measuring equipment in Mongolia and smoothly conduct inspections, it is necessary to ①form an organization for measurement and ②improve its performance through activities that can strengthen its measurement capabilities. The capabilities of the operating personnel will be strengthened by implementing regular and irregular and on- and off-line education for the personnel in charge of measurement and also by conducting activities such as distribution of operational manuals. • Maximized effects can be expected in connection with the KOICA's project, 'Build Capacity in Quality Control Management of Energy Resources to Improve Air Quality in Mongolia", which will be conducted during 2021–2025, when considering that the project is planning not only to establish regulations (plan) related to testing and analysis for the implementation of the emission inspection system, but also to build testing and analysis equipment and conduct activities that can strengthen capabilities.

(1) Pilot installation of a DPF for reducing emissions from old diesel vehicles in Mongolia

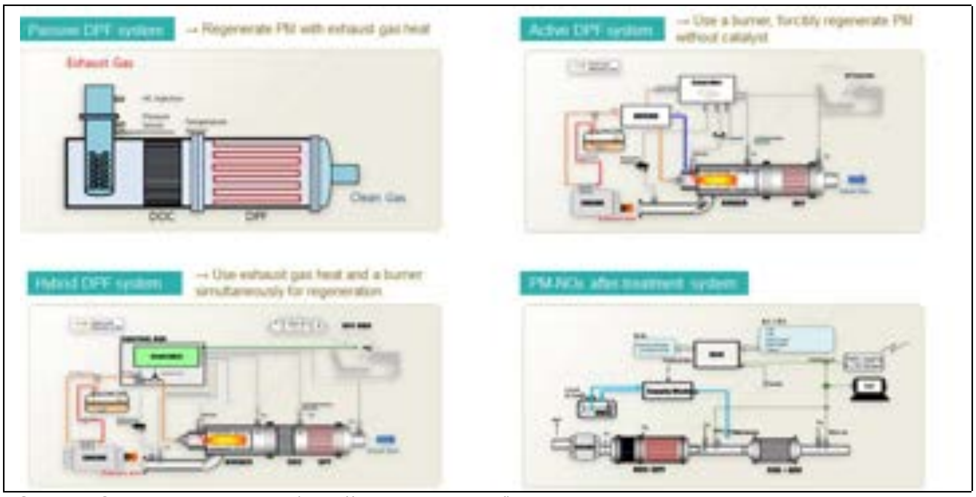
General status	**[Literature research]** • As of 2019, 570,000 vehicles were registered in Ulaanbaatar. The proportion of vehicles more than 10 years old was 74.4%, and vehicles 7 to 9 years old accounted for 19.8%. In this way, used cars made up a large portion, emitting large amounts of air pollutants. Also, the proportion of diesel vehicles emitting PMs, the main cause of fine dust, was 25.2%. (source: National Statistical Office of Mongolia) **[Interviews and advisory]** • The currently supplied DPFs are expensive and hard to clean. It is hoped to introduce a device that is relatively cheap and easy to use. • While there is a DPF installation standard in the NPRAEP, Mongolia's laws don't specify articles related to the attachment of a DPF and relevant figures on the performance of a DPF. (Mr. Sh. Khavidolda, Ministry of Road and Transport Development, Feb. 24, 2021) • A three-way catalyst replacement project for gasoline vehicles has never been conducted in Mongolia. The project would incur huge costs because of purchase of parts. Mongolians lack knowledge about the three-way catalyst, and many tend to drive their vehicles with it removed in many cases. • There is a standard related to old public transportation vehicles, and the operation of diesel buses more than 12 years old are banned. • To reduce imports of old vehicles, the government imposed high tariffs on imported old vehicles, and as a result, most of the vehicles running in the country are the ones that were produced after 2012. (Mr. Munkhbat, Ministry of Environment and Tourism, Feb. 26, 2021) • Mongolia's current vehicle emission regulation standard conforms to Euro 2, which is a very low standard compared with Euro 4 or 5 major developing countries comply with, not to mention Euro 6 or higher standard that OECE countries observe. (General Manager Song Je-hong, Ceracomb Co., Ltd., Oct. 15, 2020)

General status	**[Reference] Cases of introduction of DPFs of domestic and overseas international companies to Mongolia** • A case where a domestic company introduced a DPF for diesel vehicles in Mongolia - In 2010, a domestic company participated in a DPF attachment pilot project and attached DPFs to 10 vehicles in Mongolia on a trial basis in cooperation with a vehicle inspection station under the Ministry of Environment. • A case where an international aid organization introduced a DPF for diesel vehicles in Mongolia - As part of the project for improving air pollution in Ulaanbaatar conducted by JICA, DPFs were introduced for public buses in Ulaanbaatar on a trial basis. In this process, the 'standards for DPF installation and use' were established.
Institutional arrangement	**[Laws] Law on Air** • Section 3, Article 20: For the mobile sources that emit pollutants into the air exceeding the standard and cause harmful physical effects, the police officers having the environment audit authority can apply restrictions in accordance with the procedures specified in the Act on the investigation and resolution of violations **[Policy] NPRAEP** • NPRAEP Goal 3: Comprehensive measures to reduce pollutant emissions from vehicles - Activity plan 3: Change of motor vehicle fuel to gas and electricity, introduction of eco-friendly automobiles and R&D, and phased conversion of public transport fuel to gas **[Standards] MNS5013:2009, MNS5014:2009, MNS6757:2019** • Permissible standards for gasoline engine vehicle exhaust gas (MNS5013:2009) • Standards for diesel engine vehicle exhaust fume (MNS5014:2009) • Standards for DPF installation and use for diesel vehicles (MNS6757:2019)
Details	**[Contents of the project]** • **Introduce DPFs to reduce exhaust fumes emitted from old diesel vehicles in Mongolia** - Many air pollutants are discharged from old diesel vehicles traveling in Ulaanbaatar City, adversely affecting its ambient air quality. We propose a project to introduce a DPF device for the old diesel-powered vehicles because the device can reduce the amount of discharged air pollutants in Ulaanbaatar City. The attachment of DPFs is expected to contribute to improving the ambient air quality in Mongolia. **[Reference] Diesel Particulate Filter (DPF) technology** • Diesel particulate filters purify the exhaust gas by removing hazardous substances such as exhaust fumes (fine dust), carbon monoxide, nitrogen oxide, etc. emitted by gasoline and diesel vehicles. - Passive DPF system: While collecting particulate matters (PMs), emitted from an engine, in a DPF, this system continuously regenerates the filter by using the exhaust heat of the engine. In this way, this system can be applied at a low temperature compared with existing products. ▶ Features: Passive regeneration of the filter through catalysis. Supplied to more than 500 Chinese vehicles of 8,000-12,000cc. Can be easily installed, making it easy to manage the system after it is attached. - Active DPF system: This system consists of a DPF and a burner, and actively regenerates the filter by burning off the PMs collected in the filer by using the burner. ▶ Features: Manual active regeneration system. Applied to construction machinery and heavy equipment of 3,000-15,000cc. - Hybrid DPF system: When installed, this system can reduce the PMs of the exhaust gas by more than 98% and can perform regeneration based on active regeneration method by using a diesel burner even under low speed/low load conditions where it is difficult to secure a certain temperature of the exhaust gas. ▶ Features: Can be applied to low-speed intra-city vehicles with low exhaust gas temperature. Passive regeneration can be performed through catalysis under high speed/high load conditions. Can be easily installed, making it easy to manage the system after it is attached.

Details

- PM-NOx After-treatment System: This system effectively removes the PMs and nitrogen oxide (NOx) emitted by diesel engines simultaneously.
  - ▶ Features: Can reduce PMs by more than 80% and nitrogen oxide (NOx) by more than 70% at the same time. Applied to buses and construction equipment with large diesel engines of less than 16,000 cc.

[Figure 58] Diesel Particulate Filter types



Source: Ceracomb webpage (http://ceracomb.co.kr/)

[Proposal]

- **Proposal 1: An institutional system to expand the introduction of diesel particulate filters is needed**
- To encourage diesel vehicle users to install a DPF, it is possible to consider the introduction of a system in which the government subsidizes a portion of the cost.

- **Proposal 2: Need to develop and introduce a DPF that reflects conditions such as Mongolia's climate, fuel specificity, etc.**
- Considering Mongolia's climate and fuel specificity, it is difficult to introduce the DPFs that other countries use. The reasons are as follows: 1) It is hard to guarantee the durability of DPFs because the fuel used in Mongolia has high sulfur content. 2) With severe deterioration of vehicles, oil leaking from the engine may flow into the DPF, which is highly likely to cause a fire. 3) Severe cold in winter makes it difficult to secure the minimum engine heat at which a catalytic device can operate. It is required to develop a durable system that reflects Mongolia's climate and fuel specificity through joint technology development with developed countries and to plan for spreading the system.

(3) Expansion of LPG stations/ Expansion of electric vehicle charging stations.

General status	**[Interviews and advisory]** • Promote the introduction of eco-friendly automobiles (electric vehicles) and plan to introduce 900 eco-buses by 2024. • Although 100 Korean LNG buses were imported, their engines were converted to diesel ones because of a lack of fuel. No gas-fired bus is currently in operation in Mongolia. • Currently, there are eight Chinese electric buses in Mongolia and two or three electric vehicle charging stations. There is a plan to increase the number of gas filling stations and electric vehicle charging stations over the next four years, and more than 12 stations are expected to be installed a year, increasing the total number of stations up to 60. (Mr. Sh. Khavidolda, Ministry of Road and Transport Development, 12:00 pm, Feb. 24, 2021) • There are not enough gas filling stations in Mongolia, and gas vehicles cannot be operated in other areas except for the Ulaanbaatar City. It is estimated that one gas filling station per 21 aimags will be needed, so the government should gradually expand the number of gas filling stations. (Mr. Munkhbat, Ministry of Environment and Tourism, 13:00 pm, Mar. 2, 2021)
Institutional arrangement	**[Laws] Law on Air** Section. 2.4, Article 17 of the Law on Air: The relevant national central administrative agency is required to establish standards for fuels such as gasoline, diesel and LPG by cooperating with other national central administrative agencies in charge of road transportation and petroleum, and then acquire approvals for the standards from the competent authority. **[Policy] NPRAEP** • NPRAEP Goal 3: Comprehensive measures to reduce pollutant emissions from vehicles - Activity plan 2: Support the import and consumption of fuel that meets the Euro 5 quality standard, implement a phased ban on the import and consumption of fuel that does not meet the standards, and improve fuel quality monitoring system. - Activity plan 8: Establish and implement a master plan for gas supply. - Activity plan 9: Gradually prohibit imports of old vehicles and other old transport equipment, expand consumption of electric and gas vehicles, and establish legal regulations.
Details	**[Contents of the project]** • **Introduce gas fuel for mobile sources in Mongolia and expand electric vehicle charging stations** - Gas fuel and electric vehicles should be introduced to reduce air pollutants emitted by mobile sources in Mongolia. To facilitate this, a project for expanding gas and electric vehicle charging stations is essentially required. - The trends of the market show that import of LPG is gradually increasing. To promote the use of imported LPG, a charging infrastructure that provides users with LPG is essentially required. Because a project for building an infrastructure requires large-scale capital, it is possible to devise a method for expanding charging stations utilizing concessional loans, etc. - In the long term, it is also necessary to consider projects to expand electric charging stations through the introduction of policies to encourage the introduction of electric vehicles at the government level.

5.2.3 Environmental Cooperation Projects in the Sector of Monitoring

Totally four projects ① Establishment of a national ambient air quality monitoring information system (NAMIS), ② Improvement of an air quality monitoring system of Mongolia (Agaar), ③ Expansion of air pollution monitoring stations, ④ Introduction of mobile air pollution monitoring stations (vehicles) were identified by anticipating the regions where air pollution monitoring stations should be expanded, in cooperation with domestic and foreign outsourcing service agencies, and by interviews with the National Agency for Meteorology and Environmental Monitoring (NAMEM), Mongolia's national meteorological management agency under the Ministry of Environment and Tourism, and the Ulaanbaatar City Air Pollution Reduction Department (ARPD).

(1) Establishment of a national ambient air quality monitoring information system (NAMIS)/ Improvement of an air quality monitoring system of Mongolia (Agaar)/ Expansion of air pollution monitoring stations/ Introduction of mobile air pollution monitoring stations (vehicles)

General status	**[Literature research]** • Two agencies are operating air pollution monitoring stations separately, and the regulations for air pollution monitoring network operation are insufficient. • Although real-time air pollution data is open to the public through the Agaar system, it is not easy for the personnel in charge to access and use the data. **[Interviews and advisory]** • There are 12 automatic air pollution monitoring stations (7 for CLEM, 5 for APRD) in Ulaanbaatar City, Mongolia. While there is no maintenance regulation for the stations, some experts in the relevant field are maintaining the air pollution monitoring stations. (Mr. G. Davaajargal, APRD, Feb. 25, 2021) • Recently, the installation regulations (related to station standards, list of equipment, etc.) for air pollution monitoring stations have been prepared. • As of now, there is no legal standard for operation, data management, etc. (NAMEM, Feb. 25, 2021) • To operate air pollution monitoring stations, it is necessary to secure and train experts. Although many activities were proposed through cooperation with JICA, it was difficult to conduct them because of a lack of specialists. • It is more urgent to expand air pollution monitoring stations than to replace existing stations, and education is needed to secure experts who can operate the stations. (Mr. G. Davaajargal, APRD, Feb. 25, 2021)
Institutional arrangement	**[Laws] Law on Air** • Chapter 3: This chapter refers to ambient air quality monitoring and information, includes a plan to expand ambient air quality monitoring, and presents the ambient air quality standards for nine substances including PM2.5. **[Policy] NPRAEP** • Includes the activity plan to strengthen environment monitoring in an NPRAEP article (4.5) - Establishes a plan to purchase related equipment to improve the capacities of the Central Laboratory of Environmental Monitoring (CLEM) and local laboratories, which are supposed to conduct monitoring. - Prepare activity plans to expand and manage automatic air pollution monitoring stations in large cities. **[Standard] MNS4585:2016** • Ambient air quality standards (MNS4585:2016)

Details	
Details	**[Contents of the project]** • Prepare a basis to produce reliable ambient air quality data by building an ambient air environment monitoring system, which will enable the policymakers to prepare ambient air quality improvement policies based on such scientific basis. **[Details]** • **Project content 1. Establish a reliable real-time ambient air quality monitoring system** - Measure the ambient air quality values representing the ambient air quality of Ulaanbaatar and secure data reliability by adding six automatic air pollution monitoring stations (five stationary stations and one mobile station) in Ulaanbaatar City, Mongolia. *Note: Areas for which monitoring stations needed to be installed additionally were determined through modeling. (Appendix 1) - Improve the existing data management system by building an ambient air quality management system (with development of equipment and systems), making the ambient air quality data more accessible to the policy makers and providing the public with good-quality information. As a result, this project is expected to contribute to the enhancement of reliability of the ambient air quality data through establishment of a precision control (QA/QC) system, enhancement of the reliability of the data produced, provision of scientific basis for ambient air quality improvement policies, and preparation of operation rules for air pollution monitoring stations to ensure compliance with unified procedures. • **Project content 2. Strengthen capability for managing the ambient air** - Through technical advice, provide support in determining the equipment specifications to establish a system suitable to Mongolia, and suggest the establishment of a road map (plan) related to the monitoring network operation method and ambient air quality monitoring in future. - Contribute to preparing effective policies for ambient air quality improvement by training the operators to run newly installed systems and monitoring stations efficiently and by reinforcing the capabilities of policymakers. - Dispatch Korean staff in charge to the sites in Mongolia to provide trainings (theories and practicing) on the operation of the new monitoring network and systems by demonstrating the operating method to Mongolian staff in person. - For the installation and relocation of the new monitoring network and systems, invite Mongolians in charge (policymakers and staff), conduct pre-training on the systems that will be installed in future, introduce them to the cases of major ambient air quality policies in Korea, enabling them to apply the cases to Mongolia's policies for the improvement of ambient air quality. • **Project content 3. Lay the ground for ambient air management (dispatch experts for a long time)** - Dispatch experts in various fields to help reduce the ambient air pollution and improve the ambient air quality in Mongolia in the long term. - Dispatch experts in various fields for a long time to improve the ambient air quality in Mongolia and conduct an analysis of data acquired by the new systems mutually with Mongolian staff and policymakers and suggest application methods. **[Reference] Korean air pollution monitoring operation status** • Korea's National Ambient Air Quality Monitoring Information System (NAMIS) - This system manages the ambient air quality data of the entire nation, and it also collects and manages comprehensive data in connection with foreign agencies as well as related domestic agencies.

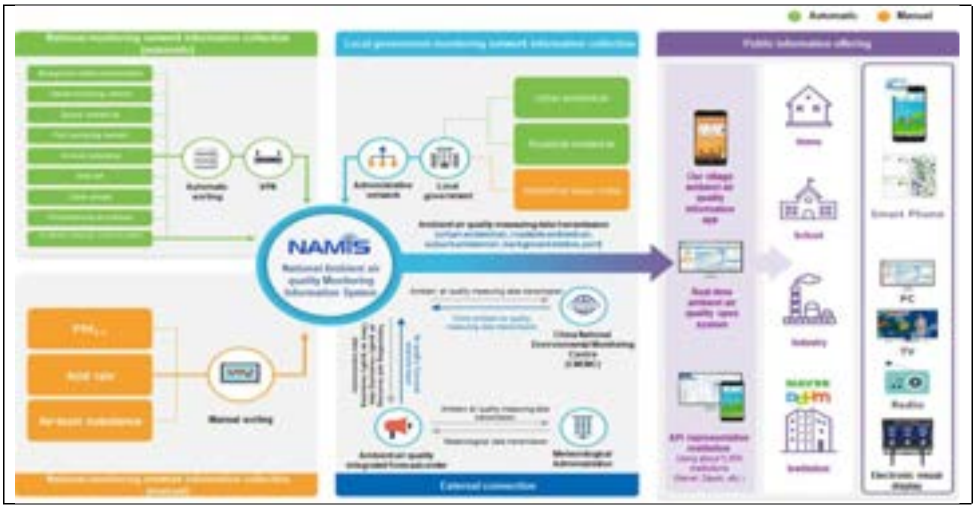
Details

<Table 95> Korean air pollution monitoring station operation status (as of June 2019)

Item	General item				Special item						Super site
Total (station)	Urban area	Suburb	National background	Road side	Toxic air pollutant	Heavy metal	Photochemical (VOCs)	Acid precipitation	Climate change	PM-2.5	
647	378	22	3	41	38	56	18	42	1	42	6
Central government (172)	-	22	3	-	38	-	18	42	1	42	6
Local government (475)	378	-	-	41	-	56		-	-	-	-

Source: Korea Environment Corporation

[Figure 59] Details of the NAMIS system



Source: Korea Environment Corporation

- NAMIS collects data managed by the national monitoring network and local governments and external related materials. To open some of this data to the public, a separate system, called Air Korea, is operated. The information is made public on the website and the mobile application.

• Emission source management status (there are various emission sources that cause air pollution)

[Figure 60] Types of air pollution emission sources

5.3 Method for Securing Funds

To promote the identified environmental cooperation projects, it is essential to secure funds for implementing the projects. If it is difficult for the Mongolian government to make a budget on its own, it can utilize domestic and foreign Official Development Assistance (ODA), Other Official Flow (OOF), and Private Flow (PF) funds.

5.3.1 Method for Utilizing the Official Development Assistance Fund of Korea

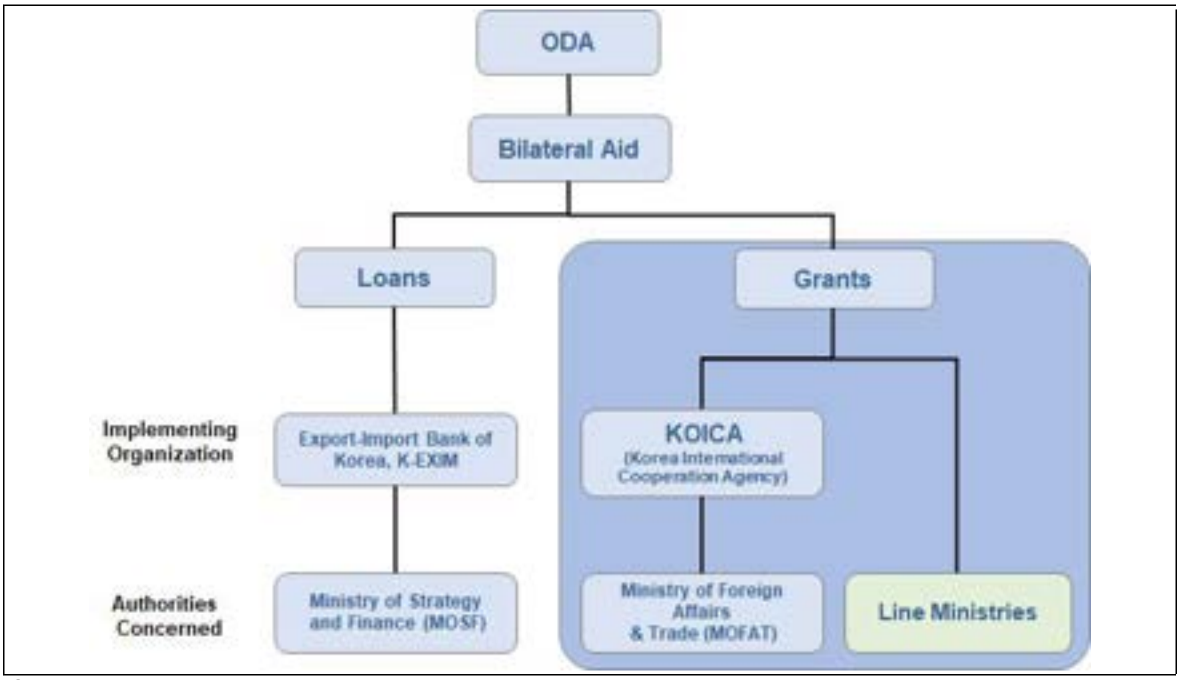
The official development assistance of Korea refers to the grants or concessional loans that public institutions such as central or local governments or execution organizations of assistance provide to developing countries or international organizations for the economic development and welfare improvement of developing countries. Grants, called free aid, refer to cash, supplies, or services that are provided without conditions of repayment. Grants also include debt repayment, NGO support, specific expenditures to carry out aid projects, and so on. Concessional loans means that recipient countries are in debt for cash or supplies they received. Concessional loans, also called soft loans, have favorable conditions for the borrowing countries compared with regular loans in terms of interest rates, period of repayment, the term unredeemed. In particular, if the grant element exceeds 25%, it is appropriated as ODA.

The form of the Official Development Assistance of Korea can be divided into grants and loans.

Grants are free-of-charge support in various forms and the cash or in-kind transfer that is not accompanied by legal liabilities. In other words, the developing countries are not obligated to repay the donated assistance funds, and examples of these include technological cooperation, food assistance, and disaster relief. The execution agency in Korea is KOICA under the Ministry of Foreign Affairs. Other ministries also disburse grant funds for supporting specific sectors, such as "Infra ODA" by the Ministry of Land, Infrastructure and Transport, "Industry and Energy ODA" by the Ministry of Trade, Industry and Energy, and "Green ODA" by the Ministry of Environment.

Loans are concessional public loans donated under favorable conditions compared to private funds in developing countries and the cash or in-kind transfer that is accompanied by legal liabilities. In other words, the developing countries are obligated to repay the donated assistance funds, and examples include support for public development programs and projects in developing countries. The execution agency in Korea is the Export-Import Bank of Korea.

[Figure 61] Types of ODA funds in Korea



Source: Reviewed and written by the Research team

(1) Grants

Grants include project aid, program aid, technical cooperation, and so on. Project aid refers to deriving results by implementing activities using the resources agreed with the recipient country to achieve specific goals or results for a certain area within a given time with a limited budget.

A program aid is provided for general development goals (general program aid) and specific field development (program aid by field) of the recipient country without any special restrictions on the use of financial resources. This aid is mainly provided for the recipient countries to achieve the goals of macroeconomic policies and goals of individual sectors.

Technical cooperation means that governments of donor countries provide recipient countries with knowledge and technology through experts, volunteers, and various equipment to contribute to the economic and social development of recipient countries. It mainly refers to independent technical cooperation that utilizes human cooperation, such as education and training. Technical cooperation encompasses supportive activities planned for human resource development through improvement of technical levels, knowledge, technical expertise, and productive abilities. One of the most important goals of technical cooperation is system development, and the necessary condition is human resource development. Developing the capacities of people and organizations is very important for helping major government institutions to enhance their ability to analyze, develop, and manage policies. Technical cooperation is conducted in various ways as follows: educational training, dispatch of experts, advice on policy and technology, support for preparation for investigation and research, and contributions for scientific research and technology development.

The procedure for implementing free aid projects is as follows: exploring and discussing projects with the government of the recipient county, receiving an official project request form from the recipient country's institutions that generally oversee projects, conducting a project feasibility study, performing preliminary selection of projects, and finalizing contents of projects after intergovernmental consultation. Next, project operators are selected, and the project is implemented. Lastly, appraisal of the project is made.

<Table 96> Procedure for implementing grant projects

Stage	Procedure
Exploring and discussing projects with the government of the recipient country	• Identify and discuss grant projects based on mid-term strategies and national aid strategies. • Identify appropriate projects to effectively meet the recipient country's poverty reduction strategies and development tasks of the national developmental plan. • Identify projects throughout the year through discussion with the recipient country. • Identify projects through diplomatic missions abroad, project exploring conference groups, major diplomatic events, and so on.
Receiving an official Project Request Form from the recipient country's institutions that generally oversee projects	• Receive the recipient country's official Project Request Form for projects created in the stage of "exploring and discussing projects" through diplomatic channels.
Feasibility study for projects that the recipient country officially requests (dispatching research group, etc.)	• Examine the recipient country's official Project Request Form first and classify it as "target projects of investigation for project formation." • For the projects selected for the feasibility study, conduct a feasibility study on whether the projects are appropriate to support by dispatching research groups, etc. (revise and supplement contents during the study).
Project preliminary selection (project review committee, etc.)	• After completing the feasibility study, evaluate the projects in terms of economic, financial, environmental, and social aspects. • The preliminary selection of a project is performed by the "project review committee."
Intergovernmental consultation	• Make an agreement between both governments to officially confirm projects that implementing institutions of the two countries agree on at the government level. • If the two governments cannot enter into an agreement because of project scale, the character of projects, national situations, diplomatic reasons, etc., implement projects by agreement between two organizations.
Confirmation of contents of the projects (Conclusion of a Record of Discussions)	• Discuss details of selected projects with the recipient country. • Conclude the Record of Discussions (R/D) specifying the details and burdens of project items.
Selecting project operators and implementing projects	• After the agreement between the two governments, start on the projects by confirming a plan for executing projects and selecting project operators. • The stages of project execution are as follows: ①establishing an execution plan, ②selecting project operators, ③executing projects and monitoring, ④ finishing projects.
Project appraisal	• Project evaluation is conducted by evaluating project plan establishment, execution, and results, and implement the evaluation by dividing it into interim evaluation, termination evaluation, and post evaluation according to the time of evaluation.

Source: Overseas Information System for Construction Engineering (http://ovice.or.kr)

(2) Concessional loan

There are various types of loans: the Development Project Loan, the Equipment Loan, the Public-Private Partnership Loan, the Two-Step Loan, the Commodity Loan, and Mixed credits.

The Development Project Loan provides funds for economic development projects in developing countries such as dams, water supply and sewerage systems, roads, hospitals, environmental facilities, and plant facilities.

The Equipment Loan provides developing countries with funds for equipment and related services necessary for specific industries, specific development plans, or specific projects.

The Public-Private Partnership Loan provides funds to the governments of developing countries or private investment project corporations established separately for the implementation of private investment projects.

The Two-Step Loan supports specific sectors or specific programs through financial institutions of developing countries. This loan is intended for many final beneficiaries by providing funds to small and medium-sized enterprises or farm owners.

The Commodity Loan is intended for emergency financing of the balance of payments of developing countries and provides funds for importing commodities from Korea to stabilize the domestic economy.

Mixed credits combine loans, which are aid funds, and export credits to provide favorable financial conditions. There are three types depending on the fund combination.

<Table 97> Types of co-financing in EDCF

Classification	Overview
Parallel financing	Despite supporting the same projects, this financing requires that the scope of the projects should be divided depending on the characteristics of the support fund and each fund should be offered only within the designated scope, and the ordinary support procedure should be also conducted separately. (e.g., within the same projects, provide EDCF for the civil engineering field and export credit for other equipment.)
Joint financing	Several funds are combined to make a pool of funds, and each fund is spent at a fixed percentage (normally, a total mixed percentage) according to the progress of the same projects.
Pre-mixed credit	Like joint financing, each fund is spent at a fixed percentage on all the same projects. However, funding institutions reconstruct a single financial package by integrating several funds in advance and conclude a loan contract with one borrowing condition.

Co-Financing of Multilateral Development Bank (MDB) refers to participating in funding for development projects in developing countries in association with major MDBs such as the Asian Development Bank (ADB), the Inter-American Development Bank (IDB), the World Bank (WB), the African Development Bank (AfDB), and the European Bank for Reconstruction and Development (EBRD). There are two main types of co-financing: parallel financing and joint financing. Other than these, there is umbrella or standby financing, channel financing and participation financing.

<Table 98> Types of MDB co-financing in EDCF

Classification	Overview
Parallel financing	Institutions of co-financing share a project and divide it into several parts and provide financing in a shared form. Each participating agency decides loan conditions and purchase procedures on an equal and independent position and writes up an independent loan contract. ※ It is suitable when supplying tied aid such as EDCF loans.
Joint financing	Without dividing a project into independent multiple parts, co-financing institutions set a specific loan percentage and lend money accordingly. Because the International Bank of Reconstruction and Development (IBRD) or the Asian Development Bank (ADB) is likely to lead projects, institutions should follow the purchase guidelines of these two banks.

Supporting grant for developing projects refer to the dispatch of consultants free of charge in a case where a recipient country cannot properly respond to difficulties caused when preparing, implementing, and managing loan projects because of lack of capital and expertise.

Compact loans were introduced to simplify the procedures for small EDCF loans and to expand the participation of small and medium-sized Korean enterprises in EDCF support projects. The loan size is less than 2 million SDR (about USD 3 million), and project participants are restricted to small and medium-sized enterprises in Korea. All procedures such as project applications, evaluations, purchases, etc. are simplified for the smooth progress of the projects.

The procedure for implementing loan projects is as follows: The recipient country's government submits a request for support to the Korean government through diplomatic channels, and the Minister of Strategy and Finance of Korea requests the Export-Import Bank of Korea to evaluate the project. In sequence, an intergovernmental agreement is concluded following the Strategy and Finance Minister’s final approval of the evaluation results. The president of the Export-Import Bank concludes a loan agreement with the recipient government according to the intergovernmental agreement. Project implementation organizations conduct consultant employment, purchasing, and expenditures based on the loan agreement, and perform post-project evaluation.

<Table 99> Procedure for implementing loan projects

No.	Stage	Details
1	**Project support request**	• The recipient country’s government submits a request for support of the project to the Korean government through diplomatic channels. • The recipient country’s government attaches related documents such as Feasibility Study (F/S) and Implementation Plan (I/P).
2	**Field evaluation**	• The Minister of Economy and Finance requests the Export-Import Bank to evaluate the project. • The Export-Import Bank evaluates main contents of the Loan Agreement (L/A) and items necessary to implement the project, concludes the Minutes of Discussion (MOD) on the agreement, writes an evaluation report, and submits it to the Minister of Economy and Finance.
3	**Project approval**	• The Minister of Economy and Finance determines support policies including the scale of support for the project and support conditions after consultation with the Minister of Foreign Affairs, the Minister of Science, ICT and Future Planning, the Minister of Trade, Industry and Energy, and the competent minister of the project.
4	**Approval notification**	• The Minister of Foreign Affairs notifies the government of the recipient country of the support policies notified by the Minister of Economy and Finance.
5	**Intergovernmental agreement conclusion**	• If the government of the recipient country accepts the support policies, the Arrangement between governments shall be signed. However, in the case of countries that have contracted a Frame Arrangement (F/A), the Arrangement between governments shall be omitted.
6	**Loan agreement negotiation and conclusion**	• The president of the Export-Import Bank concludes the Loan Agreement after negotiation on the contents of the Loan Agreement with the government of the recipient country according to the intergovernmental agreement (including the Arrangement).
7	**Consultant employment**	• Project implementation organizations select consultants and conclude employment contracts according to the contents of the Loan Agreement.
8	**Purchase**	• Project implementation organizations execute bids according to the contents of the Loan Agreement and conclude purchase contracts with successful bidders.
9	**Expenditure of funds**	• Spend funds according to the Loan Agreement, employment contracts, and purchase contracts.
10	**Ex-post management**	• Conduct a project completion evaluation reviewing whether the project is proceeding as originally planned, after receiving the project completion report • Conduct a project comprehensive evaluation including the social and economic ripple effects of the project from the preparation stage, and the level of contribution to welfare promotion of the recipient country’s people and economic development after two years from receiving the project completion report

Source: Overseas Information System for Construction Engineering (http://ovice.or.kr)

5.3.2 Method for Utilizing Funds from Multilateral Development Bank

The Multilateral Development Bank (MDB) is a bank that provides economic development funds. The MDB refers to a bank in which multiple borrowing countries, developing countries, multiple financial donors, or developed countries participate without restriction on membership. Generally, the MDB includes the World Bank (WB) and four regional development banks (Interamerican Development Bank (IDB), African Development Bank (AfDB), Asian Development Bank (ADB), and European Bank for Reconstruction and Development (EBRD).

The MDB provides economic development funds only for businesses that are profitable and have a clear outlook for debt repayment by raising funds with investments and loans. Therefore, low-income developing countries with low external credibility and poor debt repayment capabilities are almost impossible to borrow from the MDB or raise funds in the international financial market. Therefore, as the long-term and low-interest concessional lending window for low-income developing countries, the MDB has established and operated special organizations or funds, separately, such as the International Development Association (IDA), the Africa Development Fund (AfDF), and the Asia Development Fund (AsDF).

Korea has used funds from the World Bank to build national key industries since the early 1960s when it joined the World Bank. However, since the late 1970s, Korea has been actively participating in economic development projects of developing countries led by the World Bank as a donor rather than a beneficiary. Also, although it was provided with funds by the ADB to develop the economy and overcome the financial crisis, Korea is now exerting its influence on ADB policy, such as holding the position of executive director. In addition, Korea joined the AfDB, the EBRD, and the IDB to strengthen cooperation with member countries and participate in financing projects. (KRIHS electronic library, 2017)

5.3.2.1 World Bank Group

The World Bank Group was established under the Bretton Woods system[2)] after World War II to create the International Monetary Fund (IMF), whose purpose was to stabilize the international currency and financial system, and the International Bank for Reconstruction, and Development (IBRD), whose purpose was financial support for the restoration of war damage and long-term development. At its establishment, the World Bank Group was mainly focused on financial support for postwar reconstruction, but gradually expanded its business area to include financial support for the economic development of underdeveloped countries.

(1) Summary of World Bank Group's organizations

The WB Group consists of five organizations[3)],
two of which, the International Bank for Reconstruction, and Development (IBRD) and the International Development Association (IDA), are included in the WB. The IBRD provides funds for the restoration of war damage and long-term development, while the IDA provides interest-free or free funds to low-income developing countries.

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2) An international monetary system based on an agreement by 44 Western countries in 1944

3) The WB Group consists of the International Bank for Reconstruction, and Development (IBRD), the International Development Association (IDA), the International Finance Corporation (IFC), the Multilateral Investment Guarantee Agency (MIGA), and the International Centre for the Settlement of Investment Disputes (ICSID).

<Table 100> Summary of the WB Group's organizations

Item	IBRD	IDA	IFC	MIGA	ICSID
Features	Fund support for the restoration of war damage and long-term development	Concessional fund support for low-income developing countries	Investment and financing in private enterprises	Non-commercial risk assurance for direct investment in developing countries	Promotion of international private investment through mediation and arbitration of international investment disputes
Year of establishment	1945	1960	1956	1988	1966
Support target	GNI $7,035 or less per person[1)]	GNI $1,195 or less per person[1)]	Private enterprise	Private enterprise	Private enterprise
Number of member countries	188 countries	172 countries	184 countries	177 countries	147 countries
Year Korea joined	1955	1961	1964	1988	1967
Voting power	1.17%	0.73%	0.66%	0.47%	1/146

1) Standard value set in 2012 (no change as of 2015)
Source: KOTRA, Multilateral Development Bank's Funding Methods and Procedures (2016)

① International Bank for Reconstruction and Development (IBRD)

The International Bank for Reconstruction and Development (IBRD) provides loans for economic development, cooperative loans, payment guarantees, advisory services, etc., to governments in developing countries and underdeveloped countries with high credit ratings. Economic development loans will be provided to member countries with per capita GNI below a certain level (as of 2015, about 100 countries are eligible). In recent years, it has focused on providing loans or technical support to governments or private companies in developing countries to expand international trade or develop the economy.

Whether the borrower is a recipient country or a private company, it must have the ability to repay foreign currency loans, and if the borrower is a private company, a guarantee from the government of the recipient country is required. It is also possible for private projects with high profitability and repayment potential to receive non-guaranteed loans.

The loan types can be divided into "investment loan" and "development policy loan." The investment loans provide loan support for long-term development projects, and the development policy loans support policy and system reform projects in the short term. Investment loans account for 70-80% of the total loans.

The loan interest rates are at market rate levels, and loan periods are usually 15 to 25 years (usually including a 3- to 8-year deferred payment period). In 2015, IBRD provided 112 projects in 45 countries with $23.5 billion in loans (an average loan amount of $450 million per project).

② International Development Association (IDA)

The International Development Association (IDA) provides long-term concessional loans without interest or free of charge to eradicate poverty and create a foundation for long-term growth in the poorest countries and plays a complementary role to the IBRD.

It was established in 1960, has 170 member states, supports the poorest countries, and its list of eligible countries is updated annually. IDA loans are only available to the government of the recipient country and to the public sector guaranteed by the government of the recipient country. While IBRD loan interest rates are determined by market interest rates, IDA loans can be interest free, and the repayment deadline may be extended up to 35 to 40 years (including a 10-year grace period).

IDA's financing methods include investment, contribution, IBRD transfer income, self-financing, etc. In 2015, IDA provided loans to 190 projects ($18.9 billion in total) in 103 countries. IDA provides free grants, which accounts for about 20 to 30% of the total amount of support.

③ International Finance Corporation (IFC)

The International Financial Corporation (IFC) provides investment and loan support without government payment guarantees mainly to private projects and companies in developing countries and emerging countries. It was established in 1956 to support private sector activities in developing countries, and its investment and lending take the form of acquisition of stocks or bonds, opening of credit limits, etc., that may be repaid over 7 to 12 years with a maximum of 4 years of deferment. The investment and lending limit is within 25% of the total cost of the project and 35% of the total capital.

IFC's financial resources are raised through investment, IBRD/international financial market borrowing, investment and loan asset sale or recovery, revenue, etc., and borrowing is its main funding source, accounting for more than 50% of the total. In 2015, IFC provided investments and loans to 406 projects ($10.5 billion) in 83 countries.

④ Multilateral Investment Guarantee Agency (MIGA)

The Multilateral Investment Guarantee Agency (MIGA) was the most lately established (1988) among the WB Group's five organizations. It was established in order to support the economic growth of the target countries by promoting foreign direct investment in emerging countries and to eradicate poverty and improve living standards.

MIGA helps resolve disputes by providing guarantees for various political risks that may arise to investors and lenders (expropriation, breach of contract, restriction on currency transfer, war and disturbance, non-fulfillment of the government's fiscal obligations, etc.).

It has provided support to more than 600 projects in more than 100 developing countries, and as of 2010, its guaranteed amount is about $22.4 billion. MIGA's total insurance (guarantee) provision reached $7.7 billion, exceeding the $7.3 billion mark it recorded in 2009.

(2) WB's lending types and characteristics

WB's lendings are divided into investment loan and development policy loan. Investment loan provides construction, goods, etc. and takes the form of long-term project. Development policy loan provides support for system reform in the field of national policy and economy as a whole and takes the form of short-term project.

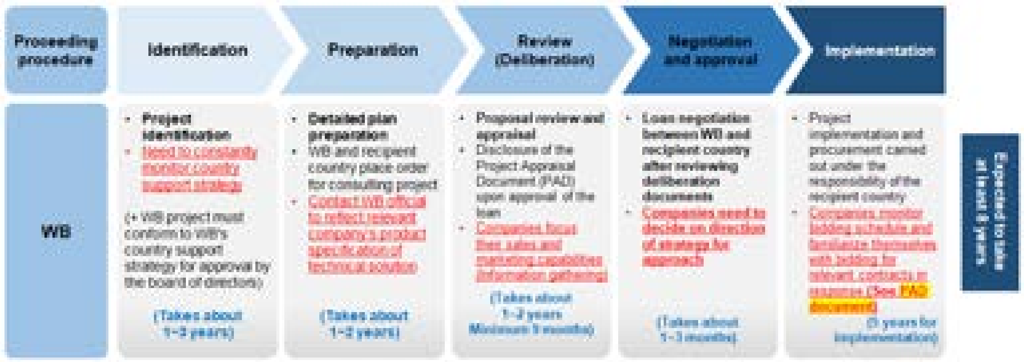
<Table 101> WB loan characteristics by type

Item	Characteristics
Investment loan	• Construction, goods, consulting • Pre-determined project • Long-term project (5–10 years) • Confirmed procurement and implementation schedule
Development policy loan	• Support for system reform in the field of national policy and economy as a whole • Short-term project (1–3 years) • Short-term finance system

Source: KOTRA, Multilateral Development Bank's Funding Methods and Procedures (2016), World Bank webpage

Although the characteristics of each project in the WB loan project implementation procedure are different, they all proceed according to an identical process, which goes through a total of five steps and is expected to take at least 8 years.

[Figure 62] WB loan project implementation procedure



Source: Korea Energy Agency, WB Bidding Guidelines (2018)

① Identification

Identification of the project is the step for devising and planning a project. This is the step where several project plans that belong to the WB's Country Assistance Strategy are realized. The project must meet the fields and purposes mentioned in the WB's Country Assistance Strategy to obtain approval from the Executive Board. Therefore, companies need to consistently monitor the WB's Country Assistance Strategy.

② Preparation

Preparation is a step where projects in the devising and conceptual stage are materialized through detailed planning of the project, etc. Recipient countries and the WB cooperate to establish detailed project plans, and recipient countries and the WB will place an order for consulting projects such as feasibility studies, plan analysis, environmental impact assessment, etc. Projects that have entered the preparatory stage can secure Project Information Documents (PIDs) that provide a basic overview and information (contact information, etc.) on key persons in charge from the WB webpage. From the beginning of the project implementation process, it is possible to attempt to reflect the relevant company's technology, solutions, and product specifications in the project through contact with the recipient country and the WB persons in charge.

③ Review (Deliberation)

In the appraisal step, the WB reviews and evaluates project proposals. The appraisal step is where the WB reviews procedures and regulations to be applied to procurement and the specifications of construction, goods, services, and equipment required for the project. Whether sufficient funds are available until the completion of the project is reviewed and evaluated. Factors for review and evaluation include fund-raising plans, the possibility of and necessity for joint loans, required budget details, etc. The Project Appraisal Document (PAD) is released on the WB webpage right after approval. This is a document that contains a detailed description of all components of the project. Thus, companies interested in the project should refer to it to obtain specific information and prepare accordingly.

[Figure 63] WB's PAD document (example)

Source: World Bank webpage (https://www.worldbank.org/en/home)

④ Negotiation and approval

The negotiation and approval step is where the WB and a recipient country officially begin loan negotiations after reviewing the appraisal documents. When the recipient country agrees to the specific project implementation plans and schedule, support terms, etc. it is proposed to and approved by the WB executive board. After obtaining approval, WB and the recipient country sign a loan agreement.

At this stage, interested companies must decide which strategy they will approach the project under. For example, it may be necessary to supplement the shortcomings of the relevant company through strategies such as forming a consortium with other companies or using local companies as agents.

⑤ Implementation

In the implementation step, procurement related to the implementation of the approved project is carried out under the responsibility of the recipient country, and the WB supervises the proceedings. The WB is not a party to the procurement contract, but supervises whether the procurement process is proceeding well in accordance with the specifications in the loan agreement. Because this is the step where project opportunities materialize in the procurement unit of the project unit's specific field, interested companies should seek bidding opportunities by demonstrating their marketing and sales capabilities. After completion of the project, the WB conducts a post-evaluation to check if the originally set goal has been achieved, and follow-up projects can be developed depending on the development demands of the recipient country.

5.3.2.2 Asian Development Bank (ADB)

The Asian Development Bank (ADB) was established with the aim of promoting economic growth in Asia and the Pacific region and cooperation among ADB member countries, and boosting economic growth in developing countries.

ADB's main functions are (1) Promoting regional investment of various public and private capital for regional development of Asia and the Pacific region; (2) Supporting the funding of developing countries' development projects for balanced regional development; (3) Supporting and coordinating the development policies and project plan establishment for regional member states for the efficient use of the loan funds and expansion of trade; (4) Providing technical support for the preparation and execution of development project plans in the recipient country; and (5) Promoting cooperation with international organizations, private organizations and member states interested in development investment in the UN, its affiliated organizations and other Asia-Pacific regions. Unlike the organization of the WB Group (consisting of five independent organizations), the ADB has industry-specific organizations under regional departments centered on the headquarters, and projects are carried out with the department at the center.

(1) Current status of ADB's financial resources

ADB raises its financial resources through equity capital and special reserves of member states, financing through the issuance of WB bonds, and profits through lending or investments. ADB consists of Loan, Grant, Equity Investment, Technical Assistance, etc., and all funds are directly controlled and executed by ADB headquarters.

<Table 102> ADB loan types

Item	Fund source	Remarks
Ordinary Capital Resources (OCR)	Financing through international financial markets and profits through various projects	Mainly member states and private institutions with repayment capabilities utilize these funds
Asian Development Fund (ADF)	Contribution from member states	Provided to the poorest member states at the lowest interest rate
Equity Investment	Financing through international financial markets and profits through various projects	Mostly invested in private projects (Private Sector Operations Department (PSOD))
Technical Assistance Grant (TA)	Technical Assistance Special Fund (TASF)	• Project Preparation Technical Assistance (PPTA) • Advisory and Operational Technical Assistance (AOTA)
Other Bilateral Funds	Specific countries and institutions designate ADB as fund managers and provide them in the form of Bilateral Funds	-

Source: KOTRA, Multilateral Development Bank's Funding Methods and Procedures (2016), ADB webpage

(2) ADB loan project implementation procedure

ADB's loan project implementation procedure goes through five steps, and the entire cycle is expected to take at least eight years.

[Figure 64] ADB loan project implementation procedure

Source: Korea Energy Agency, ADB Bidding Guidelines (2018)

① Project identification

When the recipient country submits its own plan to the ADB, the ADB conducts a Feasibility Study (F/S), and when the fund is approved, the ADB and the recipient country establish a Country Partnership Strategy (CPS). The CPS draft is reviewed by relevant organizations in the recipient country, and the implementation plan of projects subject to ADB support are prepared as annexes. Afterwards, when CPS is approved by the ADB board of directors, it will be released on the ADB webpage, and companies can identify mid- to long-term ADB strategies and development plans of the countries they are interested in.

② Preparation

In the preparation step, when the establishment of a program containing development strategies and plans for a specific region of the recipient country is completed, a plan shall be prepared accordingly. ADB's assistance plan is released on its webpage. ADB periodically conducts Project/Program Preparatory Technical Assistance (PPTA) so that member state governments can identify and prepare their own programs/projects. In the PPTA process, the recipient country and ADB hire consultants for project feasibility analysis, and in the case of TA projects, ADB directly employs consultants. This is probably the biggest difference from the WB's case where the recipient country directly selects the consulting.

③ Appraisal

In the appraisal step, the ADB investigates the feasibility of the project through consulting reports and a fact-finding survey. The fact-finding survey is for assessing the risk and impact of implementing the project, and is an intensive analysis of the technical, financial and environmental impact of the project. This is also the time when the loan period and conditions are reviewed, and project planning is carried out.

④ Negotiation and approval

After the fact-finding survey, on-site due diligence, analysis through consultation, etc., for full-scale project review are performed. Upon completion of the loan negotiations between ADB and the recipient country, an agreement to provide loans called the Report and Recommendation of the President (RRP) will be presented to the board of directors, and when it is approved by the board of directors, the RRP will serve as a guide for implementing the project. The RRP is a document with an identical meaning as the PDA, the WB's project review report. If the RRP is approved, the procurement process can proceed immediately. Thus, interested companies need to thoroughly review the RRP.

⑤ Implementation

In the implementation step, the recipient country and the implementation agency will have direct authority over paid and free projects, excluding TA. Depending on the nature of the project, ADB projects are carried out over a period of two to five years. And there are bidding activities even during the implementation period of the project, so interested companies should also pay attention to the detailed bidding information of ongoing projects. ADB prepares an outcome report and a TA outcome report for project evaluation within 1–-2 years of project completion to share the experience of the project.

5.3.2.3 Asian Infrastructure Investment Bank (AIIB)

AIIB was established in 2016 with the aim of promoting Asia’s economic and social development, regional connectivity and cooperation through infrastructure investment. AIIB’s focus is on infrastructure investment, while the first priority of the WB, ADB, etc., is global poverty eradication.

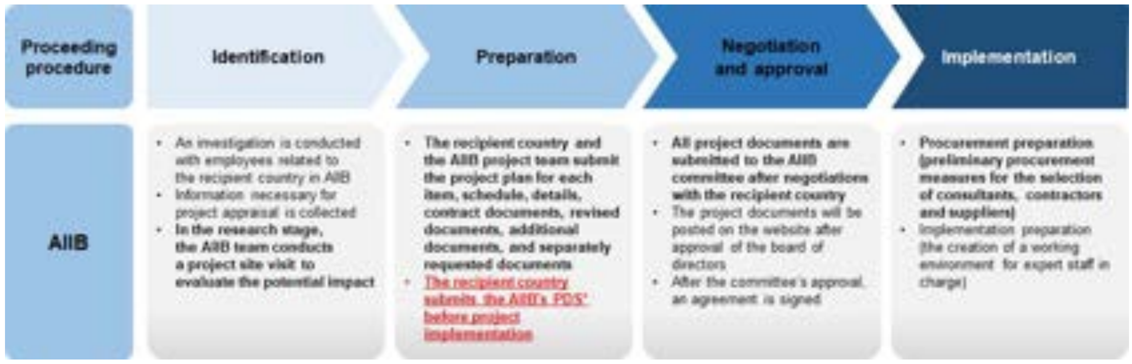
The background behind the establishment of AIIB is that there is a surge in demand for infrastructure in Asia, but MDB funds could not meet the annual development demand. It is expected that AIIB will contribute to resolving the shortage of investment funds by investing heavily in infrastructure construction in Asia. AIIB is seen as the first attempt to form a Chinese-centered financial order in response to the international financial order led by the United States and Japan.

AIIB’s capital is composed of general capital and special funds, where general capital consists of authorized capital, loans, repayment of loans and collateral, profits from equity investments, etc., and special funds consist of capital entrusted as a special fund, loans and collateral using the special funds, equity investment dividends, derivative income from special fund investments, etc.

(1) AIIB loan project implementation procedure

The AIIB loan project implementation procedure is carried out in a total of four steps: project identification, preparation, negotiation and approval, and implementation.

[Figure 65] AIIB loan project implementation procedure



* PDS documents are project delivery strategy, and procurement plans (PP) are also submitted when submitting the documents to the AIIB. AIIB review and approval required

Source: Korea Energy Agency, AIIB Bidding Guidelines (2018)

① Identification

In the project identification step, the recipient country submits its own plan to the AIIB, which includes a simple project summary, preliminary or final possibility report, etc. Further investigation for evaluation may be requested after reviewing the information received by the AIIB. In the research stage, AIIB conducts a project site visit to evaluate the potential impact.

② Preparation

In the preparation step, AIIB consults with the recipient country to prepare projects used for internal deliberation based on initial review and additional supporting research. The AIIB project team submits the project's plan for each item (including procurement plan), schedule, details, contract documents, revised documents, additional documents, and separately requested documents.

③ Negotiation and approval

In the negotiation and approval step, project documents are submitted to the AIIB committee after negotiations with the recipient country. At this time, after approval of the board of directors, it will be posted on the AIIB webpage with the consent of the recipient country. After the committee's approval, the recipient country signs the agreement.

④ Implementation

To prevent delays in project implementation, AIIB will proceed with procurement and implementation preparations. During procurement preparation, preliminary procurement measures for the selection of procurement consultants and suppliers are carried out. Preparations for implementation include the creation of a working environment so that project execution agencies can effectively implement projects.

AIIB provides a Project Completion Report (PCR) within 6 to 12 months of project completion. The PCR provides implications such as project outcome, performance of the project recipient country and AIIB, degree of achievement of the project's development goals, linkage with related projects, etc.

(2) Current status of AIIB Project Preparation Special Fund creation

The AIIB Project Preparation Special Fund was established in June 2016 to assist developing countries in the preparation step of infrastructure projects free of charge, as developing countries need funds in the preparation step of infrastructure projects for such things as project plan establishment, feasibility study (F/S), etc.

Rather than identifying new projects and establishing basic plans for projects, the fund assists in the follow-up preparation step of a project that is already somewhat specific after having completed the basic preparation step. The target of the AIIB Project Preparation Special Fund is mainly government-guaranteed projects, mid- to low-income countries[4)]), and supports F/S review and improvement, environmental, financial and technology analysis, purchase and contract-related advice, capacity building program, etc.

However, AIIB limits support for private projects other than government-guaranteed projects to less than 10% of the total special fund support amount, and limits support for countries other than mid- to low-income countries to less than 20% of the Project Preparation Special Fund. Because the AIIB Investment Bureau (overall management of infrastructure project) conducts deliberation on Special Fund projects, the projects approved by the Special Fund are likely to be ultimately linked to the AIIB infrastructure project.

[4)] A beneficiary of the International Development Association (IDA), a country with a per capita GNI of $1,165 or less as of 2018

5.3.3 Method for Utilizing Climate and Environment Funds

(1) Definition

International funds that support the financing of projects necessary for developing countries to set and achieve sustainable development goals related to a response to climate change include the Global Environment Facility (GEF), the Global Climate Fund (GCF), and the Adaptation Fund (AF).

(2) Global Environment Facility (GEF)

GEF was the first multilateral financial organization launched in 1994 to improve the global environment as one of the UN Framework Convention on Climate Change (UNFCCC) policy mechanisms, and was established at the 1992 Rio Earth Summit and officially launched in 1994 after a trial period.

Under the perception that environmental issues are not local but cross-border, it supports the implementation of international environmental agreements of developing countries and countries in transition.

The five main areas it supports are climate change, biodiversity conservation, international water resource protection, desertification and forest degradation prevention, and chemical and waste management, and it consists of 18 implementation organizations including international organizations (UNEP, UNDP, FAO, etc.) and multilateral development banks (WB, ADB, etc.).

GEF's subsidies consist of board-approved grants and concessional funds and GEF provides funds in four ways: Full-Size Project (FSPs), Medium-Size Project (MSPs), Enabling Activities (EAs), and Small Grant Program. The projects are divided into full-sized programs ($2 million or more) and mid-sized programs ($2 million or less).

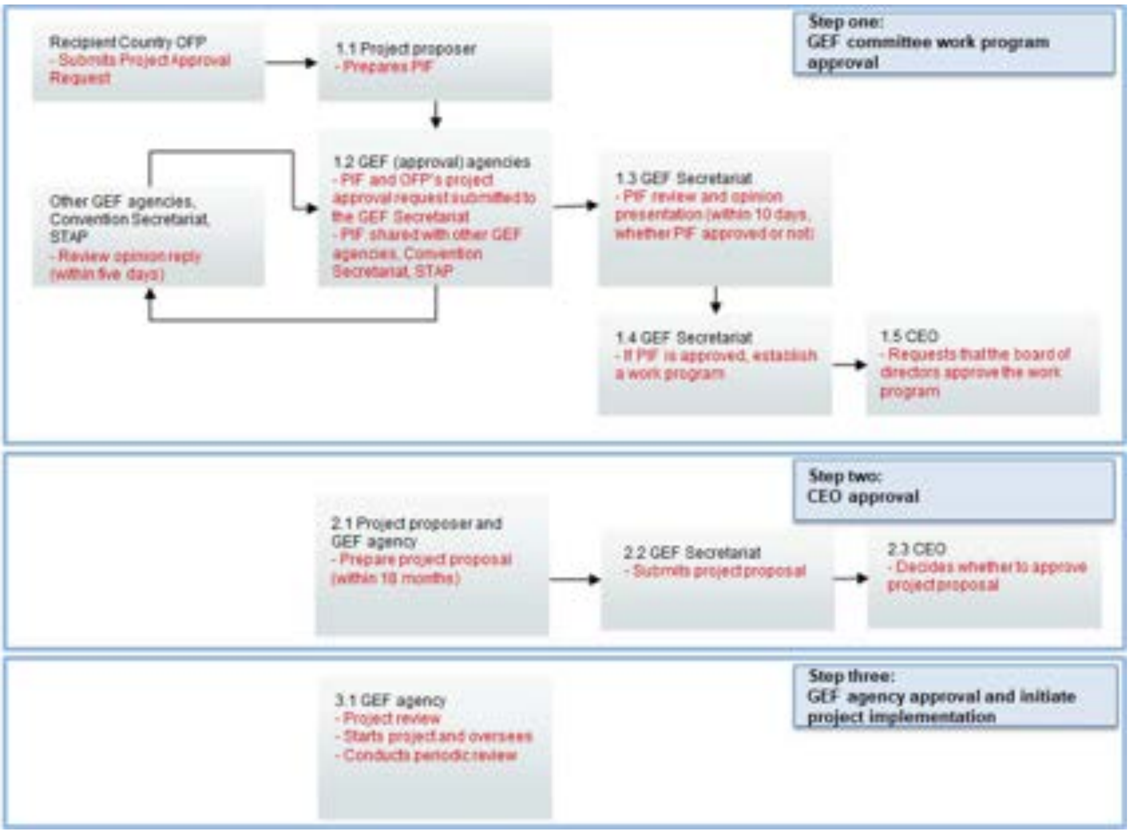
The procedure for performing the Full-Sized Program ($2 million or more), which accounts for more than 80% of GEF funds, is as follows: To start with, when promoting a GEF project, cooperation with pre-approved GEF organizations is essential. The list of GEF organizations is shown in the table below. It usually takes five to six years to support an FSP worth more than $2 million.

<Table 103> GEF approved organizations

Item	Name of organization
Regional and national agencies	Asian Development Bank (ADB), African Development Bank (AfDB), West African Development Bank (BOAD), Development Bank of Latin America (CAF), Conservation International, Development Bank of South Africa (DBSA), European Bank for Reconstruction and Development (EBRD), Ministry of Environmental Protection of China's Foreign Economic Cooperation Office (FECO), Brazil Biodiversity Fund (FUNBIO), Inter-American Development Bank (IADB)
International organizations	International Fund for Agricultural Development (IFAD), International Union for Conservation of Nature (IUCN), United Nations Development Programme (UNDP), United Nations Environment Programme(UNEP), United Nations Industrial Development Organization (UNIDO), World Bank (WB), World Wildlife Fund (WWF-US)

Source: Korea Institute for International Economic Policy, Evolution of the financial mechanism of international organizations, and our countermeasures (2016)

[Figure 66] GEF's Full-Size Project (FSP) implementation procedure



Source: Korea Institute for International Economic Policy, Evolution of the financial mechanism of international organizations, and our countermeasures (2016); GEF webpage (https://www.thegef.org/)

Step one: First, the project proposer prepares a Project Identification Form (PIF) and submits it to the GEF Secretariat. This must be shared with other GEF agencies, relevant Convention Secretariats, and the Science and Technology Advisory Panel (STAP) (receive review opinion replies within 5 days and share them with the GEF Secretariat).

The GEF Secretariat reviews the PIF and replies with the results within 10 days. If the PIF is approved, the GEF Secretariat establishes a work program to promote the project, and the GEF CEO submits it to the board of directors and requests approval. The board of directors frequently reviews work programs and decides whether to approve them. The PIF consists of contents such as the identified project's conformity with the GEF focus area, the components of the project, the size of the requested GEF fund, the size of the cooperative loan, etc. Whether the project requirements are satisfied requires a review and description of conformity with the requirements, such as the consideration of interested parties in the recipient country, gender, project risk factors, national priority, etc. This is the time to indicate whether to agree to the project promotion with the confirmation of the recipient country's Operation Focal Point (OFP) and the GEF agency.

Step two: If approved by the board of directors, the project proposer and the GEF agency prepare a specific project proposal within 18 months of PIF approval. If a project proposal is not submitted within 18 months, the CEO notifies the GEF agency and the recipient country's OFP of the project cancellation. When submitting a project plan, a cooperative loan agreement, a plan to monitor the progress, etc., are attached.

When a project proposal is submitted to the GEF Secretariat, the Secretariat reviews it, delivers it to the CEO and requests approval from the CEO. When delivering the project proposal, the GEF Secretariat must also submit whether feedback from the committee or the Science and Technology

Advisory Panel has been reflected. After the CEO's approval, the project and related materials are released on the GEF webpage.

Step three: Implementation is initiated after project approval by the GEF agency, and the GEF agency oversees the work of the project implementation cooperation agency and conducts periodic reviews.

(3) Green Climate Fund

It was founded at the UNFCCC General Assembly (held by COP16, Cancun) as a UN-affiliated organization. Developed countries decided to raise $100 billion annually until 2020 to support developing countries in reducing greenhouse gases and adapting to climate change.

Because of the limitations of the climate change fund created through the GEF's public aid fund, the need to contribute to new multilateral financial institutions that can facilitate the use of funds for developing countries has emerged. It is a key organization of financial mechanisms established to expand the infrastructure in developing countries where it is difficult to implement projects focusing on the environment because of weak infrastructure.

GCF's financial resource access method is divided into Direct Access and International Access. Direct Access will be applied when financial resources are requested through a subnational, national or regional Accredited Entity (AE) designated by the recipient country, and International Access will be applied when financial resources are requested through an international AE, such as UN organizations, multilateral development banks, and international financial institutions.

The project fields that GCF supports are divided into greenhouse gas mitigation and climate change adaptation, and a cross-cutting field that includes these two fields.

<Table 104> GCF-supported project fields

Greenhouse gas reduction	Climate change adaptation
• Low-carbon energy access and production • Low-carbon transportation • Energy-efficient building, city and industry • Sustainable forestry and land use	• Assistance for residents, communities, and regions vulnerable to climate change • Health, quality of life, food and water security • Infrastructure and internal capabilities to respond to climate change threats • Ecosystem

Source: GCF webpage (https://www.greenclimate.fund/)

The size of the GCF projects refers to the total amount of investment, including GCF funds and joint investment, and is divided into four categories: Micro, Small, Medium, and Large.

<Table 105> project size

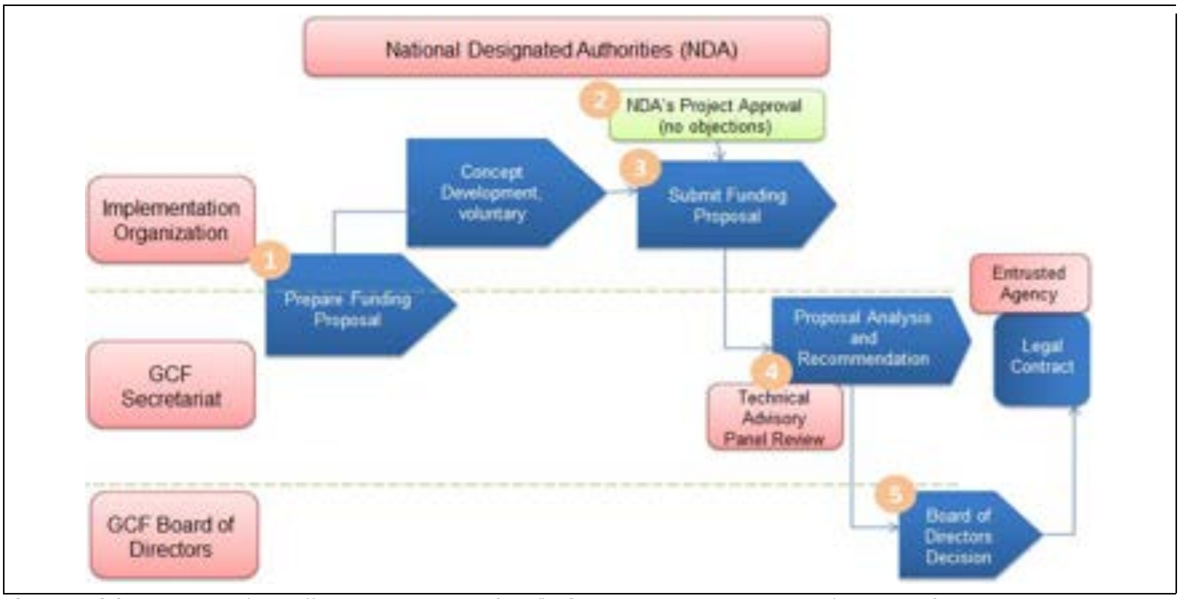
Project size	Criteria
Micro	≤ USD 10M
Small	＞USD 10M, ≤USD 50M
Medium	＞USD 50M, ≤USD 250M
Large	＞USD 250M

Source: GCF webpage (https://www.greenclimate.fund/)

The project approval procedure proceeds in five stages. First, the implementation organization prepares a project proposal, and a public notice of project proposal acceptance is posted on the GCF webpage. Projects proposals are received from time to time, and they are collected for the board of directors to discuss whether to approve them.

It is possible to develop concept notes and submit them to the GCF Secretariat for consultation before the project proposal is prepared. It is the time when the implementation organization checks with the target country's state-designated organization on whether the project conforms to the target country's strategic framework and priorities, and the secretariat reviews and provides feedback on the submitted concept notes.

[Figure 67] GCF project proposal and approval procedure



Source: GCF webpage (https://www.greenclimate.fund/); Government press release (Ministry of Economy and Finance ('15.8), Current Status of the Green Climate Fund Promotion)

Prior to submitting a project proposal, the implementation organization must obtain a no-objection letter in cooperation with the target country's state-designated organization. This is to evaluate the conformity of the priority, policy, strategy, sense of ownership, conformity, etc., with the target country of the project. If the no-objection letter is omitted when submitting the project proposal, the proposal will not be reviewed by the board of directors.

The implementation organization submits a project proposal, appraisal report, summary, etc., to the secretariat, and an independent technical advisory panel composed of experts in the relevant field prepares a separate project proposal evaluation and review report and submits the results to the board of directors.

When the secretariat submits the results of the review to the board of directors, the board of directors discusses whether to approve it. Upon approval of the board of directors, the decision shall be notified, and if the project is approved, the secretariat finalizes the draft agreement and the terms of funding and concludes an agreement between the GCF Secretary General and the implementation organization.

The secretariat notifies the entrusted agency of the conclusion of the project approval agreement, and the entrusted agency can commence the project after checking and forwarding the agreement to the implementation organization and the state-designated organization.

(4) Adaptation Fund

As the risks from climate change were recognized, developed countries have shown great interest in mitigating climate change, but developing countries' response to climate change has been weak. The Adaptation Fund for Climate Change Adaptation Projects was established under the Kyoto Protocol of the UN Framework in 2001 as the importance of adaptation to climate change in developing countries as well as developed countries was recognized in the COP 13 Bali Action Plan.

The AF is applied to developing countries in Kyoto Protocol. And the fund's management and supervision by the Adaptation Fund Board (AFB), legally qualified for fund management, provided an opportunity to revitalize adaptation fund support in developing countries. The AF consists of 16 representatives and 16 deputy directors among countries vulnerable to climate change and holds meetings once every two years.

The AF is a Direct Access approach in which a state agency or multipurpose agency designated by a developing country undergoes an approval process, receives approval, submits a project proposal to the board of directors, receives funds, and implements the project. AF's direct access approach differs from other funds in that it allows developing countries to directly access funds.

Governments in developing countries submit project plans through state agencies, and project plans submitted to AF are submitted to the board of directors through approval panels.

Part 2 Identification of Follow-Up Projects

Chapter 1 Implementation of Environmental Cooperation Projects

1.1 Identification of the Environmental Cooperation Project

1.2 Method for Securing Financial Resources for the Environmental Cooperation Project

1.3 Overview of Priority Cooperation Project

Part 2. Identification of Follow-Up Projects

Chapter 1 Implementation of Environmental Cooperation Projects

1.1 Identification of the Environmental Cooperation Project

In the process of establishing the master plan for ambient air quality improvement in Ulaanbaatar, Mongolia, 19 cooperation projects were identified, of which 12 projects can be commercialized in connection with implementation funds and are as follows.

<Table 106> Environmental cooperation projects identified

NO.	Sector	Name of the project
1	Stationary source	Improvement and installation of electrostatic precipitators in the combined heat and power plants in Ulaanbaatar city
2		Introduction of desulfurization facilities in the combined heat and power plants in Ulaanbaatar city
3		Pilot installation of the workplace air pollutant management system (CleanSYS)
4		Introduction of gas fired heat only boilers (HOBs)
5	Mobile source	Introduction of measuring device for implementing the emission gas inspection system
6		Pilot installation of DPF for reducing emissions from old diesel vehicles in Mongolia
7		Expansion of LPG stations
8		Expansion of electric vehicle charging stations
9	Monitoring	Establishment of a national ambient air quality monitoring information system (NAMIS)
10		Improvement of an air quality monitoring system of Mongolia (Agaar)
11		Expansion of air pollution monitoring stations
12		Introduction of mobile air pollution monitoring stations (vehicles)

1.2 Method for Securing Financial Resources for the Environmental Cooperation Project

The project was configured as a project of “ICT-based integrated ambient air quality management a system in the UB City” by integrating the projects of “Establishment of a national ambient air quality monitoring information system (NAMIS)”, “Improvement of an air quality monitoring system of Mongolia (Agaar)”, “Expansion of stationary air pollution monitoring stations”, “Introduction of mobile air pollution monitoring stations (vehicles)” and “Pilot installation of a workplace air pollutant management system”, and the creation of the project concept paper was promoted to implement the project with ODA funds from the Ministry of Environment.

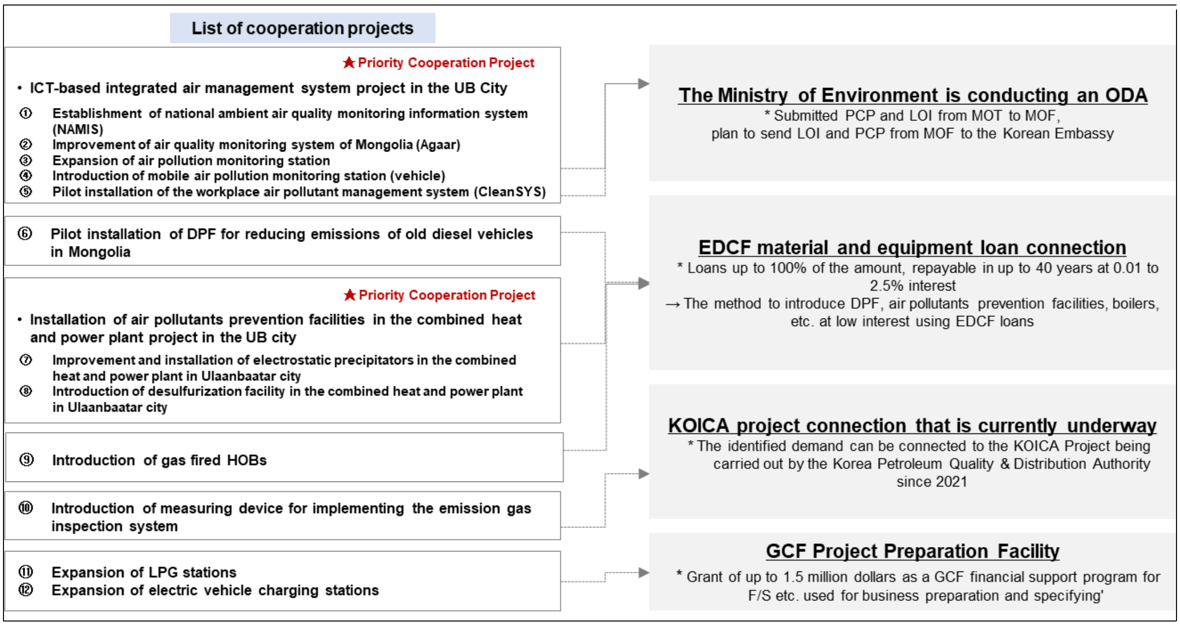
For the types of projects that introduce material and equipment to Mongolia, such as the project of “Installation of air pollution prevention facilities in the combined heat and power plants in the UB City”, into which both the project of “Improvement and installation of electrostatic precipitators in the combined heat and power plants in Ulaanbaatar city” and the project of “Introduction of desulfurization facilities in the combined heat and power plants in the Ulaanbaatar city” are integrated, the project of “Pilot installation of a DPF for reducing emissions of old diesel vehicles in Mongolia, and the project of “Introduction of gas fired heat only boilers (HOBs)”, it is possible to secure financing in connection with the Equipment Loan provided by EDCF.

* The Equipment Loan of the EDCF can be borrowed up to 100% of the amount of the materials and equipment to be introduced to the target country, and repayment can be made over a 40-year period. The interest rate shall be between 0.01% and 2.5%.

The relevanct sector of the “Introduction of measuring devices for implementing the emission gas inspection system” project is included in a KOICA project “Project to Build Capacity in Quality Control Management of Energy Resources to Improve Air Quality in Mongolia” that is being carried out by the Korea Petroleum Quality & Distribution Authority(K-Petro) from 2021 to 2025, and therefore, the identified demand can be carried out in connection with this project. This project aims to establish a mid to long-term roadmap for the central laboratory of the Mineral Resources and Petroleum Authority of Mongolia to manage energy quality in Mongolia such as inspecting petroleum product quality and establishing related regulations, constructing equipment for testing and analysis of the petroleum product and minerals, etc.

As the projects, “Expansion of LPG filling stations” and “Expansion of electric vehicle charging stations” will require large-scale funds, it is possible to consider promoting the projects in connection with the GCF funds, and therefore, it is possible to promote the projects by utilizing GCF Project Preparation Facility, which is the F/S funds that can be utilized for preparing and specifying the projects prior to implementing the main GCF project.

[Figure 68] Method for connecting funds to the environmental cooperation project



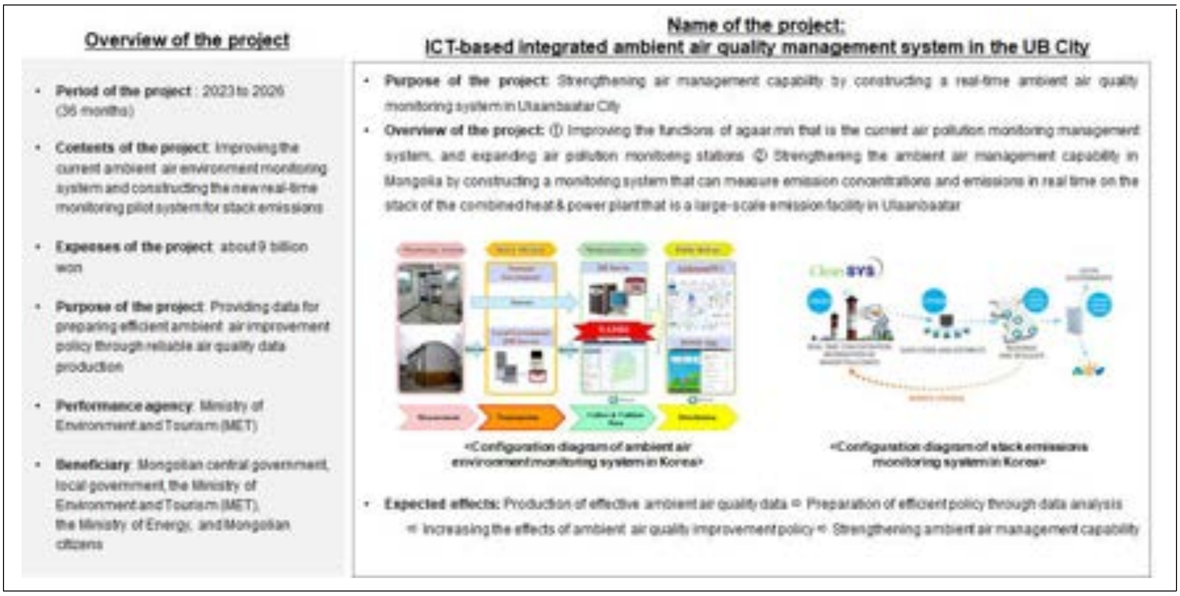
1.3 Overview of Priority Cooperation Project

Based on the urgency, justification, and impact from the perspective of the local introduction in Mongolia of the identified cooperation projects to Mongolia, “ICT-based integrated ambient air quality management system project in the UB City” and “installation of air pollution prevention facilities in the combined heat and power plant project in the UB City” were selected as priority cooperation projects.

In the case of “ICT-based integrated ambient air quality management system project in the UB City,” to implement the project with ODA funds from the Ministry of Environment, the Project Concept Paper (PCP) was written in cooperation with the Ministry of Environment and Tourism of Mongolia, and a Letter of Intent (LOI) of the Ministry of Environment and Tourism of Mongolia was submitted to the Ministry of Economy and Finance of Mongolia.

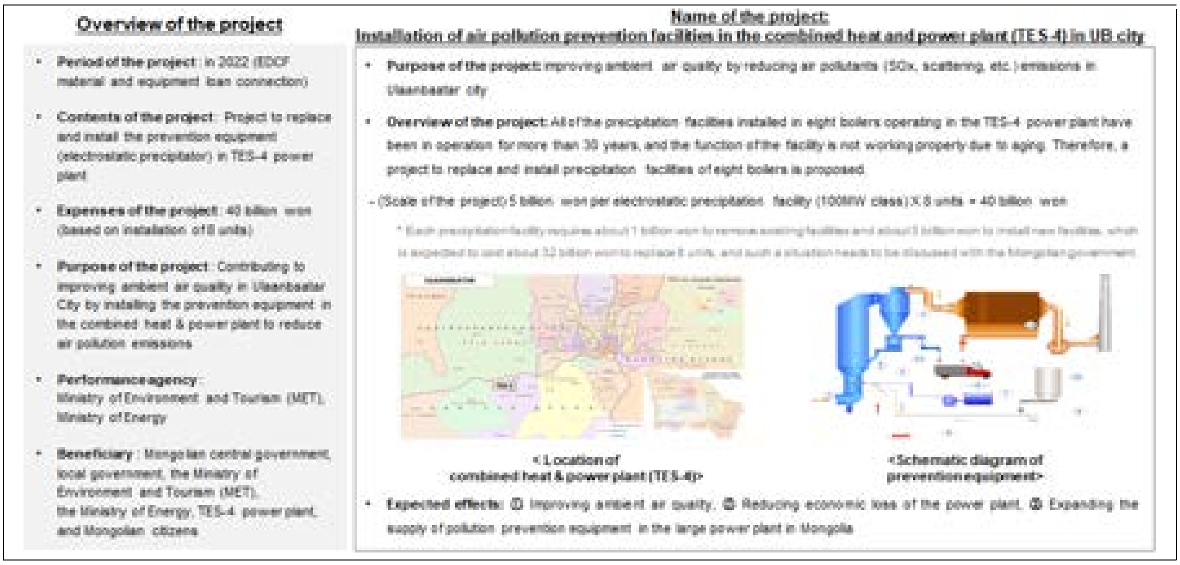
"ICT-based integrated ambient air quality management system project in the UB City" is a project that improves the ambient air quality monitoring system of Mongolia (Agaar) and increases the number of ambient air quality monitoring stations and introduces the Stack Air Pollution Emission Monitoring System (CleanSYS) that can measure and monitor air pollutants discharged from workplaces in real time on a trial basis.

[Figure 69] Overview of the ICT-based integrated ambient air quality management system project in the UB City



The project of "Installation of air pollution prevention facilities in the combined heat and power plants in the UB City" is intended to install the replacements for old precipitators of the TES-4 combined heat and power plant that accounts for 60% or more of the power supplied to Ulaanbaatar City and it has the country's largest power generation capacity of 700 MW.

[Figure 70] Overview of the installation of air pollution prevention facilities in the combined heat and power plants (TES-4) project in the UB City



Chapter 2 Basic Plan for the Installation of Air Pollution Prevention Facilities in the Combined Heat and Power Plant project in the UB City

Chapter 2 Basic Plan for the Installation of Air Pollution Prevention Facilities in the Combined Heat and Power Plant project in the UB City

2.1 Overview of the Project

2.1.1 Background for Project Selection

(1) Current air pollution in Ulaanbaatar due to stationary sources

A large portion of the stationary sources in Ulaanbaatar is taken up by combined heat and power plants. According to the JICA Annual Report (2017), the three combined heat and power plants located in Ulaanbaatar were found to be the largest emission sources for SO_2, NOx, and PM10. As of 2015, SO_2 produced by combined heat and power plants accounted for 70.1% of total SO_2 emissions, NOx for 74.4% of total NOx emissions, and PM10 for 69.3% of total PM10 emissions.

(2) The current pollution prevention equipment in Ulaanbaatar for large stationary sources

Combined heat and power plants, the main source of air pollutants in Ulaanbaatar, do not have pollution prevention equipment installed, with the exception of electrostatic precipitators, which are dust processing devices. The TES-4 combined heat and power plant is the most modernized of the power plants in Mongolia and features four-field electrostatic precipitators in the later stages. However, other older and decrepit power plants mostly feature older mechanical precipitators, which are much worse at processing dust. Moreover, the air pollution prevention equipment installed is not being fully utilized due to a lack of education regarding dust processing devices, a lack of reserve stocks, etc. The deterioration of electrical precipitators has given rise to difficulties in their maintenance, and this in turn was found to partially effect the emissions management and overall operation of the power plants. As such, it is deemed important to first of all, within reasonable bounds, improve and supplement the performance of the environmental equipment that has already been installed (such as electrostatic precipitators).

(3) The necessity of installing pollution prevention equipment within combined heat and power plants in Ulaanbaatar and enhancing their capacity

An interview with an official from the Mongolian Ministry of Energy and an engineer from the TES-4 combined heat and power plant revealed the current state of pollution prevention equipment in the combined heat and power plants of Ulaanbaatar. The investigation revealed that the most urgent improvement needed locally was the replacement of the deteriorating electrostatic precipitators currently installed in the combined heat and power plants. As such, a replacement project for the worn-out electrostatic precipitators installed at the TES-4 combined heat and power plant is required, along with a capacity building project that will provide education and training regarding the operation, maintenance, and repair techniques of the pollution prevention equipment (including electrostatic precipitators) to the operators of Mongolia's combined heat and power plants and improve their capability to respond independently with regard to the pollution prevention equipment. In particular, it is expected that by including on-site visits to Korea's coal power plants in the education and training, and also providing visits to relevant Korean engineering companies, manufacturers, technological development labs, etc., we will be able to include activities that could improve various aspects of Mongolia’s energy policy development, plant operation, power generation technology, and so on.

[Reference] The necessity of installing pollution prevention equipment in Mongolia's coal-powered thermoelectric power plants

With regard to the improvement of ambient air quality in Ulaanbaatar, pollution within the city is closely linked with air pollutants emitted from large stationary sources, and thus the reduction of such emission sources appears to be a very pressing need.

- **(The current situation in Korea)** Korea has a small territory and a high population density, resulting in little environmental capacity for overall air pollution; as such, over the past 20 or so years, it was essential to install and operate state-of-the-art ambient air pollution prevention equipment in large-scale fossil fuel combustion facilities, such as coal-powered thermoelectric power plants. In addition, new technologies have consistently and actively been developed and applied, resulting in very high-level technology and strong operation management capabilities. As such, the current goal is to implement cooperation projects based on such technology and experience that will be of practical help.

- **(The current situation in Mongolia)** Mongolia has coal reserves amounting to 175 billion tons, making it the country with the fourth largest coal reserves in the world, and coal is a major energy source for the country. Mongolia also has reserves of crude oil amounting to about 4.5 billion barrels, which is a considerable amount. However, the lack of any refinement infrastructure has led the country to depend on imports for petroleum products used within the country. A 1.5-million-ton capacity oil refining factory began construction in 2018, aided by a loan from the Indian government, and has now been completed. It is expected to contribute in part to Mongolia's energy independence with regard to gasoline, etc., but it will likely take a considerable amount of time for oil to replace coal as the main energy source for power generation, heating, etc.

  Therefore, short- to mid-term measures must be established regarding coal use that considers its climate and fine dust aspects. Most coal-powered power plants, boilers, etc., have been built with Russian technology and are quite dated, with low efficiency and featuring very insufficient prevention equipment for ambient air quality. As previously mentioned, in view of Mongolia's current situation, it appears that coal will continue to be an important fuel in electricity and industrial applications for the next 20 years in terms of national energy management. In the long term, the introduction of green energy, a transition to clean fuels, etc., are necessary, but considering the large land area of the country, it is deemed that coal use is still needed for energy generation.

  However, the prerequisites for the continued use of coal must include the introduction of fuel efficiency, selective application to industries, and eco-friendly facilities. It is important to enhance internal capacity for this purpose. It has been confirmed that a transition to gas for fuel is underway in some public institutions and specific regions, mainly around large cities like Ulaanbaatar.

- **(The necessity of pollution prevention equipment)** The first thing that's necessary is an improvement in heat efficiency through the advancement and improvement of large-capacity coal combustion devices. On the other hand, it is deemed necessary for the air pollution prevention equipment of such coal fired generation/boiler facilities to be continuously supplemented. Such policy directions can coincide with regard to the climate environment, as they will reduce current coal usage and consequently reduce the production of carbon dioxide.

Also, in the case of gas imports from overseas, apart from the emission from burning coal, when considering lifecycle emission that includes the emission from construction, transportation, and distribution, etc., it may not lead to greenhouse gases reduction, unless achieving a transition to gas fuel through the domestic production of LNG and LPG. As such, in the case of Mongolia, it is important to make efficient use of the main energy source, coal. It is also equally necessary to pursue the eco-friendly use of coal. It is deemed necessary to build up concrete experience regarding the application of pollution prevention equipment technology to actual coal-fired power plants, etc., as they are operated.

With the replacement of the aged electrostatic precipitators and operation of the new facilities, it is possible to share Korea's technologies of ambient air quality management and further enhance knowledge of Mongolian personnel by virtual operation and maintenance of the facilities. In this regard, it it expected to be a good way to contribute as a cooperating partner for the stable operation and self-reliance of the technology in energy plants, and continuous efforts to improve ambient air pollution in Mongolia.

2.1.2 Procedure for Project Implementation

Meetings with the official of the Ministry of Environment and Tourism were held between May and November of 2020 in order to ascertain the demand for ambient air quality improvement with regard to stationary sources. However, due to the COVID-19 pandemic, actual visits to the combined heat and power plants in Ulaanbaatar, Mongolia, were not possible. Instead, the research of various Korean and foreign information was conducted. In addition, interviews were held with staff in charge of stationary sources in Mongolia through a local institution, MIRECO MGL, to collect necessary materials and data regarding stationary sources. In July 2021, discussions regarding the project for the installation of electrostatic precipitators in the TES-4 combined heat and power plant were held via virtual meetings with the Ministry of Energy and TES-4 staff.

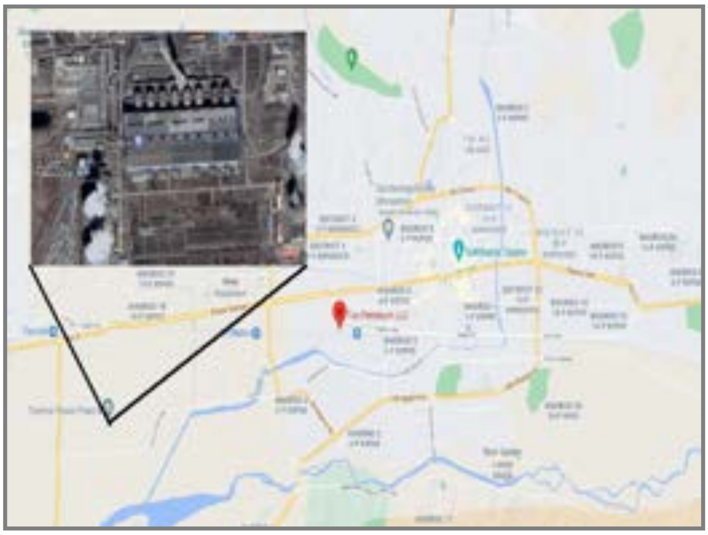
<Table 107> Procedure for project implementation

Item	Period	Procedure for implementation of the Priority cooperation project
Investigation of demand	May 2020 - Nov 2020	Ascertainment of demand in the field of stationary sources for improvement of Mongolian ambient air quality with Deputy Director Munkhbat
Literature research	May 2020 - May 2021	Ascertainment of management institutions of stationary sources (HOBs): HOBs in Ulaanbaatar are registered with and managed by the Ulaanbaatar Mayor's Office, while HOBs inside power plants are managed by the Ministry of Energy
		Ascertainment of the current situation in Mongolia regarding stationary sources with emission standards of HOBs and power plant, and boiler registration materials, etc.
Meeting with the staff in charge of Stationary sources	Feb 24, 2021	Discussion with the Ministry of Environment and Tourism as well as the Ulaanbaatar Mayor's Office regarding a stationary source cooperation project (installation of pollution prevention equipment)
Meeting between executing team	Held frequently within the project period	Confirmation of the TES-4 combined heat and power plant to be the optimal location for the installation of new additional equipment, as it has the most modern air pollution prevention equipment, with a relatively longer lifetime remaining and large-capacity generation facilities.
Intermediate reporting workshop	Mar 25, 2021	Implementation of a core cooperation project: installation of pollution prevention equipment in TES-4 combined heat and power plant
Meeting with the Ministry of Environment and Tourism	Held frequently within the project period	A discussion was to be held regarding the pollution prevention equipment installation project for TES-4 combined heat and power plant with the Ministry of Energy through the Ministry of Environment and Tourism, but COVID-19 prevented proper scheduling
Local investigation	Mar 2021 - Apr 2021	The following were performed through a Mongolian institution called MIRECO MGL: ① collection of current operational data regarding combined heat and power plants of Mongolia; ② ascertainment of the current situation regarding energy/fuel usage, emissions, pollution prevention equipment, etc., through interviews with the staff from power plant; ③ photographs of the exterior of the power plant were also taken.
Meeting with the Ministry of Energy and the staff of TES-4	Jul 20, 2021	Meetings with the Ministry of Energy deputy director and a TES-4 engineer were held to ascertain the current status of TES-4 pollution prevention equipment, details regarding the pollution prevention equipment installation project, and implementation methods

2.1.3 Detailed Project Overview

This project targets the eight boilers in TES-4, the largest combined heat and power plant in Ulaanbaatar, to replace the aged electrostatic precipitators in them to improve dust collection performance and enhance the capabilities of administrators by providing training regarding operation, maintenance, and management of the newly installed pollution prevention equipment.

[Figure 71] Location and facility status of TES-4



(1) Replacement/reinforcement of deteriorating electrostatic precipitators

The boilers installed in the large-scale combined heat and power plants of Ulaanbaatar mostly use lignite coal as fuel. They currently do not feature gas processing devices such as the desulfurization facilities etc., but do adhere to permissible emissions standards.

From the information found so far, a more pressing need seems to be the reinforcement and replacement of the electrostatic precipitators installed in some of the large-scale power plants. The electrostatic precipitators currently installed have aged considerably, leading to lowered performance, difficult management and maintenance, and increased resource usage.

The combined heat and power plants in Ulaanbaatar were mostly built a long time ago and are located in the center of the city. The goal is to replace the existing aged electrostatic precipitators in the eight boilers of the TES-4 combined heat and power plant to enhance performance and increase the operational resilience of the entire power plant.

This requires a close analysis of the existing electrostatic precipitators in addition to the furnishing of new power supply devices, automated operation functionality of electrostatic precipitators, etc., and strengthening dust collecting capacity to widen range of coal types that can be burned at the power plant. Not only will this reduce the amount of dust emitted, but it is also a necessary preliminary step for the future installation of desulfurization equipment.

In addition, in the planned reinforcement of electrostatic precipitators, the devices used to discharge the coal ash that collects in the hoppers must be designed in consideration of recycling through dry output of coal ash. Most modern power plants have pneumatic ash discharge equipment, coal ash silos, etc., within the power plant site. But this requires further evaluation of basic plans for the power plant, and thus the design of the electrostatic precipitators must take such possible plans into account. It is necessary to design the installation work for this project so that as little additional civil engineering as possible is required so that the operation of the power plant in general will not be affected.

The fluid velocity of the exhaust gas drawn to the electrostatic precipitators is 325,000 Nm3/Hr, and the temperature of the gas at this time is estimated to be around 135 ℃. Final confirmation with the power plant is required regarding design conditions.

The electrostatic precipitators shall be of the horizontal flow type, which is the same as the currently installed precipitators. The suggested basic specifications for the electrostatic precipitators are as follows, and these will be finalized through discussions with, and the approval of the selected supplier based on their technology, experience, and know-how etc.

<Table 108> Basic specifications for the electrostatic precipitators

Type	Horizontal-flow dry electrostatic precipitator design
Discharge electrode	Rigid Body Type
Rapping system	Magnetic impulse type
Gas distribution device	Perforated sheet format
Main body material	Normal carbon steel
Dust collecting plate/discharge electrode material	Normal carbon steel

The air volume has not been confirmed, but the suggested basic preliminary design conditions are as follows.

<Table 109> Basic design conditions for the electrostatic precipitators

Internal fluid velocity	Within 1.2 m/sec
Bag arrangement	20 by 18 per compartment
Collecting plate height	14 m maximum
Field count	4 fields (no change)
Collecting plate spacing	400mm SPC
Hopper	Pyramid shaped
Power device	Pulse-type power device

The total duration of this project shall be three years. Detailed construction methods will be devised based on the power plant's operation/maintenance plans, and this process normally takes four months. In addition, the detailed construction plans must be fine-tuned through future discussions with the power plant.

The boilers cannot be operated while the electrostatic precipitators are being removed and installed, and therefore the procedure shall be performed in summer, when the demand for power and heating is low. If necessary, performing replacement work simultaneously for two units at a time may be considered.

In contrast, in winter construction conditions are suboptimal and the rate of operation of TES-4 is high. Therefore, it is deemed likely that the period of maintenance and cessation for the boilers will be summer, but if the project period stretches on for too long, the costs of project management, site operation, etc., may increase. Therefore, it seems advisable for a schedule and milestones to be established for the project.

(2) Enhancement of operation, management capabilities for pollution prevention equipment

Training regarding the operation, management, and maintenance technologies for the pollution prevention equipment shall be offered in order to improve the response capabilities of the operators of combined heat and power plants in Mongolia for local facilities.

Visits to Korea's coal-fired power plant sites as well as engineering companies, facility manufacturers, technological development labs, etc., shall be arranged in order to enhance various capabilities of the operators of Mongolia to develop energy policy and operate power plants.

<Table 110> Enhancement of operation and management capabilities for pollution prevention equipment

Contents	Targets and main contents	Period
Overseas-trained working-level staff/policy makers	Introduction of the current management situation in Korea for policymakers	2 weeks
Training invitation	Engineering companies, facility manufacturers, technological development labs	2 weeks
Locally trained working-level staff	Education on the operation of pollution prevention equipment	2 months

2.1.4 Expected Effects of the Project

(1) Improved ambient air quality

Replacing the aged electrostatic precipitators in TES-4, the largest power plant, with high-performance precipitators will reduce the emission of pollutants such as PM10. In addition, this will improve the efficiency of the power plant and pave the way for coal ash discharge and recycling through additional investment, and these are expected to improve the ambient air quality of Mongolia. The primary effect will be the reduction of filterable fine dust, while in the mid-term, it will enable preparations for the issue of coal storage, which is a major cause of secondary pollution. Therefore, it is expected to be highly effective in reducing fine dust in Ulaanbaatar.

(2) Reduced financial losses for the power plant

The Law on Air Pollution Tax stipulates those operators of large-stationary sources must pay a fee based on the volume of pollutants discharged. This project will reduce the emissions from the boilers in the power plants and also contribute to the energy efficiency of the plants for the stable operation, which is expected to result in financial gain

(3) Nurturing ambient air quality manpower for the field of stationary sources

Training regarding the operation, management, and maintenance of collection facilities will result in the enhancement of their ability to deal independently with their equipment.

(4) Expanded deployment of pollution prevention equipment at a large power plant in Mongolia

By modernizing the precipitators that Mongolia requires at a large coal-fired combined heat and power plant, the dust discharged by the main power plant with the capacity of 100-MW can be reduced. In addition, education and training can be utilized to improve the plant's operational capability and to operate facility rationally streamline operations. Furthermore, this will be helpful for the accumulation of the technology and operational experience needed for the operation of all plants, including ambient air quality facilities. It will allow for reliable and stable plant operation over the long-term, and it is expected that this will be expanded and applied to similar industries in the future.

2.2 Local Investigation

2.2.1 Analysis of Stakeholders

(1) Project implementation

The project for the replacement of aged electrostatic precipitators in TES-4 and their reinforcement shall be overseen and managed by the Ministry of Environment and Tourism as well as the Ministry of Energy of Mongolia. After the equipment has been installed, the APRD will periodically measure emissions in order to ascertain the performance of the pollution prevention equipment. It is expected to provide basic data that can be used in the future to expand and deploy pollution prevention equipment in Mongolia. This project will also likely contribute to the self-reliance of operation, maintenance, and management through capacity building.

(2) Beneficiaries

The direct beneficiaries of this project are the TES-4 managers and employees in addition to the citizens of Ulaanbaatar. The TES-4 managers and employees will see reduced emissions from their power plant boilers, resulting in less financial loss from the fees levied for emissions based on the Law on Air Pollution Tax. They will also be able to enhance their work capacity. The installation of pollution prevention equipment will improve ambient air quality, enhancing the health and quality of life of Ulaanbaatar's citizens.

<Table 111> The stakeholders for the project and their roles

Item	Stakeholder	Role
Project management	Ministry of Environment and Tourism	• Overseeing the management of the project • Periodic monitoring regarding progress and writing of reports
Project management	Ministry of Energy	• The Ministry of Energy is a national institution of Mongolia that manages the power plants in the country. It will co-manage the project and oversee it with the Ministry of Environment and Tourism.
Emissions measurement	APRD	• Ascertaining and monitoring of facility performance through emissions measurements after desulfurization equipment installation • Collecting basic data for the later expansion and deployment of pollution prevention equipment
Beneficiaries	TES-4 management and employees	• Reducing the fees charged under the Law on Air Pollution Tax by emission reduction • Capacity building through participation in education on pollution prevention equipment maintenance • Improvements in the health of TES-4 employees due to the ambient air quality improvement
	Ulaanbaatar's citizens	• Enhancement of health and life quality of Ulaanbaatar's citizens with the improved ambient air quality from the installation of desulfurization equipment in TES-4 and the improved performance of precipitators

2.2.2 Status Investigation

TES-4 is a combined heat and power plant located to the east of Ulaanbaatar's downtown area. Construction began in 1979, and the first unit began operation in 1983. The capacity has been steadily increased, with 380 MW added in 1987, 540 MW in 1990, 20 MW between 2007 and 2009, 120 MW between 2012 and 2014. The current generation capacity of TES-4 is 700 MW, making it the combined heat and power plant with the greatest capacity in Mongolia. TES-4 supplies 58.2% of the electricity used by the central Mongolian region and about 55% of the entire Ulaanbaatar area. (Source: TES-4 webpage)

[Figure 72] Photos of TES-4

(1) Status of energy production and fuel usage of TES-4

The energy production of TES-4 has been steadily rising since 2015 and the generation efficiency is approximately 35-39%.

<Table 112> Status of electricity and heating production at TES-4 (as of Nov 2020)

Item	2015	2016	2017	2018	2019
Electricity (Mwh)	332,789.76	336,062.78	346,952.96	354,522.18	380,559.84
Heating (Gcal)	504,150	448,481	487,174	560,625	556,113

Source: The Ministry of Energy of Mongolia (https://energy.gov.mn/content?t=3) (reviewed and written by the research team)

When power plants in Ulaanbaatar are compared based on annual coal usage, TES-4 is shown to operate a total of eight boilers, using about 3.4 million tons of coal. This is 73% of the total annual coal usage of all the power plants in Ulaanbaatar.

<Table 113> Annual coal usage of power plants in Ulaanbaatar

Plant	Boiler count	Amount of coal used annually (tons)
TES 2	5	253,720
TES 3	13	665,322
TES 4	**8**	**3,397,772**
AMGALAN PP	3	225,385
NALAIKH PP	3	62,994
BAGANUUR PP	9	51,594
Total	41	4,656,787

※ Source: APRD, 2020 Activity Report (2021) (reviewed and written by the research team)

(2) Stauts of boilers and fuel usage in TES-4

<Table 114> TES-4 boiler specifications

No.	Item	Display	Unit	Value	
1	Maximum steam production	D	ton/h	420	1
2	Average minimum production volume	Dmin	ton/h	300*	2
3	Expected boiler pressure	Ptog	kgf/cm2	160	3
4	Maximum steam pressure for output	Pxy	kgf/cm2	140	4
5	Maximum steam temperature	txy	℃	560	5
6	Water temperature	tty	℃	230(160)**	6
7	Temperature of emissions	tyx	℃	140	7

* 300: - Capacity was added to BKZ-420-140-10C boilers, upgrading them to a similar capacity to BKZ-500-140-1 boilers (boilers 1, 2, 3, 4, 7, and 8 are changed)

※ Boiler usage changes: If at 350 ton/h or lower, 7.5 ton/h, 350 ton/h; if higher, 20 ton/h

**160 - When a boiler is in use and the water reaches 160 ℃, usage is lowered to 89% of normal usage (400 ton/h). In this case, short-term use without reduced coal usage is allowed.

In TES-4 a total of eight BKZ-420-140-10C (БКЗ-420-140-10С) boilers were installed. They burn coal and discharge the resulting ash in a dry form. The boilers are constructed in a "ㄷ" shape.

Among the eight boilers, #1 - #4 use Baganuur lignite coal while #5 - #8 use Shivee-Ovoo coal. The results of fuel inspection for the coal are as follows.

<Table 115> Quality inspection results for Baganuur lignite coal

No	Item	Display	Unit	Value
1	Ash	Ap	%	10.1
2	Water	Wp	%	32.61
3	Sulfur	Sp	%	0.3
4	Nitrogen	Np	%	0.58
5	Oxygen	Op	%	11.93
6	Hydrogen	Hp	%	2.72
7	Carbon	Cp	%	41.76
8	Volatile matter	Vr	%	41
9	Low heating value	QpH	kcal/kg	3550
10	Oxygen volume	V0	kg/kg	4.05

<Table 116> Quality inspection results for Shivee-Ovoo coal

No	Item	Display	Unit	Value
1	Ash	Ap	%	8.48
2	Water	Wp	%	42.19
3	Sulfur	Sp	%	0.9
4	Volatile matter	Vr	%	41
5	Low heating value	QpH	%	2950

(3) Current status of pollution prevention equipment in TES-4 boilers

(Desulfurization facilities) Meetings with TES-4 staff revealed that boilers in TES-4 currently do not feature desulfurization or denitrification equipment. All boilers in TES-4 apply the MNS5919:2008 emission standards and the current emission of SO_2 is below the standard. It was found that no future plans for installation have been made. (Meeting on July 20, 2021.)

(Electrostatic precipitators) The boilers in TES-4 each have ЭГА2-58-12-6-4 (EGA2-58-12-6-4) electrostatic precipitators installed, and the specifications of which are shown in the table below.

<Table 117> TES-4 electrostatic precipitator specifications

No	Item	Unit	EGA2-58-12-6-4
1	Capacity	m^3/h	677520
2	Temperature of steam gas	℃	150
3	Steam speed	m/s	1
4	Dust content upon steam input	g/m^3	90
5	Pole count	Count	4
6	Power unit count	Count	8
7	Surface area of equipped electrodes	m2	21740
8	Length of charging electrodes	m	57322
9	Capacity of shaking mechanism	kW	4.4
10	Capacity of single mechanism	kW	0.22
11	Revolution speed of shaking mechanism	rpm	0.5

The components of the electrostatic precipitator are shown in the below table. Each unit has 232 charging electrodes, with one pole having 58 electrodes installed.

<Table 118> TES-4 precipitator components

Components	Remarks
Main Body	
Confuser and diffuser for emissions intake/discharge	
Gas distribution bag	
Equipped electrode (Precipitating)	
Charging electrode (Coroning)	
Hinge mechanism hammer	- System 4 of the equipped electrodes - System 16 of the charging electrodes
Electric motor of the shaking mechanism	- System 4 of the equipped electrodes - System 16 of the charging electrodes
Air duct ash discharge system	
15 coal ash storage areas	

MIRECO's 2019 visit to TES-4 and communication with the power plant staff revealed that the precipitators in the power plant are operating at reduced efficiency, and that loans from Japan (the original source of support) were no longer available, leading them to request aid from other countries.

Moreover, through a meeting with TES-4 staff, it was revealed that because the currently installed precipitator equipment has been used for over 30 years and has been causing many problems, and the bulk of the equipment is too large for cleaning, the replacement of said equipment is desired. (Meeting on July 20, 2021)

[Reference] EGA2-58-12-6-4 precipitator specifications

The name EGA2-58-12-6-4 is a description of the precipitator's specifications.

- E - Electrostatic precipitator
- G - Horizontal type (direction of gas emissions)
- A - Unit/power/
- 2 - Section count
- 58 - Double electrode count
- 12 - Equipped electrode length (m)
- 6 - Equipped electrode element count
- 4 - Pole count

2.3 Calculation of Approximate Project Expenditure

2.3.1 Calculation Standards for Approximate Project Expenditure

The approximate project expenditures were calculated based on the amount of deposit involved for a contract for an electrostatic precipitator of similar size in Korea. Recent rates of increase in material costs, transport costs to Mongolia, etc., were considered, and pulse-type power supply devices, measuring devices, etc., for improving the performance of the electrostatic precipitators were included.

Costs were calculated for the demolishing of the existing aged electrostatic precipitators, the installation of new electrostatic precipitators, the installation of continuous dust measuring devices, and parts for linked operation but some of the amounts need to be checked after additional confirmation through a visit to Mongolia.

2.3.2 Calculation of Approximate Project Expenditure

(1) Approximate construction expenses

The estimated project expenditures for the installation of high-performance electrostatic precipitators in the 100 MW-level combined heat and power plant TES-4 in Ulaanbaatar are as follows. The estimated costs included a considerable cost increase in material and construction costs due to the recent steep rise in steel costs, and as such the per-unit cost was calculated to be KRW 6 billion, 20% higher than before in terms of material cost considerations. Assuming this cost will be applied to all eight units, the expected total project expenditure was found to be KRW 48 billion. Additional cost increases are expected depending on when the project contract is finalized, as the uncertain global economy has led to continued material cost and transportation cost increases as well as increases in local construction supervision costs.

<Table 119> Approximate project expenditure

For 100 MW-level coal-fired power plants			
Item	**Aged electrostatic precipitators (per unit)**	**Remarks**	**Capability Building**
Tools and materials	KRW 4 billion	Includes electrical devices	• Includes 1 week of invitational training (maximum of 5 people) • Includes two sessions of local worker operation/maintenance training
Transport costs	KRW 300 million		
Demolition/ construction	KRW 1.4 billion	Excludes civil engineering	
Site construction supervision costs	KRW 200 million		
Reserve fund	KRW 100 million	Includes spare parts	
Subtotal	KRW 6 billion		KRW 50 million
Basic specifications	Includes new power supply devices, as this is a total replacement project for reinforcing the performance of existing aged electrostatic precipitators		

(2) Operation and management costs

The annual maintenance costs are normally estimated at around 7.5% of the total facility costs. In the case of personnel expenses, this project does not require additional operating personnel. The personnel who perform electrostatic precipitator maintenance shall be drawn from existing power plant personnel.

Installation shall be performed for all eight boilers in TES-4, and operation and maintenance work shall be performed as it is now. However, a long-term service agreement (minimum five years) needs to be signed with the supplier for professional facility advice.

Other necessary costs include the costs of consumables, required spare parts, etc., and the spare parts, special tools, etc., for the first year can be included as part of the contract.

2.3.3 Project Period

When it comes to improving the performance of aged electrostatic precipitation devices, most of the major devices must be demolished and installed. For improved performance with a similar dust collection surface area, new power devices, etc., are required. As such, to minimize interference with the power plant's operation, the civil engineering construction work must be kept to a minimum after the contract is signed; in addition, major parts must be brought into the power plant prior to installation so that the overall construction schedule can proceed smoothly.

The project, which involves the replacement of a total of eight units, will take a total of three years and, education, training, etc., must be carried out after the installation. Electrostatic precipitators are normally designed to have a lifetime of 20 years, but in many cases, they may actually operate for much longer. The replacement of internals such as dust collecting plates and discharge electrodes, not just the application of new technology to partial power devices, rapping system, and auxiliary facilities, also assumes a design lifetime of 20 years (except in the case of partial repair or replacement). However, there are cases where partial deterioration or damage from operation leads to a need for repairs and depending on the type of damper or driving part, maintenance and replacement may be required every 2-5 years.

Some types of electrical instrumentation are difficult to acquire in Mongolia, and the procurement of most engineering parts may be limited in Mongolia. In addition, with the lack of local installation experience regarding such devices, a little difficulty is expected for the procurement of heavy equipment and technical personnel in mechanical/electric/instrumentation sectors.

The combined heat and power plant must form an internal project team during this period and provide not only general project management but also the basic materials and cooperation necessary for the implementation of the project.

<Table 120> Project period for the replacement of aged electrostatic precipitators

Project contents	Period
Basic design and local investigations	2 months
Detailed engineering	4 months
Supply of tools and materials	8 months after approval
Demolition and installation	4 months
Test runs and training	1 month

2.4 Policy-level Feasibility

Vision 2050, Mongolia’s national long-term development policy, has as its goal of the creation a comfortable and hegienic environment for people. Projects created for the achievement of this goal include the implementation of air and environmental pollution reduction programs, environmental pollution reduction through eco-friendly technology, etc.

The Action Program of the government of Mongolia 2020-2024 includes an 80% reduction of air pollution in Ulaanbaatar in Goal 5. Green Development, and the green development policy as well as NPRAEP have set the introduction of state-of-the-art and eco-friendly technology for the reduction of pollutant emission from pollution sources as the action plan and goal, respectively.

In addition, Article 23 of the Law on Air, Mongolia’s air management law, stipulates the mandatory installation of pollution prevention equipment for large stationary sources and the regular monitoring of the installed equipment.

This project seeks to replace the aged electrostatic precipitators in large, combined heat and power plants in Mongolia and enhance certain functions. This will result in more efficient removal of dust emitted from the plant, enhance the operational management capability of the facilities, and ultimately improve ambient air quality, all of which are in conformance with Mongolia's ambient air quality improvement policies. In the long run, this will serve as a basis for the installation of desulfurization equipment and also advance facility reinforcement preparations for the expansion of coal ash recycling.

2.5 Technical Feasibility

(1) Introduction to electrostatic precipitatior

The technology of electrostatic precipitator currently used in coal-fired power plants uses electricity to selectively remove dust from emissions. High voltage currents are sent through discharge electrodes, which cause a corona discharge, and the electrons created latch onto the dust in the gas and charge the particles. The charged dust particles are moved by the electric fields of the dust collecting plates and removed from the emissions. Since all the equipment that comes into direct contact with exhaust gas is mostly composed of steel, the base lifetime has a high degree of reliability. Moreover, as this dust separation method only works on dust, when it is compared with the cyclone method (which applies pressure to the entire gas volume for separation) or filtration devices—even taking the cost of the equipment into account—there is an operational advantage to this method up to certain discharge concentration levels.

In the case of electrostatic precipitators, the electrical resistivity of coal impacts their performance and the modern pulse-type power supply devices are capable of handling a wider range of coal ash resistivity. The design of electrostatic precipitators often leads to the failure of discharge electrodes, making the operation of electrostatic precipitators difficult. In Mongolia’s case, it may be difficult to perform maintenance for this situation, so the use of the discharge electrodes with a rigid body type is suggested. In the case of exhaust, mechanical devices are currently installed and operated. As long-term exposure to the internal polluted air can easily lead to the corrosion, abrasion, etc., of the exhaust equipment, it is recommended that a design with simple internal operation methods be employed. Instead of powering rapping system mechanically, it is suggested that electromagnetism-based external exhaust driving mechanisms be used. Electrostatic precipitatiors have various designs such as wet method devices, dry method devices, mixed method devices, etc., but in coal-fired power plants, the dry electrostatic precipitators are mostly used.

Since the basic performance of electrostatic precipitators is proportional to the surface area of the dust collecting plates, it is difficult to secure sufficient collecting surface area when the surface area is defined based on civil engineering. As such, it is necessary to install pulse-type power supply devices to additionally enhance dust collection performance.

(2) The necessity of installation of the integrated discharge electrodes

It is assumed that the discharge electrodes of the currently installed electrostatic precipitators have a wire format. The failure of a single wire-type electrode will cause a disturbance in the charging state of the precipitator and prevent the normal operation. Thus, the internal- inspection must be performed regularly to remove such wires or replace them, and the stoppage of power plant operation would be required, which may be an issue. In this regard, discharge electrodes with a rigid body design appear to be relatively suitable for the new electrostatic precipitators. Although wire-type electrodes have the advantage of individual replacement, when considering the durability of the precipitators, the installation of discharge electrodes with a rigid body design is suggested.

(3) The necessity of installation of the magnetic impulse type rapping system

The electrical precipitation devices currently installed in TES-4 have mechanical rapping system. Mechanical rapping system with a rotating driving part inside, is exposed to the dust in exhaust gas, and it requires the regular maintenance. Therefore, the method suggested for the exhaust driving mechanism in this project is an external magnetic impulse type. When this type is applied, the rapping function in the electrostatic precipitators becomes a fixed process that only delivers simple vibrations, minimizing the maintenance requirement. The replacement of magnetic impulse type rapping system, can be performed on the exterior, which allows for a huge reduction in maintenance time. In consideration of such aspects, magnetic impulse type rapping system is suggested.

2.6 Economic Feasibility

2.6.1 Analysis methodology

A cost-benefit analysis involves the estimation and comparison of the costs and benefits that a project produces based on current values from the perspective of individual beneficiaries, business entity, and also the society as a whole. It requires an understanding of basic concepts such as costs and benefits.

- One method of comparing costs and benefits utilizes the net benefit or calculates the benefit/cost ratio. If the total benefits from a project are greater than the total costs, that project is profitable.
- Costs and benefits become apparent over a long period, and the future costs or benefits are calculated via conversion (discount) into current values.
- The standards used to convert all costs and benefits into present values and compare them are net present value (NPV), benefit-cost ratio (B/C) and internal rate of return (IRR).(KOICA, 2017)

(1) Net Present Value (NPV)

The net present value is the total net benefit converted into a present value. If the NPV is shown to be positive, the project is deemed profitable.

$$NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t}$$

B: benefit; includes all additional social benefits accruing from the project

C: cost; mainly includes the costs of initial investment, maintenance, and operation

r: discount rate

n: analysis period

(2) Benefit Cost Ratio (BC ratio)

The benefit/cost ratio is the present value of the benefits divided by the present value of the costs. If the B/C is greater than 1, the project is deemed to have economic feasibility.

$$B/C = \sum_{t=0}^{n} \frac{B_t}{(1+r)^t} / \frac{C_t}{(1+r)^t}$$

(3) Internal Rate of Return (IRR)

The internal rate of return is a discount rate that turns the net present value from the project into 0. If the IRR is greater than the social discount rate, it is deemed to be economically feasible.

$$\mathrm{IRR}: \sum_{t=0}^{n} \frac{B_t}{(1+R)^t} = \sum_{t=0}^{n} \frac{C_t}{(1+R)^t}$$

<Table 121> Comparison of major economic feasibility analysis methods

Analysis method	Judgment	Advantage	Disadvantage
Benefit/cost ratio (B/C)	B/C≥1	• Easy to understand • Project scale can be considered	• Errors such as the selection of mutually exclusive alternatives may occur
Net present value (NPV)	NPV≥0	• Suggests clear standards when alternatives are selected • Suggests the present value of future benefits • Takes marginal net present value into account • Available to be used for other analyses	• Difficult to understand • Errors may occur when priorities for alternatives are decided
Internal rate of return (IRR)	IRR≥r	• Available to measure a project's profitability • Easy to compare with other alternatives • Easy to understand the results of the evaluation process	• Does not take the absolute size of a project into account • There is a possibility that several different internal rates of return may be arrived at simultaneously

Source: Korea Development Institute (2008) p.56

(4) Discount rate

As costs and benefits of a project occur over a long period of time, they must be converted to values in a single point in time (usually the present) in order to add up and compare all the costs and benefits that occur at different times.

- The value of future costs and benefits is smaller than that of present costs and benefits.
- The conversion of future costs and benefits into present value is referred to as a discount, and the interest rate applied at this juncture is called the discount rate.
- The discount rate used in cost-benefit analysis for a public project is a social discount rate, which refers to a social opportunity cost. This is different from the market interest rates applied to a corporation’s private loans, government bonds or savings/loans at a financial institution.

When discount rate is r, the discount coefficient at time t is 1/(1+r)t. In other words, the present value of the benefit Bt at time t is Bt×1/(1+r)t, while the present value of the cost Ct is Ct×1/(1+r). The discount rate applies to both costs and benefits, but as costs mostly tend to occur early on while benefits occur over a longer period, the net benefit grows smaller as the discount rate grows higher.

It is a difficult task to decide on an appropriate discount rate, and many types of data must be referenced before deciding based on the target of analysis. The decision on the appropriate discount rate comes down to the subjective choice of the person performing the analysis, and a realistic way to go about this is to deduce the best discount value by referring to the standards of major international organizations or the discount rates of similar projects.

- International organizations usually apply a discount rate of 9-12% for projects implemented in developing countries.
- The World Bank applies a rate of 10-12%, while the Asian Development Bank (ADB) applied 12% until 2017, when they lowered the rate to 9%.
- The guidelines for writing feasibility investigations of Korea's EDCF recommend a discount rate of 12%.

This investigation will follow the feasibility investigation guidelines of the EDCF and use a discount rate of 12%.

(5) Results interpretation and final review

Generally, when the conditions of NPV>0, B/C>1, and IRR>r are met, a project is said to be economically feasible. However, the final decision must be based on the sensitivity analysis results, whether the NPV has been exaggerated or underestimated, the costs, benefits, and other elements that could not be included because of difficulties with quantification and monetary value estimation, etc.

2.6.2 Cost and Benefit Analyses

(1) Cost analysis

- Electrostatic precipitator installation cost: KRW 48 billion
- Operation management costs KRW 3.6 billion
- Capacity enhancement cost: KRW 50 million

(2) Benefit analysis

- Benefits from additional job creation through the reduction of diseases that can occur from air pollution (asthma, etc.)

As of 2021, Ulaanbaatar's population is about 150,000. The World Bank has revealed that 155.9 out of 100,000 Mongolians died from air pollution in 2016. These two sets of data were used to calculate the number of those who had died from air pollution in Ulaanbaatar. It was hypothesized that the installation of prevention equipment in the power plant would improve ambient air quality and prevent 100% of related diseases. Ulaanbaatar’s average yearly salary, USD 1,681.25, was applied to calculate the additional employment creation benefit of USD 394,429,337 arising from fewer deaths due to ambient air quality.

- Average annual salary in Ulaanbaatar: USD 1,681.245 (source: Ceidata)
- Ulaanbaatar's population: 1,499,140 (source: Mongolian National Statistical Office)
- Ratio of Mongolian population that died from air pollution: 155.9 for every 100,000 (source: World Bank)

- Benifits of reduced disease treatment costs through air pollution reduction

According to the UNICEF report “Mongolia's air pollution crisis: A call to action to protect children's health,” a total of 73,747 Mongolians aged 0-18 spent USD 4.8 million in public health service costs for treatment of air pollution-related diseases in 2016. Utilizing this data, the treatment cost of diseases due to air pollution was found to be approximately USD 65 for each Mongolian person. Based on the hypothesis that an improvement in ambient air quality would lead to reduced costs for medical treatment, the population of Ulaanbaatar and the population ratio of deaths due to air pollution were used to calculate the figure of approximately USD 152,120 medical treatment savings stemming from reduced air pollution.

- Ulaanbaatar's population: 1,499,140 (source: Mongolian National Statistical Office)
- Ratio of Mongolian population that died from air pollution: 155.9 for every 100,000 (source: World Bank)
- Medical treatment costs arising from air pollution: USD 480,000 in treatment costs for 73,747 Mongolians aged 0-18

- Power plant: Reduced financial losses for the power plant based on the Law on Air Pollution Tax

The Law on Air Pollution Tax stipulates that operator of large stationary sources must pay a fee based on the amount of emissions. It is expected that this project will reduce emissions and thereby reduce economic loss.

- The Law on Air Pollution Tax of Mongolia specifies that a 1-10 MNT fine be levied for each kilogram of pollutants emitted by a stationary source, based on the emissions amount.

- Benefits from an increase in the number of tourists

The travel website Lonely Planet has stated that the average amount of money used daily by tourists visiting Mongolia is around USD 50. The number of tourists that visited Mongolia in 2018 was 577,290. Assuming a 10% increase in the number of tourists due to the improvement of ambient air quality, a benefit of about USD 31,750,950 can be estimated.

- Daily expenditure of a single tourist in Mongolia: USD 50 (source: Lonely Planet)
- Number of tourists to Mongolia: 577,290 (source: AMICUS webpage)
- Rate of increase in the number of tourists assumed to be 10%

<Table 122> Calculation of total costs and benefits

Item	Cost[5] (USD/year)	Benefit (USD/year)	Remarks
Electrostatic precipitator installation costs	40,000,000		1 time
Yearly operation management costs	3,000,000		Yearly
Capacity enhancement costs	41,667		1 time
Benefit from additional job creation through reduction of diseases due to air pollution		3,929,337	Yearly
Benefit from reduction of treatment costs for diseases due to air pollution		152,120	Yearly
Benefit from reduced financial losses for the power plant based on the Law on Air Pollution Tax		-	Yearly
Benefit from an increase in the number of tourists		35,832,407	Yearly
Total	**43,041,667**	**39,913,864**	

2.6.3 Economic Feasibility Analysis (IRR)

In the case of installing air pollution prevention equipment for combined heat and power plants, it is difficult to find the economic feasibility of costs compared to profit. Accordingly, the decision must be made from the viewpoint of policy-level choices related to ambient air quality and priorities. However, since this project contributes to the environment, the socioeconomic effect of providing improved ambient air quality to the citizens of Ulaanbaatar, Mongolia, was estimated.

The socioeconomic feasibility analysis for this project was performed using the IRR. The IRR, when calculated based on the estimated project costs and expected benefits as previously derived, was found to be 23%. This is higher than the 12% discount rate suggested by the EDCF for projects in developing countries, which gives the project ample feasibility from an economic perspective.

In the case of environmental equipment, though it is true that additional equipment will be installed and supplemented, it is also important to seek the stability of the installed environmental equipment and increase the entire power plant's operational efficiency through the reasonable supplementation and reinforcement of existing equipment. This time, the following reasons were behind the suggestion for the replacement and reinforcement of aged electrostatic precipitators in Ulaanbaatar's TES-4.

The existing electrostatic precipitators were installed over 30 years ago. Their performance has deteriorated, and much time is consumed for their maintenance, among other things. It affects the operation of the power plant. Even if the remaining lifetime of the power plant's boilers is considered, it is mandatory from an environmental point of view to reinforce the electrostatic precipitators.

As the power plant must cease operation while the necessary work is performed, the installation work following demolition must proceed smoothly so that there will be minimum downtime. This requires that civil engineering changes should be minimized for this project and accordingly the expansion of the collecting surface area may be restricted in some extent. With regard to this aspect, new power devices must be installed to contribute to the performance enhancement and operational flexibility of the power plant.

It is appropriate for power plants in Mongolia to follow a design that keeps maintenance requiring large-scale construction work to a minimum and minimizes internal inspections of electrostatic precipitators. If possible, it is better to follow the design that keeps the maintenance a

As such, stronger designs have been used for the main parts, and the convenience of maintenance was reflected in the basic design.

[5] Exchange rate: KRW 1200/USD

Finally, the matter of recycling coal ash—to be implemented at a future date—must be considered in the reinforcement of the electrostatic precipitators. In order to transition from the wet method, which discharges ash to an ash pond, to a dry method so that the ash may be used as a construction material, the discharge method used in the hoppers of the electrostatic precipitators needs to be changed. However, as the details have yet to be confirmed, it is recommended that this aspect be reflected when the basic layout is confirmed. This work is currently provisional and such considerations are not deemed likely to increase costs greatly.

2.7 Environmental Impact Assessment

2.7.1 Environmental Impact Assessment Law (EIA Law)

The Environmental Impact Assessment Law (EIA Law) was enacted on Jan 22, 1998, and was most recently amended on Feb 2, 2017. The law has as its goals the protection of the environment; prevention of ecological imbalances due to human activities; usage of natural resources with little environmental impact; and development and planning of the project regarding decision making and preparations by stakeholders, and the performance of environmental impact analysis for the execution of regional and sectoral policies. In the revised law, the implementation of environmental strategy analysis for policy development and planning and the establishment of plans regarding climate change were newly added.

2.7.2 The Expected Potential Environmental Impact from Project Implementation, and its Evaluation

The purpose of the project is to replace existing aged facilities in a large-scale combined heat and power plant to reduce ultrafine dust (PM 2.5). However, as this involves the supplementation of air pollution prevention equipment within an existing combined heat and power plant, no additional environmental impact assessment is deemed necessary.

<Table 123> Evaluation of the potential environmental impact of the project

Item	Expected impact	Stage	Contents
Ambient air	Dust, etc., from vehicles and facilities	Installation	There is supply transport, etc., but the impact is expected to be negligible. The impact of equipment installation on ambient air quality is minimal.
	Impact of facility operation	Operation	The same method as before was used. No remarkable changes.
Noise	Noise caused by facility operation	Operation	The same method as before was used. No remarkable changes.
Waste	Construction waste	Construction	Construction waste is expected to be generated during construction. Accordingly, a list should be created, and discussions held with the city authorities so that the waste may be disposed of according to relevant procedures and approvals.
Soil	Construction	Construction	Civil engineering construction work for a facility substructure will be kept to a minimum. There is nothing of note.

2.8 Performance Utilization

From a general perspective, there may be limits to the identification and application of new technologies and experiences in the combined heat and power generation industry in Mongolia. As such, direct application to a combined heat and power plant that is currently in operation, confirmation of performance, and expansion of application from that point on will make the process stable and reliable, allowing ample time to secure internal competence. It means that providing support based on knowledge and experience so that known technologies may be internalized by Mongolia will allow for stable and active attempts to introduce new environmental equipment not only for the ambient air quality related to the combined heat and power industry but also that of the potential iron/nonferrous metal manufacturing business sector in Mongolia.

Since industrial environmental facilities are not unit devices, but process facilities built according to the industries for which they are designed, a shared overall understanding between the facility supplier, operator, government sector, etc., can impact the speed and scope of expanded application. Such opportunities may lead to an opening for excellent Korean corporations to be introduced into Mongolia and may serve as a basis for the accelerated expansion of Korean corporations in newer markets such as the renewable energy market. The actual implementation of previous projects funded by the OECD has been blocked, and it appears a valid choice to carry this out as cooperation project with the purpose of gaining feasibility and momentum for the current issue of large-scale coal-fired power plants.

2.9 Financial Planning

This project should, by rights, be based on independent investment in Mongolian power plants, but as the current state of air pollution prevention equipment in the combined heat and power plant is suboptimal, it is suggested that international economic cooperation funds be used in part as funding sources. For this, the utilization of OECD funding from the Korean government, the GCF Fund, etc., should be actively considered.

2.10 Proposals

(1) Coal ash management needs to be introduced

The coal ash produced in Ulaanbaatar's combined heat and power plants or large-scale heat supply devices doesn't appear to be regulated by clear procedures. In many cases, large-scale combined heat and power plants are at least using ash ponds near the boilers, but the capacity is lacking, and vertical extension is being employed due to the lack of capacity. As such, it is becoming necessary to refine the policies and strategies related to coal ash.

Such coal ash processing issues may give rise to secondary pollution and will prevent the management of a potential construction material, leading to the utilization of other resources instead, which will limit the transition to a circular economy. It appears to be essential that regulations and policies regarding the discharge of coal ash be formulated, and a long-term plan made regarding the discharge method, etc., for miscellaneous coal usage.

(2) Preparations for strengthened regulations regarding sulfur oxides and nitrogen oxides

Currently, TES-4 is regulated by the MNS5919:2008 standard. It is estimated that the emission standards for SO_2 and NOx are estimated at 1,200mg/Nm^3 and 715mg/Nm^3, respectively, according to the boiler capacity used in TES-4 (4,210t/h). Considering the sulfur content of coal used in TES-4, the need for the introduction of the desulfurization equipment is relatively small. In 2016, Mongolia renewed the emission standard for HOBs in addition to that of power plants. For the HOBs, the permissible standard for SO2 was regulated at the level of 600-1000 mg/Nm^3. In the long term, it is necessary to be prepared for strengthened SO2 and NOx regulations, since the regulations have been strengthened in part and coal usage is more restricted as of 2021.For reference, Korea sets the limit at 25 ppm for power plants built after 2015, and power plants in the capital area manage to keep this to around 10 ppm.

With regard to desulfurization or denitrification equipment, it appears proper to perform an additional investigation regarding the type of desulfurization that can be optimized to Mongolia's needs and prepare for the future through independent investigation and continued international cooperation.

If the permissible standards are strengthened in the future to the point where desulfurization equipment is required, CFBC boilers (circulating fluidized bed combustion boilers)[6)] seem appropriate based on their combustibility. However, as the currently installed boilers are of the dust coal combustion type, in-boiler desulfurization[7)] will be difficult. As such, the available method for an existing power plant is to perform desulfurization after combustion.

[6)] A boiler that consumes coal with poor combustibility together with the bed material

[7)] This method involves inputting limestone powder into the boiler for desulfurization. It is circulated via an external device and the limestone serves as desulfurization reactant.

Part 2 Identification of Follow-Up Projects

Chapter 3 Basic Plan for the ICT-based Integrated Ambient Air Quality Management System project in the UB City

Chapter 3 Basic Plan for the ICT-based Integrated Ambient Air Quality Management System project in the UB City

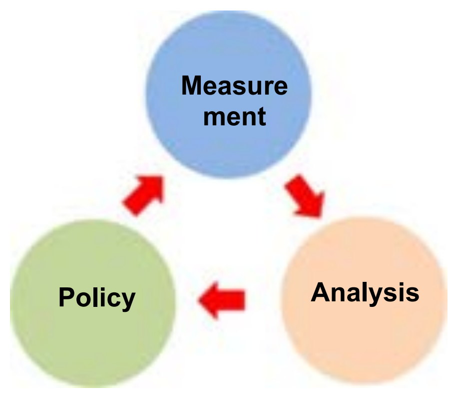
3.1 Overview of the Project

3.1.1 Background for Project Selection

(1) The basic approach for the creation of ambient air quality improvement policies

In general, four steps of measurements-analysis-policy-measurement(verification) are required to improve ambient air quality management. Efficient ambient air quality management is possible only when four steps implemented: step① is a measurement for understanding the current air pollution status, step② is an analysis to identify the air pollution source, step③ is an execution of policies for the management of air pollutant emission sources, and step④ is a measurement to demonstrate the effects and identify new improvement goals.

[Figure 73] Basic approach to ambient air quality management



① Measurement	Understanding air pollution status (status check, problem recognition)
② Analysis	Identification of emission sources through air pollutant analysis (stacks, vehicles, coal heaters, etc.)
③ Policy	Execution of various air pollution reduction policies (policies regarding fuel quality, vehicles, emissions standards, etc.)
④ Measurement	Demonstration of ambient air quality improvements (confirming the effects of the policies)

The primary method of reducing air pollution is to reduce the emissions volume of air pollutants. This can be accomplished by reducing the emissions volume itself or utilizing prevention technology to reduce the emissions discharged externally. Therefore, it is first necessary to investigate and clarify the exact air pollution emission sources causing air pollution so that air pollution reduction policies can be adopted.

Mongolia has a relatively large number of air pollution monitoring stations. However, it is not easy to prove data reliability due to the lack of quality management systems, such as the lack of the quality control system or uniformity in the management. In addition, the data management system for policy decision-makers to easily access the real-time data was inadequate.

Many policies have been implemented to improve ambient air quality in Mongolia, and it is necessary to improve the existing air pollution monitoring network to demonstrate the effectiveness of these policies. Once the ambient air quality monitoring system is enhanced to some extent, data reliability is established, and know-how is acquired regarding the management and operation of the existing air pollution monitoring network, it will be appropriate to consider introducing a real-time stack measurement system (TMS), which is similar but relatively difficult to maintain.

(2) Mongolia's air quality improvement policies

Mongolia has continually implemented various air quality improvement laws, regulations, policies, etc., for the reduction of air pollution, and some major examples of which are as follows.

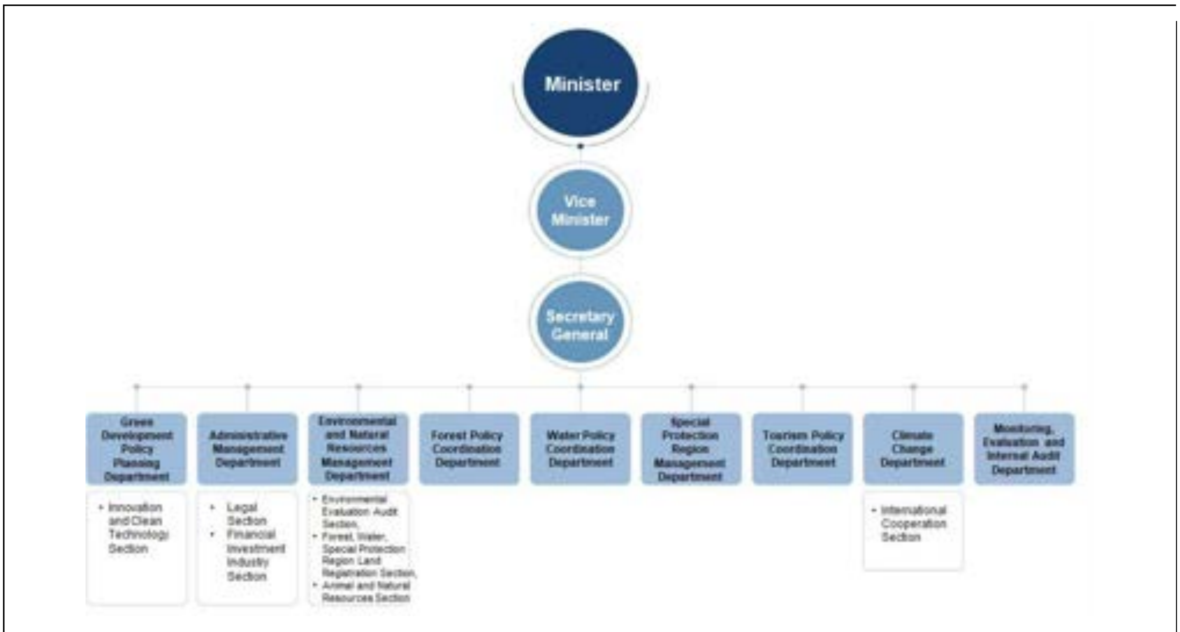
<Table 124> Mongolia's air quality improvement policies

Supervisor	High level Law & Policy	Related item
Country Strategies & Policies	Resolution 23 of the Mongolian National Assembly-2020	Five-year general guidelines for the development of Mongolia in 2021-2025 9.2.1 Reduction of 80% of Air pollution in the UB
	Resolution 52 of the Mongolian National Assembly-2020	"Vision-2050", the long-term development policy of Mongolia 2.5.8 Implementation of national program to reduce air, Environmental pollution
	Resolution 24 of the Mongolian National Assembly-2020	Action Plan of the Government of Mongolia 5.1.1 80% reduction of air pollution, expanded and phased air pollution reduction to other cities
	Resolution 98 of the Mongolian National Assembly-2017	NPRAEP 5.1 Given the program implementation, environmental pollution can be reduced up to 80%
Ministry level policy & Law	Article 7 of the Atmospheric Act	National Authority for Nature and Environment exercises their jurisdiction as follows. 7.1.5 Organization of monitoring for air quality, authorization of monitoring methodology, provision of professional guide 7.1.8 Permission, extension, cancelation, withdrawal of use in large scale of stationary air pollution sources, the establishment of emission standards, and decision of service fee through the responsible agency
	Resolution of the Ministry of Environment and Tourism, No. A/ 107 of 2017	Action plans for NPRAEP 5.8.1 Expansion of monitoring of air and environmental quality 5.10.1 Rearrangement of air, environmental pollution source, of emission material list, and registration database
UB level Policy/ Strategic Goal	Resolution the Citizens' Representatives of the Capital, No. 17/10 of 2018	Master plan to reduce air pollution in the capital city (2018-2025) 7.1 Expansion of air quality monitoring, enhancement of human resources in the monitoring sector

(3) Mongolia's air quality management system

Air quality management in Mongolia falls under the responsibility of the Ministry of Environment and Tourism, which develops and approves drafts of laws, policies, and programs regarding the environment, green development, and tourism. The ministry is also in charge of the establishment, enactment, etc., of policies and guidelines as well as forest management, the maintenance of groundwater, soil, air, and animal databases, green development policies, tourism policy adjustments, specially protected areas, etc.

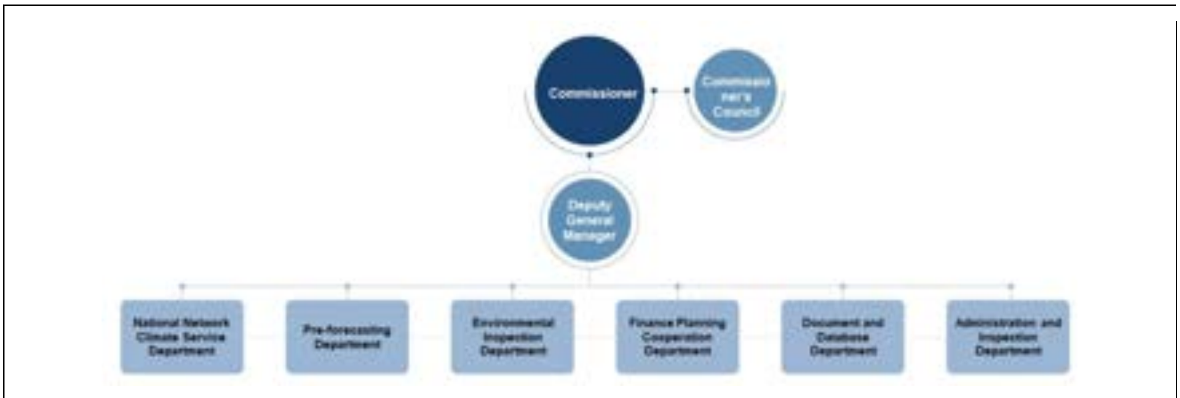
[Figure 74] Organizational structure of the Ministry of Environment and Tourism



Source: Webpage of the Ministry of Environment and Tourism (http://www.mne.mn/) (reviewed and written by the research team)

Air quality in Mongolia is managed by the Ministry of Environment and Tourism, and the operational management of the air pollution monitoring network is the responsibility of the National Agency for Meteorology and Environmental Monitoring (NAMEM), which is affiliated with the ministry. There are 10 automatic air pollution monitoring stations currently being managed by NAMEM, and they are directly management of the stations is being performed by the Central Laboratory of Environment and Meteorology, under NAMEM.

[Figure 75] Organizational structure of the National Agency for Meteorology and Environmental Monitoring



Source: Webpage of the NAMEM (http://www.NAMEM.gov.mn) (reviewed and written by the research team)

The only location in Mongolia with automatic air pollution monitoring stations installed for automatic real-time collection of data in Ulaanbaatar. ARPD of Ulaanbaatar city operates five automatic monitoring stations independently.

(4) Current status of Mongolia's policies related to air quality monitoring

Mongolia began monitoring air pollution in 1977 by measuring SO2 and NO2 via a manual sampling method. Five automatic monitoring stations were installed in 2009 through German ODA, and Ulaanbaatar established the ARPD to manage the air pollution monitoring stations. Five stationary air pollution monitoring stations and one mobile monitoring station were established in 2010 through French ODA and are still in operation today. After this, an additional installation was performed through Japan's JICA project in 2015. (UNECE, 2018)

In 2016, air quality standards regarding nine air pollutants (sulfur oxides, carbon monoxide, nitrogen oxide, ozone, total suspended particles, fine dust, ultrafine dust, lead, benzopyrene) were set through MNS 4585. In addition, through NPRAEP, plans for enhancing air quality monitoring capabilities and analysis of hazardous air pollutants were set via NARAEP in 2017.

Mongolia developed the agaar system in 2018 with the aim of managing the ambient air quality data, and consolidated publication thereof, produced by the automatic air pollution monitoring stations that have been installed. In 2019, a feasibility study was carried out regarding a business expansion of the Central Laboratory of Environment and Meteorology (CLEM) (under the National Agency for Meteorology and Environmental Monitoring) for improved air quality through Korean ECDF funding. This project included the increasing the number of automatic air pollution monitoring stations, the introduction of analysis devices that can analyze hazardous air pollutants in the atmosphere, etc.

Regulations regarding the installation of air pollution monitoring stations were created and applied in 2020, and further regulations will be forthcoming for the future operational management of monitoring stations, thereby creating a basis for the reliable generation of ambient air quality data.

3.1.2 Process for Project Implementation

Item	Contents
1	PCP writing discussion ('21.4-6): discussion regarding ICT-based integrated ambient air quality management systems such as ambient air quality monitoring systems, real-time stack emission volume monitoring systems, etc.
	⇩
2	LOI writing ('21.7): composition of the completed PCP and letter of intent (LOI) and signing by the Minister of Environment
	⇩
3	LOI submission (Mongolian Ministry of Finance) ('21.7): submission of an LOI signed by the Mongolian Minister of Environment and Tourism to the Mongolian Ministry of Finance
	⇩
4	After an evaluation by the Ministry of Finance, it is to be submitted to the Korean Ministry of Foreign Affairs (second half of 2021).

3.1.3 Basic Direction of Project Implementation

The basic direction of ambient air quality improvement involves the precise evaluation of the current state of air pollution, identification of the emission sources, and reductions in the amount of air pollutants discharged from those sources.

Ulaanbaatar has three large-scale combined heat and power plants, which use large amounts of coal in their operations. These plants are the major emission sources. As such, real-time emissions monitoring pilot systems should be installed in the stacks of the power plants to identify the actual volume of emissions.

Air pollution monitoring stations should be installed in Ger regions and other regions within Ulaanbaatar that lack monitoring stations for air pollution, and a newly developed data management system that is capable of sending, saving, and utilizing (among other things) the ambient air quality data produced by the stations in real time. In addition, a measurement data quality control (QA/QC) system should be established to increase the reliability of the data produced and the capabilities of those in charge of operational management should be enhanced to increase the utilization value of the data.

Before the new systems are installed, Mongolian staff should be invited to Korea and introduced Korea's ambient air quality management policies and a tour of ambient air quality monitoring systems to enhance their ambient air quality management competencies. After the new systems are installed, experts from Korea should be dispatched to perform in-depth training on the utilization methods of the installed programs. After the tools, materials and systems have been fully built, the goal is to dispatch experts from Korea for an extended period and perform technology transfer (e.g., sharing of utilization methods for the produced ambient air quality data, etc.) to support the policy developments needed for ambient air quality improvement.

[Figure 76] Detailed steps of the project implementation plan

① Construction of the ICT-based integrated ambient air quality management system	➔	**② Enhancement of ambient air quality management competencies**	➔	**③ Creation of a basis for ambient air quality management (policy-level support)**
1. Establish a pilot system for real-time stack monitoring 2. Improve the real-time ambient air monitoring system 3. Establish the data quality management system		1. Overseas-trained working-level staff/policy makers 2. Locally trained working-level staff		1. Long-term dispatch of experts 2. Technical Advice (Policy Support)

According to the COVID-19 situation in Mongolia, it will be planned to flexibly respond to the local Mongolia and promote work. If it is impossible to visit the local area, equipment is requested to be installed through the ambient air quality measuring device companys in Mongolia, and it is judged that it is possible to collaborate with the Central Laboratory of Environment and Metrology, which maintains and manages the air pollution monitoring network for installation-related management and supervision in Mongolia. System development and capacity building will be conducted remotely (if offline meeting is not possible, can be replaced with online training) after program development in Korea, and management and supervision will be able to promote it in cooperation with NAMEM.

3.1.4 Detailed Overview of the Project

The detailed activities for the specific tasks are as follows.

<Table 125> Detailed activities for the creation of the ICT-based integrated ambient air quality management system

Outcome	Output	Activities
Construction of an ICT-based integrated ambient air quality management system	1.1 Establish a pilot system for real-time stack monitoring	1.1.1. Hold a seminar for project participants 1.1.2. Preliminary on-site investigation on target facilities 1.1.3. Install the stack air pollutant monitoring stations 1.1.4. Develop the data management system for stack emissions 1.1.5. Establish the control center for stack emissions
	1.2 Improve the real-time ambient air monitoring system	1.2.1. Hold a kick-off seminar for project participants 1.2.2. Expand the automatic air monitoring stations 1.2.3. Improve the ambient air data management system 1.2.4. Establish the control center for ambient air data monitoring
	1.3 Establish the data quality management system (reference, QA/QC)	1.3.1. Purchase equipment required for data quality management 1.3.2. Create the data quality management manual

(1) Establish a pilot system for real-time stack monitoring

The goal is to build and manage a monitoring system capable of real-time measurement of emissions in the stacks of combined heat and power plants (the facilities responsible for large-scale emissions) in Ulaanbaatar, Mongolia.

As the target facilities is a private workplace, an agreement between the government and business operator is required before installing the measuring devices. As such, it is necessary to reconcile differing opinions and come up with a reasonable direction for implementation through conferences between the parties.

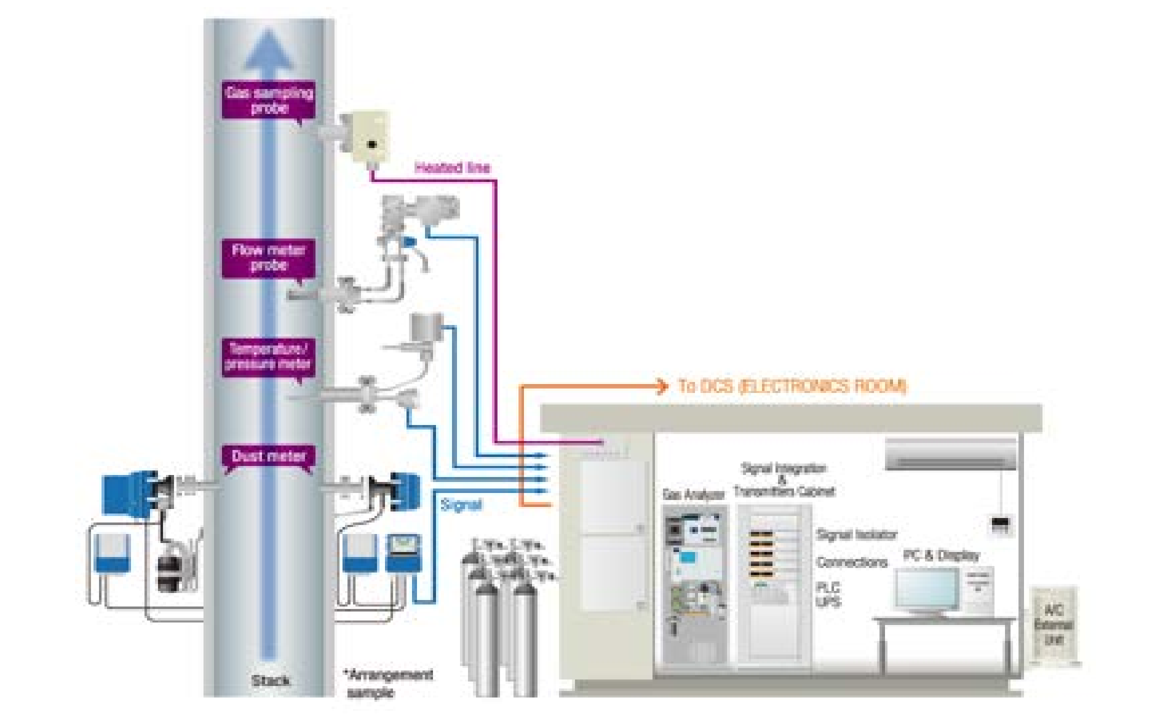
Establishments that have approved the installation of a stack monitoring system should be subjected to preliminary investigation so that the measured concentration, flow rate, temperature, types of substances emitted, etc., can be measured and a monitoring system built that reflects the unique characteristics of the target establishment.

[Figure 77] Block diagram of Korea's stack emissions monitoring systems

Source: Mongolian Ministry of Environment and Tourism (reviewed and written by the research team)

Once the items to be measured and the installation locations are determined, measuring instruments are attached and a system capable of collecting and managing the data is installed so that real-time access to the data is possible.

[Figure 78] Block diagram of the installation of real-time stack monitoring and measurement equipment



Source: Horiba webpage (https://www.horiba.com/kr/)

A stack emissions control center should be installed in the institution that manages and oversees the stack emissions so that the relevant staff may monitor the pollutants emitted by the establishment in real time and respond to emergencies.

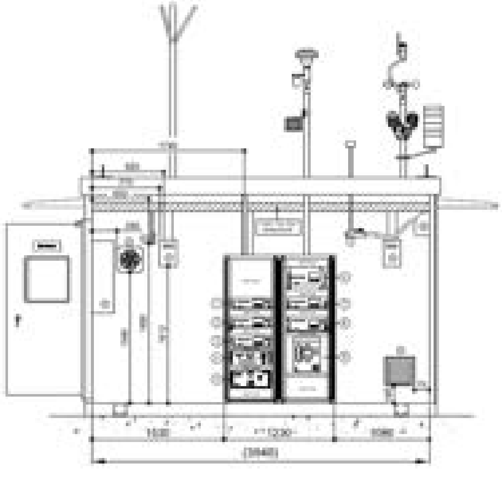
[Figure 79] Control center layout (plan)

(2) Improve the real-time ambient air monitoring system

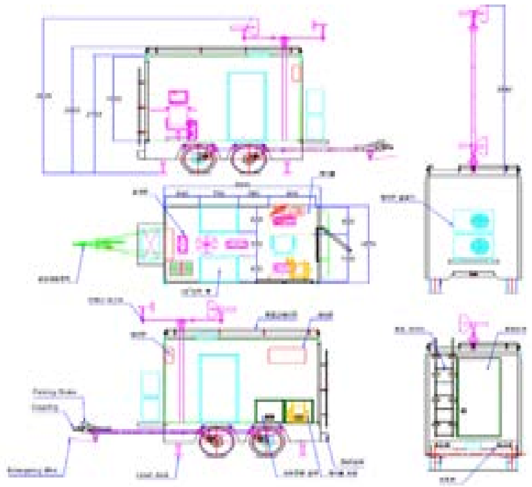
(Increase in the number of monitoring stations) A total of fifteen automatic pollution monitoring stations are currently being operated within Ulaanbaatar, ten by CLEM (under the Ministry of Environment and Tourism) and five by ARPD.

When taking the population into account, the number of monitoring stations is sufficient; however, because most of the monitoring stations are located within the city, there is a definite lack of monitoring stations in the Ger regions (Mongolia's cities are composed of a downtown area and residential districts called Ger regions), where much of the population resides. Therefore, six additional stationary monitoring stations shall be installed for background concentration measurements in the Ger regions and surrounding areas, and one mobile monitoring station shall be installed for ambient air quality measurements at a variety of locations to secure reliability and representation.

[Figure 80] Stationary monitoring station



[Figure 81] Mobile monitoring station (transport vehicle not included)



(Improvements to the data management system) Agaar, a collection system for measured data, needs to be improved into an advanced management and monitoring system capable of statistical data analysis identifications, etc., for efficient management of the measured data. The measured real-time data is collected through the Agaar of the National Agency for Meteorology and Environmental Monitoring (NAMEM). The data are publicly available to the citizens through the webpage on the PC and smartphone application.

The existing system for managing the data from air pollution monitoring stations being operated in Ulaanbaatar (Agaar) needs to have additional features implemented. However, as developing a new system is more efficient than improving an existing one, a new system—NAMIS Mongolia (tentatively entitled)—shall be developed. The basic features of the new system will include settings, monitoring network operation/management, real-time status, data selection/confirmation, statistics/analysis, miscellaneous information, and so on.

① Settings will include features that allow for the modification of the overall operational management settings of the system, with a focus on system users.

② Monitoring network operation/management includes features for the management of information regarding the management, quality control status, and so on of the monitoring station (year of installation, list of equipment, etc.), inspection logs, etc.,

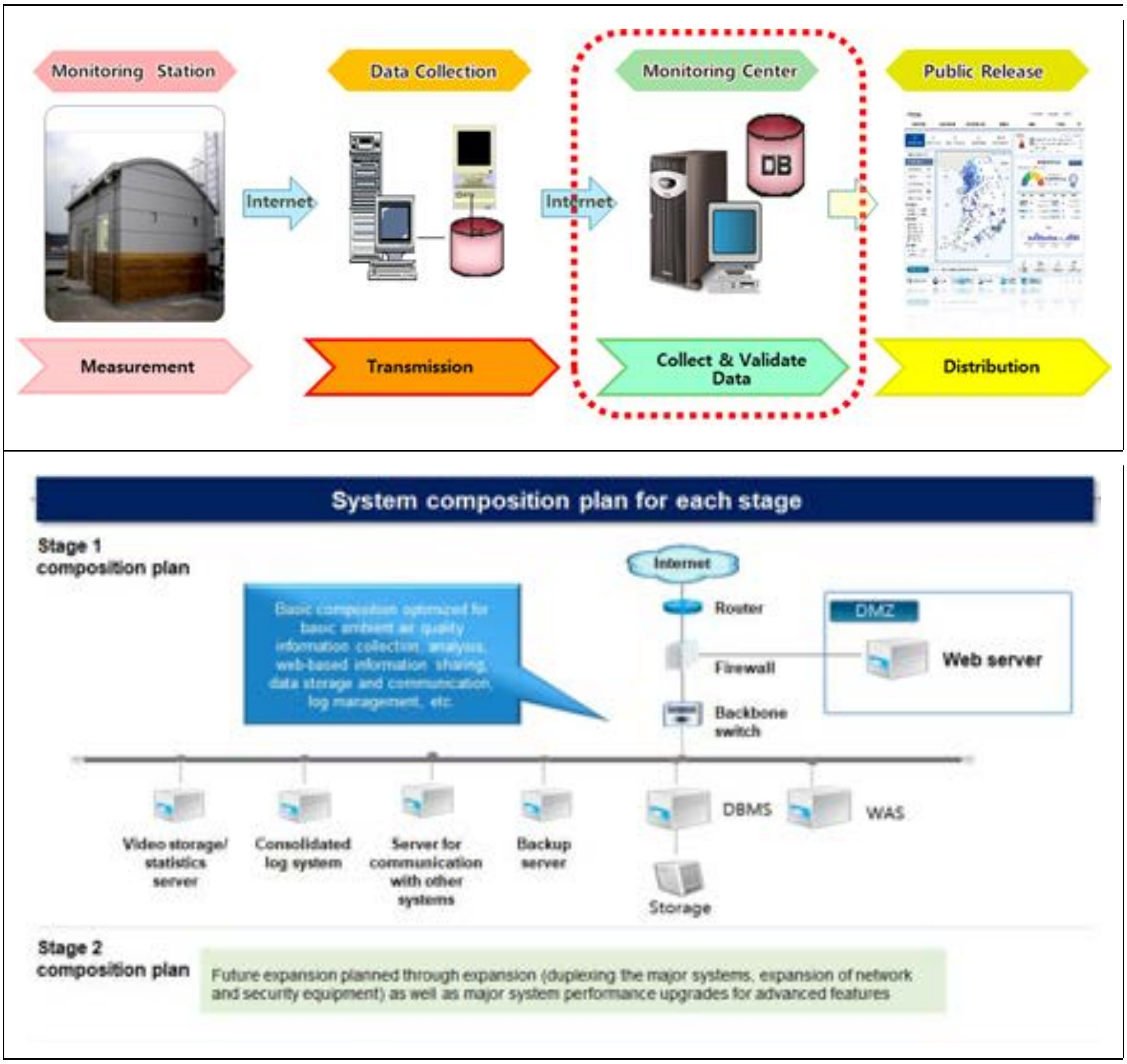
③ Real-time status includes features to monitor data from the operation of air pollution monitoring stations in real-time, download unconfirmed past data, and idnetify abnormal data.

④ Selection/confirmation includes features for differentiating and checking abnormal data from monitoring stations and confirming measured data in addition to downloading confirmed past data.

⑤ Statistics/analysis includes features for the loading of confirmed data and the creation of various statistical data (average, maximum, minimum, and median values, etc.) as well as graphs.

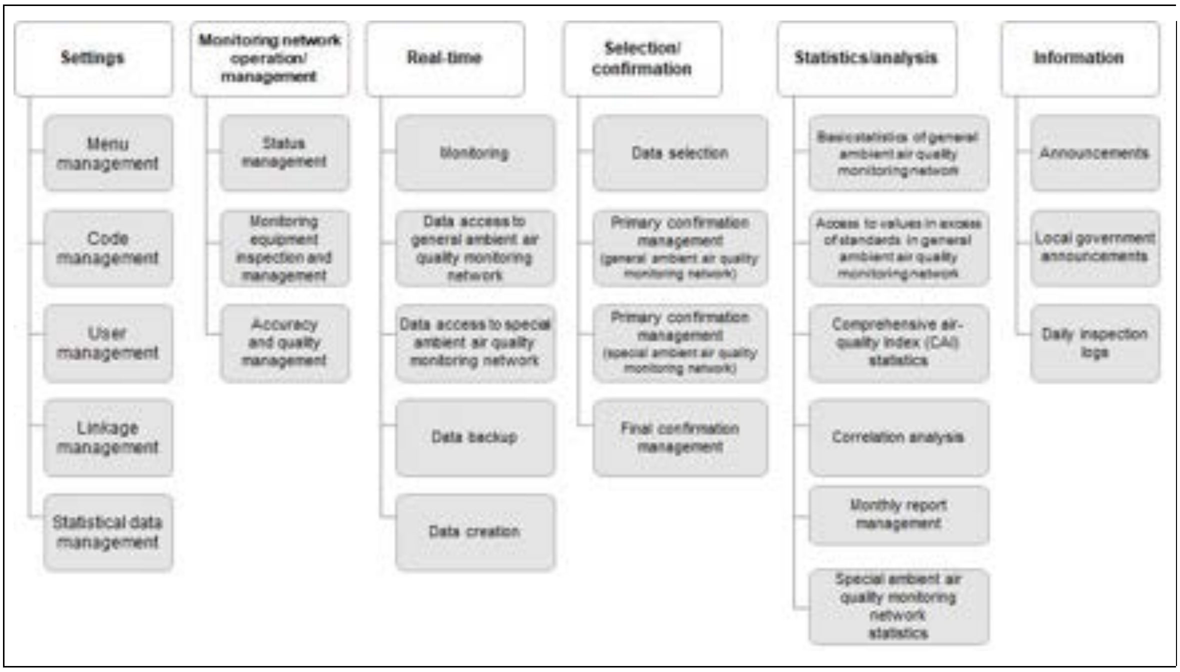
⑥ Other information refers to features for making information public as the administrator sees fit (according to necessity).

[Figure 82] System composition plan



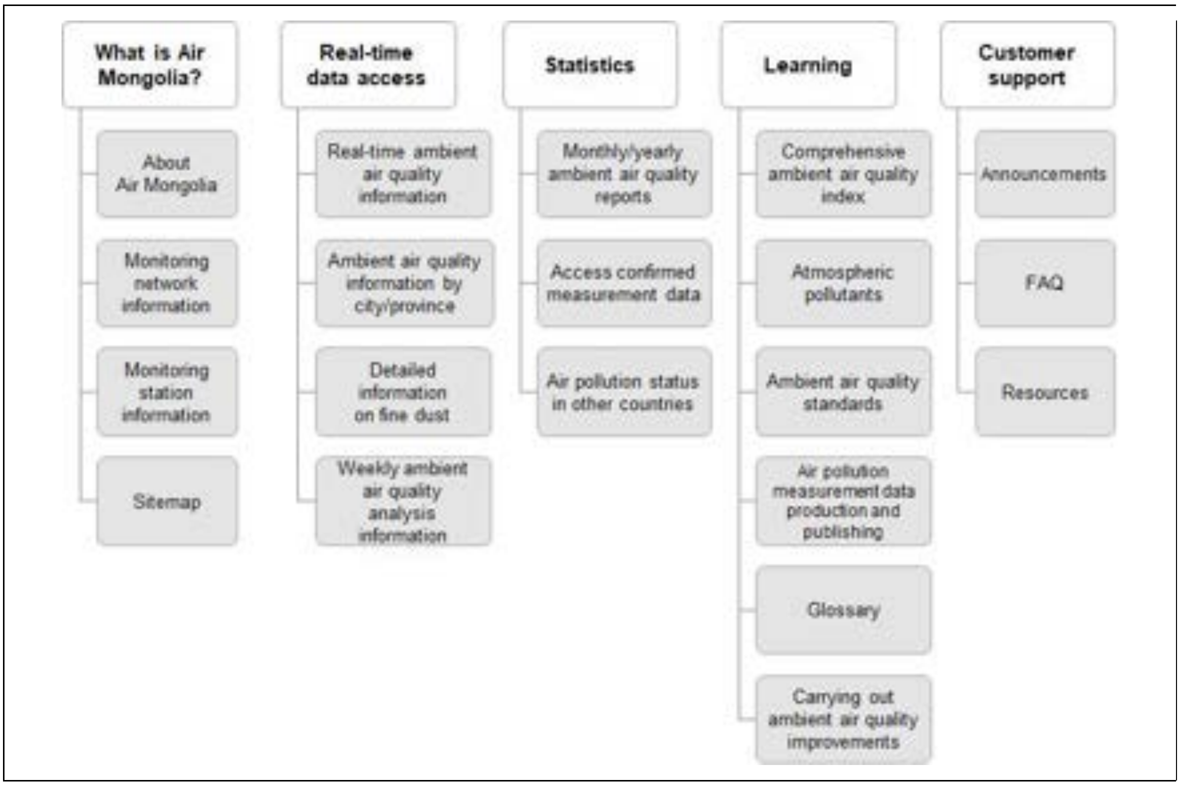
The main purpose of NAMIS Mongolia is the consolidated management of air pollution data, such as the collection, selection, and statistical compilation of data from the air pollution monitoring network for submission to the government and relevant institutions so that it may be used as base data for the creation of ambient air quality policies.

[Figure 83] Structural map of NAMIS Mongolia's features



Air Mongolia is a public information system that allows access to the measured ambient air quality status.

[Figure 84] Structural map of Air Mongolia's features



(3) Establish the data quality management system (Reference, QA/QC)

To guarantee the quality of data generated by air pollution monitoring stations, it is essential to create a quality control system for the measurement data. In addition, because equipment for the measurement of air pollution is not easy to maintain, it is not easy to secure the reliability of the data. Many advanced countries have already enhanced their quality control (QA/QC) procedures to a very high level to increase the quality of the measured data. Satisfactory quality control can only be attained when the maintenance of measuring equipment and the competence of its operators are simultaneously improved. As such, this project seeks to suggest the equipment introduction/operation methods and quality control procedures required to maintain the performance of measurement equipment at a certain level. This can be seen as the first step in quality control.

<Table 126> Actions for each stage of quality control

Quality control procedure	Actions to be taken
Planning	• Setting of data quality objectives (DQOs)* • Approaches based on practical work • Development of regulations • Creation of standard operating procedures (SOPs**) for QA • Guidelines
Implementation	• Education • Internal quality control • Data verification/validation • Data certification
Assessment/reporting	• Monitoring station characteristics • Quality inspection • Quality system evaluation and technical system screening • Data quality evaluation • QA reporting

* DQO: data quality objectives (e.g., degree of precision, identification, detection limits, etc.)
** SOP: standard operating procedure

All processes must be managed separately depending on whether they fall under external management by a third party or internal management. For the sake of systematic management, it is necessary to create an advanced management system capable of computerization from monitoring station installation to final data confirmation, the QA/QC process, and all results.

To improve the operational rate of the air pollution measurement equipment, its operational efficiency, the reliability of the measured data, etc., inspection methods and standards need to be unified, so it will secure the reliability of the inspection results.

For minimizing trial and error, experienced technicians shall participate in the creation of a list of tools and materials to be purchased and the implementation of necessary system features related to the construction of the measured ambient air quality data management system. In addition, to increase the quality of the data produced after system installation, unified “air pollution monitoring network operation guidelines” shall be created in addition to a long-term roadmap to expand the role of ambient air quality monitoring.

<Table 127> Method of constructing the quality control system

Item	Contents
Enhancement of operational techniques	• Provision of legally certified technical personnel and equipment possession standards for the operation of the air pollution monitoring network • Creation of efficient operational methods to enhance the operation rate of the air pollution monitoring network • Creation of standard operating procedures (SOPs), operational guidelines, monitoring station management cards, checklists, etc., for the systematic management of the air pollution monitoring network
Introduction of scientific monitoring network operation and management methods	• Execution of status checks and remote inspections of measuring instruments via remote programs and VPNs • Execution of proactive inspections when the data trend analysis predicts malfunctions • Execution of planned regular inspections (weekly, monthly, quarterly, semiannually, annually) and on-demand inspections - Quick information transfer via SMS followed by inspection when the status of measuring instruments is abnormal - Ascertainment of measuring instrument status through regular management of inspection correction values • Possession of equipment and consumables related to air pollution measurement operations - Possession of air pollution measuring equipment and replacement cycle of the auxiliary equipment - Possession and replacement of extra units of standard gas for inspection and measurement consumables
Introduction of quality control methods for the production of highly reliable measurement data	• Introduction of various operational and verification methods besides the existing methods of operation for air pollution monitoring stations to collect reliable data from them • Introduction of accuracy verification methods - Measurements should be performed at third party institutions, not by monitoring station administrators, to increase the reliability of the measurement data - Execution of grouped monitoring station inspections by region - Standard samples should be applied directly to measuring instruments and administrators in each region should perform measurements simultaneously at monitoring stations calibrated identically to secure the reliability of the measured data - Introduction of proficiency tests to evaluate testing inspection capabilities to enhance the accuracy of environmental testing/inspection results • Execution of equivalence evaluation testing for PM10/PM2.5 automatic air pollution monitoring devices and manual samplers - PM10/PM2.5 data measurements are greatly impacted by the climate, the season (temperature/humidity), the substances comprising the dust, etc., and this applies to the measurement data of automatic measuring equipment as well. Equivalence evaluation of automatic and manual measuring instruments will allow for the discovery of optimal operating conditions for each equipment type and lead to reliable measurement data. - Confirmation of equivalence through regular comparison and measurement of the equivalence of the automatic continual measuring instruments to the weigh method in order to secure the reliability of PM10 and PM2.5 measurement data

Introduction of calibration inspection and quality inspection systems	• Type approval for environmental measuring instruments is needed to ensure their accuracy and uniformity. • After type approval, quality inspections should be carried out to ensure that the structure and performance are being maintained according to the content of the type of approval. • A quality inspection system for air pollution measuring instrument should be introduced for the continual management and data quality enhancement of the air pollution measuring instruments. • A standardized quality control system is required for the environmental measuring instruments in the nationwide automatic air pollution monitoring network. • Type approval of the measuring instruments and introduction of quality inspection systems
Introduction of a calibration inspection system for ozone generators (an ancillary air pollution measuring device), gas dilution equipment, and meteorological equipment	• Execution of regular calibration and maintenance for ancillary equipment (gas dilution calibration equipment and ozone generators) used in inspections of air pollution measuring devices to secure the reliability of the air pollution measuring equipment • Inspection of calibration values and identifications in addition to calibration conditions (equipment calibration count, whether inspection has been performed for the standard gas used and the gas's expiry (whether the traceability of the standard supply system has been secured)) to enhance the accuracy environmental measuring device data, secure traceability, and ascertain the equivalence status of the measuring equipment calibration standards • In order to secure measurement data reliability, systematic technical training regarding the characteristics, structural understanding, theory, maintenance methods, calibration procedures, etc., of the ancillary environmental measuring equipment is required in addition to the regular replacement of consumables.

<Table 128> Definitions of type approval and quality inspection

- **Type approval**: type approval is granted by the government regarding the type of measuring instruments after equipment performance standards (performance testing) are decided upon to maintain the accuracy and uniformity of the environmental monitoring devices.
- **Performance testing**: testing performed in order to receive type approval for each measuring instrument model (and maintain accuracy and uniformity) when an institution that inspects environmental monitoring devices creates or imports such devices in order to confirm their structure or performance
- **Quality inspection**: a regular inspection performed to confirm the precision or accuracy of the environmental monitoring devices used for generating data (after type approval) to be published externally or for administrative goals
- **Certification**: this type of testing is performed on standard gases used for calibration in addition to exhaust standard sheets and exhaust standard filters for calibration in order to increase the accuracy and reliability of the measured values.

<Table 129> Difference between quality inspection and calibration

Item	Quality inspection	Calibration
Definition	• Inspections are performed to confirm measuring instrument structure, specifications, performance, etc., for the sake of the accuracy and uniformity of the instruments.	• Inspections are performed to compare the values from measuring instruments, standard substances, physical criteria, measurement systems, etc., with standardized values.
Measuring instrument usage	• The performance of measuring instruments is checked to see if it falls within a standard range and decide whether the instruments are suitable/unsuitable for further use.	• The difference between the standardized values and the measurement values is checked, and the user subtracts this difference when using the measurement values.
Utilization of data	• Measurement data is used as administrative data	• A method of securing public trust in the measurement results
Test report results	• Results are displayed as suitable or unsuitable, and unsuitable measuring instruments are prohibited from being used.	• The measurement uncertainty of the calibration results is used for data generation.
Utilization of measured data	• Measuring instruments declared suitable are used for actual data measurement, with their errors being acknowledged.	• Identifications are applied to measured data, modifying the values before use.

(4) Enhancement of ambient air quality management competencies

The detailed activities for the specific tasks are as follows.

<Table 130> Detailed activities for the enhancement of the human resource base for ambient air quality management

Outcome	Output	Activities
Enhancement of the human resource base for ambient air quality management	2.1. Overseas-trained working-level staff/policy makers	2.1.1. Policy makers (2 weeks) 2.1.2. Mid-term working-level training for hands-on workers (4 weeks)
	2.2. Locally trained working-level staff	2.2.1. Operational training for the new system (local) 2.2.2. Operational training for automatic air pollution monitoring stations (local)

Before new systems and new air pollution monitoring stations are built, policymakers and hands-on system workers will be invited for education and competency enhancement. After the new systems and monitoring stations have been expanded, additional local training will be provided to foster adaptability. Through these capacity building activites, it is intended to build a human resource base for ambient air quality management.

The data management systems to be newly installed will have basic manuals, but training is required for increased skill levels. Simple users and system administrators will each be given education tailored to their needs.

The maintenance training for the expanded air pollution monitoring stations will involve new operational guidelines for ambient air quality monitoring networks, quality control methods, etc. Such working-level education will be carried out locally in Mongolia for actual operators and administrators of monitoring stations.

(5) Creation of the ambient air quality management groundwork (policy-level support)

The detailed activities for the specific tasks are as follows.

<Table 131> Detailed activities for the creation of the ambient air quality management groundwork (policy-level support)

Outcome	Output	Activities
Creation of the ambient air quality management groundwork (policy-level support)	3.1. Long-term dispatch of experts	3.1.1. Long-term dispatch of Korean experts (technology and policy)
	3.2. Technical Advice (Policy Support)	3.2.1. Design the monitoring system facility 3.2.2. Create the O&M guideline and manual for monitoring system 3.2.3. Establish the roadmap for ambient air monitoring network 3.2.4. Support the creation of operating regulations to manage the stack emission sources

During the construction and expansion of the system for monitoring stations, experts are dispatched to oversee and manage installation and perform competency enhancement through local training. After that, experts in each field are dispatched for extended periods to teach working-level techniques for the maintenance of air pollution monitoring stations, offer advice regarding activities for the enhancement of quality control methods, create policy improvement methods utilizing ambient air quality data, and provide other technical advice to Mongolian policymakers and hands-on workers.

Technical advice is offered to create a system blueprint for the creation of a real-time ambient air quality monitoring system and a manual is written its efficient management after system installation.

A roadmap is created in preparation for the future expansion of ambient air quality monitoring, and relevant regulations (plans) are suggested for future utilization by the Mongolian government.

System operation cases from Korea are considered to suggest systems suitable for Mongolia's current situation so that the stack emissions monitoring systems being implemented at private establishments may be utilized efficiently.

3.1.5 Expected Effects of the Project

A larger scope of measurements will be possible than before, therefore it will be able to increase the reliability of the representative values of ambient air quality in Ulaanbaatar that are produced and published. Scientific and reliable ambient air quality data will be available, enabling the creation of policies tailored to Mongolia's current situation. The collection, storage, and utilization of real-time ambient air quality data will be enhanced, increasing the accessibility of ambient air quality information for policymakers. Various ambient air quality data will be available for utilization after ambient air quality improvement policies are created.

The capacity building of policymakers and hands-on ambient air quality monitoring workers will create a foundation for highly reliable ambient air quality monitoring system, and the scientific data produced by this system can be used in the future for the creation of policies, making it possible to set effective and achievable goals. In the long term, this will contribute to improved ambient air quality in Ulaanbaatar and thus to the health of its citizens.

3.2 Local Investigation

3.2.1 Analysis of Stakeholders

An analysis of the interested parties (institutions and participants taking part in the project) can be seen below.

<Table 132> Method of analyzing the interested parties

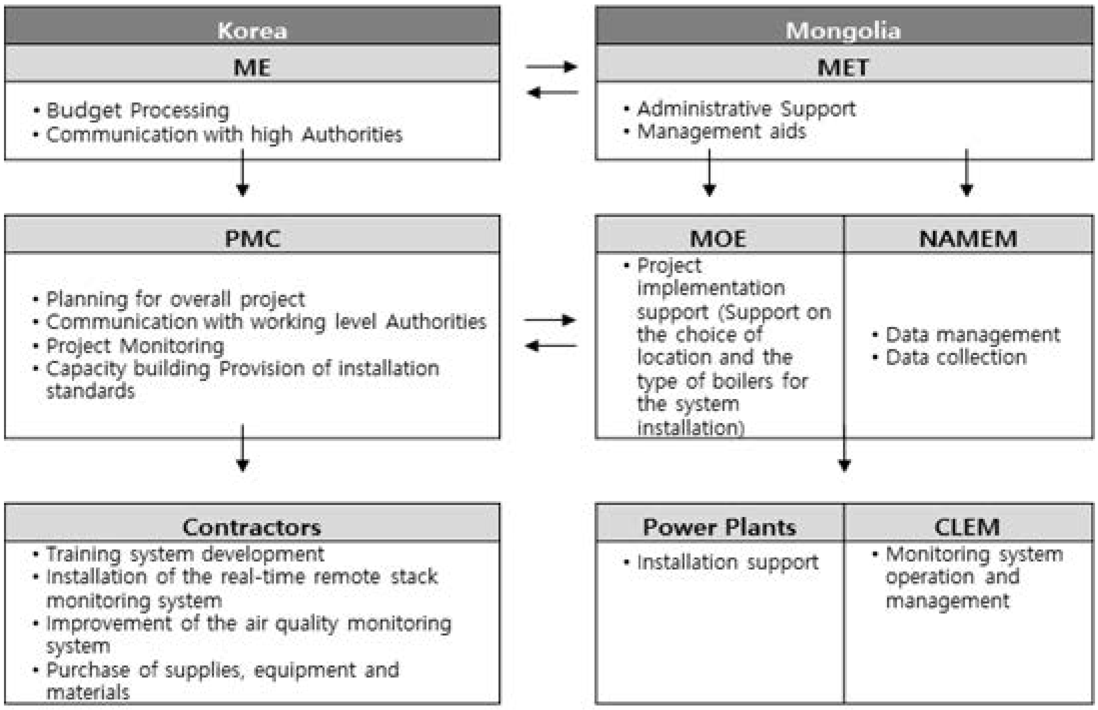
Participating group	Benefit path and participation method
Ulaanbaatar citizens	• Enhancement of health and quality of life through ambient air quality improvement
Power plants (establishments)	• Provision of targets to which emissions monitoring systems can be attached • Participation in measuring equipment maintenance education
Ministry of Environment and Tourism	• Enhancement of ambient air quality management capabilities • Participation in policy suggestions and selection of invited learners • Acquisition of know-how for policy creation
Ulaanbaatar City	• Participation in policy suggestions and selection of invited learners • Acquisition of operational management know-how for the air pollution monitoring network
NAMEM (National Agency for Meteorology and Environmental Monitoring)	• Organization/budgetary expansion for the operation of new monitoring stations and systems • Participation in policy suggestions and selection of invited learners • Support for the selection of new installation locations for the air pollution monitoring network • Acquisition of operational management know-how for the air pollution monitoring network
NDC (National Data Center)	• Cooperation of system development (Provision of hardware installation locations and support for the application of relevant laws)
Companies related to devices	• Sales of consumables and maintenance for analytical equipment
Relevant specialists	• Employment opportunities created for ambient air quality management system workers

The institution in charge of air pollution monitoring is the National Agency for Meteorology and Environmental Monitoring (NAMEM) under the Ministry of Environment and Tourism, and the actual operational management of the national air pollution monitoring network is being performed by the Central Laboratory of Environment and Meteorology under NAMEM.

Twelve of the automatic pollution monitoring stations installed in Ulaanbaatar were funded by foreign ODA in early 2010 and have been operating up to now with relative adequacy. Therefor, the Mongolian government's operational management competency for the air pollution monitoring network can be regarded as being relatively high. However, budgetary restraints make the timely supply of consumables and calibration gases difficult, and the lack of manpower leads to long inspection cycles for the measuring instruments, making the quality management aspect of the measured data somewhat inadequate.

Currently, the Mongolian government has independently built a publicly accessible real-time air pollution data system and is implementing an expansion in the number of automatic air pollution monitoring stations. As system development was independently carried out by Mongolia and increasing the number of air pollution monitoring stations is possible without external aid, the Mongolia's ambient air quality measurement capacity is deemed to be relatively sufficient. This also shows that the level of competence of policymakers relevant to the expansion of the air pollution monitoring network is not too low. However, the suggested project execution organizations out of the relevant institutions for this project—which is being implemented by an advanced country—are as follows.

[Figure 85] Project execution organization (plan)



	Policy Planning	Regulation	Monitoring	Installation	O&M	Financing	Capacity Building
MET	○	○	○			○	○
MOF			○				
NAMEM			○		○		○
MOE			○				○
Contractors				○	○		
ME (Korea)		○	○			○	
PMC	○	○	○				○
(Local) Contractors				○	○		

MET: Ministry of Environmental and Tourism
MOF: Ministry of Finance
NAMEM: National Agency for Meteorology and Environmental Monitoring of Mongolia
MOE: Ministry of Energy
ME: Ministry of Environment (Korea)
Contractors: Contractors for procurement, manufacturers, installation experts etc.

Name of organization	Role
Ministry of Environment and Tourism (MET)	As the local execution counterpart, backs the administrative procedures required for project execution and carries out management/oversight
Ministry of Energy (MOE)	The government department that is in charge of Mongolia's power plants; backs the selection of installation locations for stack monitoring and measurement equipment, boilers, etc.
Power plants	Supports the installation of measuring instruments
National Agency for Meteorology and Environmental Monitoring of Mongolia (NAMEM)	An ambient air quality monitoring institution under the MET which processes measured data and performs system maintenance
Central Laboratory of Environment and Meteorology (CLEM)	A laboratory under NAMEM in charge of the operation of monitoring devices; executes device installation and operation
PMC	As an execution institution, carries out the overall management of project execution

3.2.2 Status Investigation

(1) Status of air pollution monitoring stations

There are a total of 15 automatic air pollution monitoring stations in Ulaanbaatar, Mongolia, and the equipment currently owned and installed is as follows.

<Table 133> Measured substances for each automatic air pollution monitoring station in Ulaanbaatar

Stations	SO_2	NO-NOx-NO_2	CO	O_3	PM10	PM2.5	Meteorological sensor
*CLEM-UB01	AF22M	AC32M	CO12M	O342	MP101M	-	WXT520
CLEM-UB02	AF22M	AC32M	CO12M	-	MP101M	MP101M	WXT520
CLEM-UB03	AF22Me	AC32M	CO12Me	O342e	MP101M	MP101M	WXT530
CLEM-UB04	AF22M	AC32M	CO12M	O342	MP101M	MP101M	WXT520
CLEM-UB05	AF22M	AC32M	CO12M	O342	MP101M	-	WXT520
CLEM-UB07	AF22M	AC32M	CO12M	-	MP101M	-	WXT520
CLEM-UB08	AF22M	AC32M	CO12M	O342	MP101M	-	WXT520
**AQDCC01	APSA-370	APNA-370	APMA-370	APOA-370	Grimm EDM180		-
AQDCC02	APSA-370	APNA-370	APMA-370	APOA-370	Grimm EDM180		-
AQDCC03	APSA-370	APNA-370	APMA-370	APOA-370	Grimm EDM180		-
AQDCC04	APSA-370	APNA-370	APMA-370	APOA-370	Grimm EDM180		-
AQDCC05	APSA-370	APNA-370	APMA-370	-	BAM1020	-	-
***NEW 1	No Information						
NEW 2							
NEW 3							

* CLEM: under the jurisdiction of the CLEM, which is affiliated with the Mongolian Ministry of Environment and Tourism
** AQDCC: Under Ulaanbaatar's APRD
*** New monitoring stations (No information) (Presumed to be in regions 06, 09, and 11)

Ulaanbaatar is composed of a central region surrounded by a big Ger region, but the monitoring stations are mostly located in the inner region while the monitoring stations located in the Ger regions are smaller compared to this central region. As such, it is necessary to begin the additional installation of automatic air pollution monitoring stations in the Ger regions.

Mongolia's air pollution monitoring stations mainly measure the general air pollution substances suggested by WHO such as SOx, NOx, CO, O3, PM10, and PM2.5. Much policy-level effort is being made for the reduction of fine dust. However, toxic air pollutants (polycyclic aromatic hydrocarbons or PAHs) that were recently shown to be dangerous are not being measured. PAHs can be fatal to humans even in small doses and must be monitored. The ambient air quality standards in Mongolia are stipulated by MNS 4585 and their current situation is shown below.

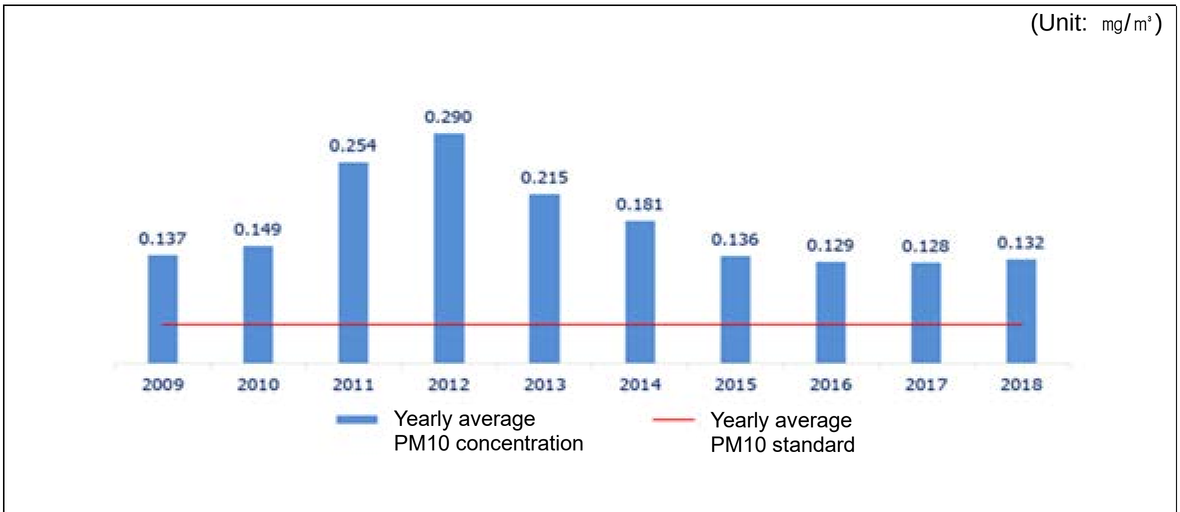
<Table 134> Mongolia's current ambient air quality standards

Item	Unit	Mongolian ambient air quality standards	
SO_2	μg/m³	20 minutes 24 hours Yearly	450 50 20
CO	μg/m³	20 minutes 1 hour 8 hours	60,000 30,000 10,000
NO_2	μg/m³	20 minutes 24 hours Yearly	200 50 40
O_3	μg/m³	- 8 hours	- 100
Total dust volume	μg/m³	20 minutes 24 hours Yearly	500 150 100
PM10	μg/m³	24 hours Yearly	100 50
PM2.5	μg/m³	24 hours Yearly	50 25
Pb	μg/m³	24 hours Yearly	1 0.25
Benzopyrene	μg/m³	24 hours	0.001

One peculiarity about Mongolia's environmental standards is the 20-minute standard. In order to apply it, measurements must be performed every 20 minutes. However, Mongolia currently collects data based on a 30-minute cycle, so it is deemed that the standards will need revision later.

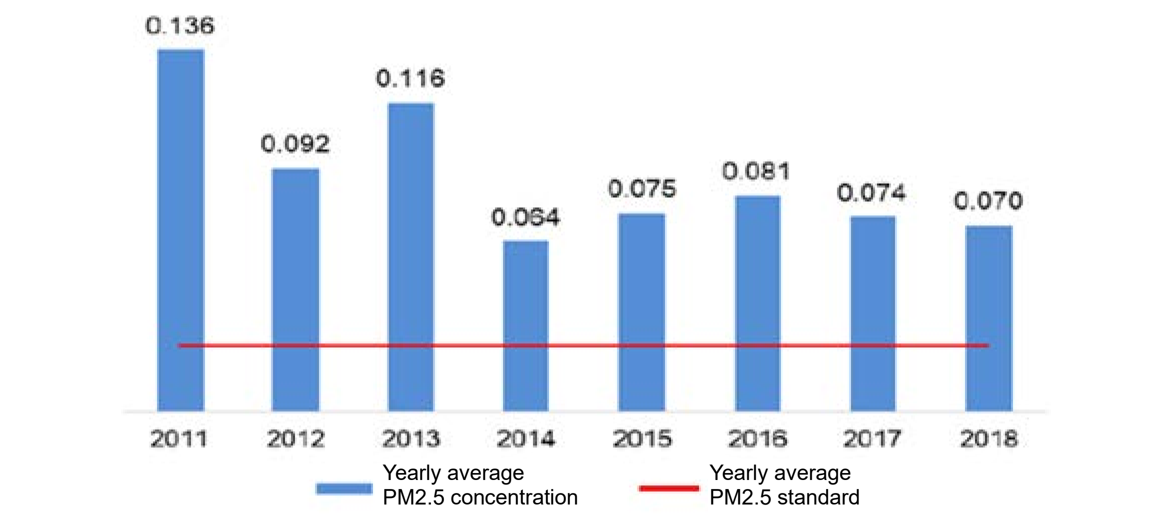
Ulaanbaatar's current situation about fine dust ambient air quality is as follows.

[Figure 86] Ulaanbaatar's fine dust (PM10) concentrations



Source: Mongolian Statistical Office (http://www.1212.mn/)

[Figure 87] Ulaanbaatar's fine dust (PM2.5) concentrations



Source: Mongolian Statistical Office (http://www.1212.mn/)

Excessively low concentration of PM2.5 was found in 2012 and 2014 in contrast to PM10, and this appears to require in-depth substance investigation and analysis. Even when such data is excluded, however, fine dust concentrations in Ulaanbaatar are already at levels two to three times higher than the ambient air quality standards and require urgent improvement.

In order to secure the reliability and measurement uniformity of the measured data and efficiently manage the air pollution monitoring network, it is necessary to clarify standards for measurement station installation and categorization, diversify measurement items and the air pollution monitoring networks, and enhance the general air pollution analysis capacity through the consolidated operation of individual monitoring networks.

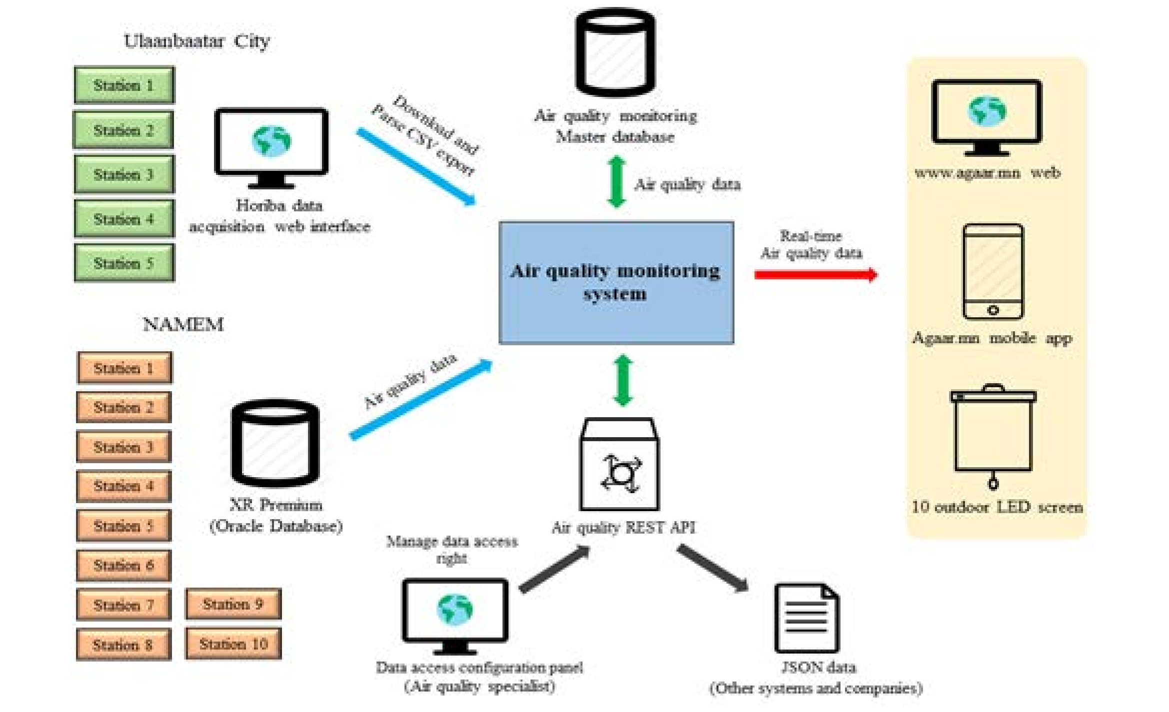
(2) Management system for air pollution monitoring stations

(Current state of data integration and collection) There are a total of 10 automatic monitoring stations operated by the Central Laboratory of Environment and Meteorology, which is an institution affiliated with the National Agency for Meteorology and Environmental Monitoring of Mongolia (NAMEM). The measurement data is collected by data loggers and sent to NAMEM via VPNs and Internet networks every 15 minutes.

Ulaanbaatar operates five monitoring stations independently with measuring equipment from the Japanese manufacturer Horiba. The measurement data is sent only to APRD and submits the confirmed data to NAMEM in excel format in weekly and monthly intervals.

The real-time public information system has its web servers located in the national data center and takes data from NAMEM via an open API and Ulaanbaatar via CSV files. The data is revealed in real time through Agaar (Real-time public information system), and the system is shown below.

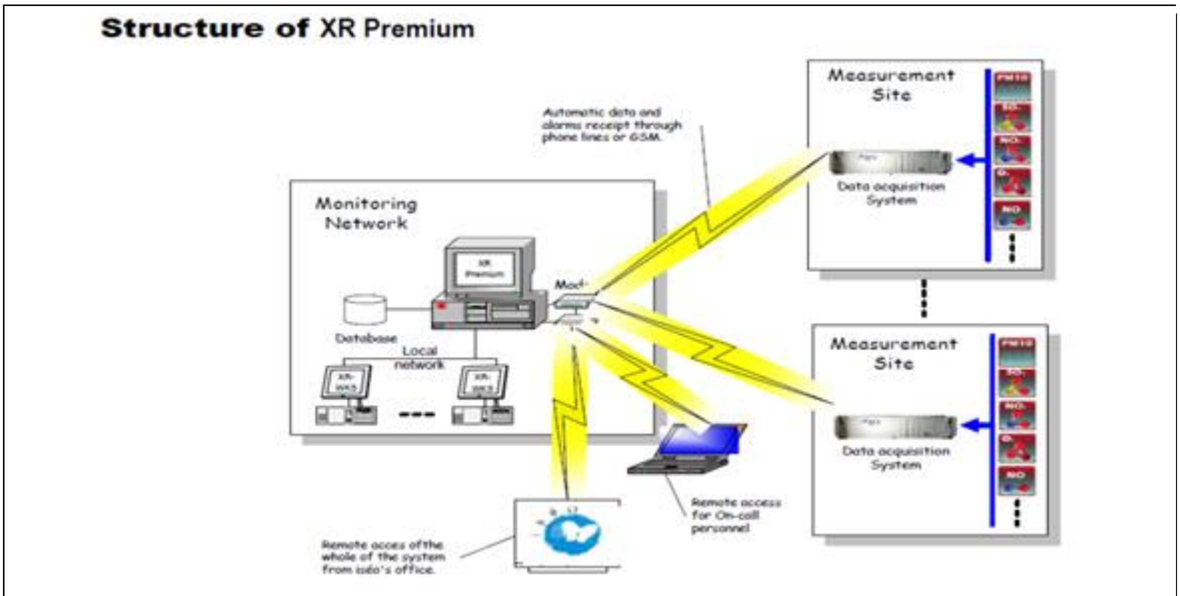
[Figure 88] Block diagram of the Agaar system created by Ulaanbaatar, Mongolia



Source: Research data from the Korea Environment Corporation (reviewed and written by the research team)

The below image shows the system through which automatic air pollution monitoring stations collect data. Because programs created by specific companies are used, licenses must be issued. If measuring instruments are created by different companies, different licenses will need to be purchased, making utilization of measuring equipment from multiple manufacturers difficult.

[Figure 89] Data collection system of the automatic monitoring stations operated by the Ministry of Environment and Tourism



Source: XR Premium manual (Environment SA)

The air pollution monitoring stations installed in Mongolia are managed by the Ministry of Environment and Tourism(NAMEM) and Ulaanbaatar City(APRD), and data produced by each body are sent to Agaar in different formats.

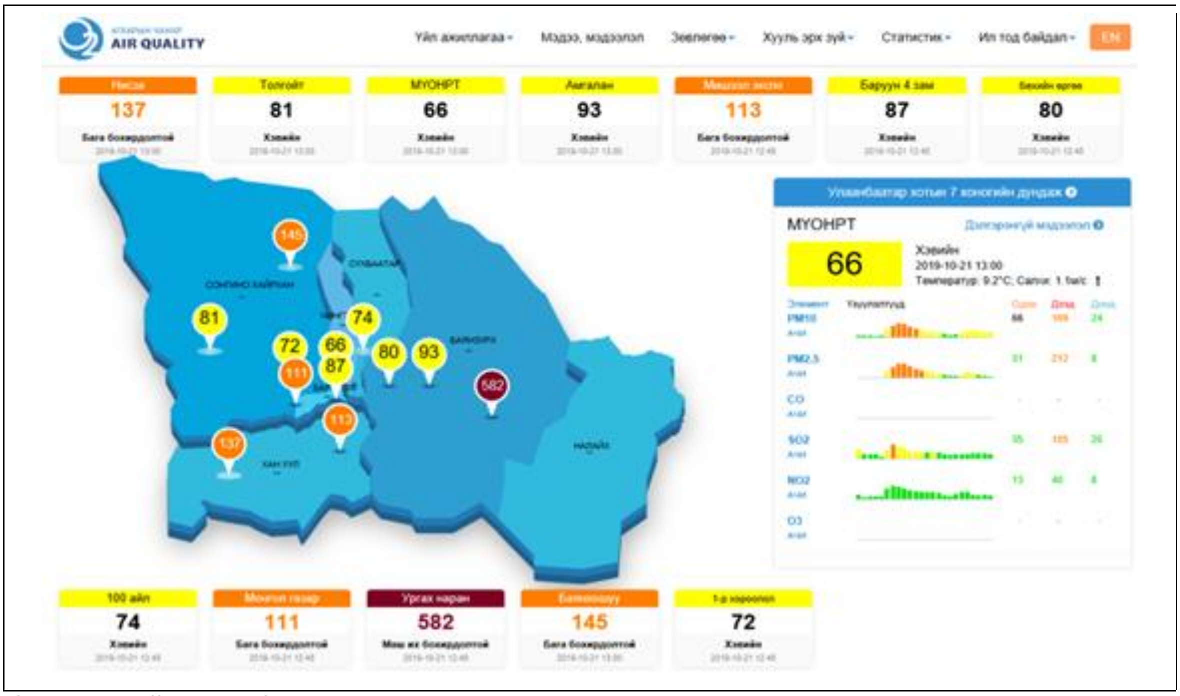
Air pollution monitoring stations can be operated by each respective managing body, but it is necessary to use a central, consolidated system to collect, store, and manage the data. In addition, to secure the reliability and uniformity of the data, standardized monitoring station operational regulations and maintenance guidelines should be created.

This is the biggest difference from Korea, which has a dedicated data collection system that collects data from various local government bodies and selects items to make public. As such, Mongolia needs a separate system for the collection and management of all measurement-related data (tentatively entitled NAMIS Mongolia) as a prior step to the existing Agaar system.

(Current situation of data consolidation and collection) It appears that quality control of the air pollution measuring equipment installed in Ulaanbaatar and the quality management of the produced data is not being performed properly. As such, it is necessary to ensure the reliability of the data through the introduction of quality inspection and calibration inspection systems.

The below image shows the real-time air pollution status indicated by monitoring stations installed in Ulaanbaatar, Mongolia. Data are collected from each monitoring station and the moving average data for three hours is shown to the public through the Agaar website.

[Figure 90] Block diagram of the public information website for the Agaar system created by Ulaanbaatar, Mongolia



Source: http://agaar.mn/

(Establishment of a measured data quality control system) It appears that quality control of the air pollution measuring equipment installed in Ulaanbaatar and the quality management of the produced data is not being performed properly. As such, it is necessary to ensure the reliability of the data through the introduction of quality inspection and calibration inspection systems.

(Inadequate data utilization) The data currently being measured in Ulaanbaatar is being utilized for real-time data publication, etc., but there appear to be no periodic ambient air quality announcements (monthly and yearly reports, etc.) and policymakers seem to experience some trouble acquiring the ambient air quality data they need.

(Inadequate evaluation and analysis system) It appears that a system for evaluating monitoring station operational planning, operation, reporting of measurement data, and other processes is lacking. As such, the utilization of measurement data needs to be improved, as well as the systems for publishing (including data publishing in the system, publishing of official data such as chronological listings and statistics) and managing measurement data.

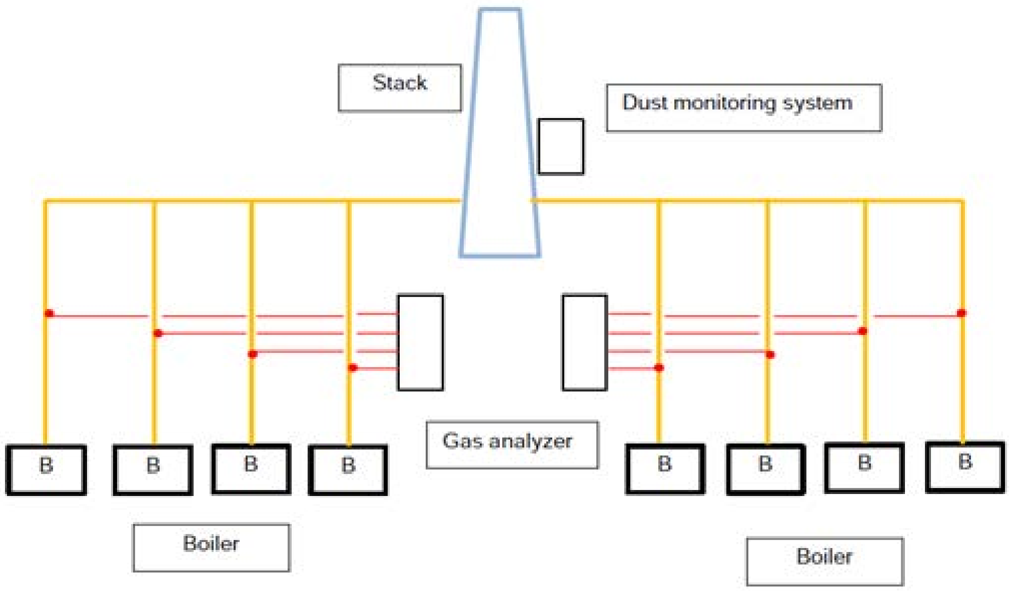
※ Reference: Ulaanbaatar added three new automatic monitoring stations in 2020, but the public information system still only has 12 monitoring stations registered while the new stations do not provide real-time ambient air quality information.

(3) Air pollution emissions monitoring system

As part of the JICA capacity building project, dust analyzers and gas pollution measuring devices have been installed at PP4 (a coal power plant).

[Figure 91] Air pollution emissions monitoring system

<Structural map of stack and monitoring instruments>



<Dust measuring device>

<Gas pollution measuring device>

Source: JICA, Capacity Development Project for Air Pollution Control in UB City Phase 2 in Mongolia Final Report (2017)

There is a CEMS (continuous emission monitoring system) installed at a large-scale coal power plant in Mongolia (TES-4) with the functionality to collect and manage data in real time, but whether it provides access to government institutions has not been confirmed.

3.2.3 Status Investigation Implications

There are 15 automatic pollution monitoring stations installed in Ulaanbaatar, Mongolia. Although air pollution management systems do exist (with systems to automatically collect and publish data, etc.), but a lack of budget and personnel seems to indicate a lack of effort to increase the quality of the measured data and produce reliable data.

Even though these systems are already collecting data, it appears that policies must be created to utilize the systems or activities performed to analyze data and draw conclusions. In other words, it appears to be necessary to provide support so that policymakers can access data systems and secure the basic data required for policy creation.

As the maintenance cycles of the measuring instruments are irregular due to a lack of budget and manpower, it is currently difficult to ensure the reliability of the generated data. In addition, because no separate regulations exist for the management of air pollution monitoring networks, reliance on the individual abilities of relevant experts is high.

Even though the measurements are performed for the same space, Ulaanbaatar, and the measurement items and purposes are similar, there are two managing bodies—the Ministry of Environment and Tourism and the City of Ulaanbaatar—and this structure makes efficient management difficult.

3.3 Calculation of Approximate Project Expenditure

3.3.1 Calculation Standards for Approximate Project Expenditure

This project can be divided into the purchase of tools and materials and the deployment of experts. Because most of the tools and materials are foreign-produced, calculations are made in dollars without considering exchange rates.

The costs of purchasing the tools and materials will be calculated on the assumption of purchase in Korea followed by transport, and the program development costs will be based on the deployment of Korean technicians. In addition, costs for basic construction and crane usage fees for monitoring station installation will be included.

The free follow-up management of apparatuses and systems will be for one year, and customs costs will be excluded as these will be supplied through ODA. Experts for technical advice, etc., will be assumed to be Korean experts with at least fifteen years of work experience. Calculations for personnel expenses will be based on the environmental section of the Engineering Business Payment Standards and those for project execution expenses will be based on the KOICA Standards for Expert Dispatch Projects.

Training costs for competence enhancement will consider local operational costs in Mongolia for local training while invitational training in Korea will consider prices in Korea. The reserve fund was calculated to be USD 700,000 (for total project expenditure).

3.3.2 Calculation of Approximate Project Expenditure

The project expenditure was calculated as follows: USD 7 million for hardware (purchase of apparatuses, installation, system development, etc.); USD 1.3 million for non-hardware items (technical advice, competence enhancement, etc.); and USD 700,000 as a reserve fund, making the total project expenditure USD 9 million.

<Table 135> Project expenditure calculations (plan)

(Unit: USD 10,000)

Total			**900**
(Outcome 1) Construction of a reliable real-time ambient air quality and emissions monitoring system	Subtotal		700
	1. Establish a pilot system for real-time stack monitoring		300
		1. Hold a seminar for project participants	20
		2. Preliminary on-site investigation on target facilities	10
		3. Install the stack air pollutant monitoring stations	210
		4. Develop the data management system for stack emissions	55
		5. Establish the control center for stack emissions	5
	2. Improve the real-time ambient air monitoring system		380
		1. Hold a kick-off seminar for project participants	5
		2. Expand the automatic air monitoring stations	210
		3. Improve the ambient air data management system	160
		4. Establish the control center for ambient air data monitoring	5
	3. Establish the data quality management system		20
		1. Purchase equipment required for data quality management	15
		2. Create the data quality management manual	5
(Outcome 2) Enhancement of the human resource base for ambient air quality management	Subtotal		60
	1. Overseas-trained working-level staff/policy makers		30
		1. Overseas training for policy makers (invited training in Korea) (2 weeks)	10
		2. Overseas training for working-level staff (invited training in Korea) (4 weeks)	20
	2. Locally trained working-level staff		30
		1. Operation of new monitoring system	10
		2. Training on operation of stack monitoring device for working-level staff	10
		3. Training on operation of ambient air monitoring network for working-level staff (local training in Mongolia)	10

(Outcome 3) Creation of a basis for ambient air quality management (policy-level support)	Subtotal		70
	1. Long-term dispatch of experts		30
		1. Long-term dispatch of Korean policy experts	
		2. Long-term dispatch of Korean technical experts	
	2. Technical Advice (Policy Support)		40
		1. Design the monitoring system facility	5
		2. Create the O&M guideline and manual for monitoring system	5
		3. Establish the roadmap for ambient air monitoring network	10
		4. Support the creation of operating regulations to manage the stack emission sources	20
Contingency Cost	1. Contingency Cost		70

3.3.3 Project Period

The project period shall last 36 months follow commencement. The plan includes 12 months of system building through government-establishment discussion on stack emissions systems, 6 months of preliminary work for design, 12 months of development and installation, 6 months of capacity building and policy proposals.

<Table 136> Project implementation plan and schedule

Project details	1Q	2Q	3Q	4Q	5Q	6Q	7Q	8Q	9Q	10Q	11Q	12Q
1. Establish a pilot system for real-time stack monitoring												
(1) Hold a kick-off seminar for project participants	o	o	o	o								
(2) Preliminary on-site investigation on target facilities			o	o								
(3) Install the stack air pollutant monitoring stations					o	o	o	o				
(4) Develop the data management system for stack emissions					o	o	o	o				
(5) Establish the control center for stack emissions									o	o		
2. Improve the real-time ambient air monitoring system												
(1) Hold a kick-off seminar for project participants		o										
(2) Expand the automatic air monitoring stations					o	o	o	o				
(3) Improve the ambient air data management system					o	o	o	o				
(4) Establish the control center for ambient air data monitoring									o	o		
3. Establish the data quality management system												
(1) Purchase equipment required for data quality management					o	o	o	o				
(2) Create the data quality management manual							o	o				
4. Overseas-trained working-level staff/policy makers												
(1) Overseas training for policy makers (invited training in Korea) (2 weeks)			o									
(2) Overseas training for working-level staff (invited training in Korea) (4 weeks)				o	o							
5. Locally trained working-level staff												
(1) Operation of new monitoring system (stack, ambient air)									o	o		
(2) Training on operation of ambient air monitoring network for working-level staff										o	o	
(3) Training on operation of stack monitoring device for working-level staff										o	o	

6.	Long-term dispatch of experts												
	(1) Long-term dispatch of Korean policy experts					o	o	o	o	o	o	o	o
	(2) Long-term dispatch of Korean technical experts					o	o	o	o	o	o	o	o
7.	Technical Advice (Policy Support)												
	(1) Design the monitoring system facility			o	o								
	(2) Create the O&M guideline and manual for monitoring system								o	o	o	o	
	(3) Establish the roadmap for ambient air monitoring network								o	o	o	o	
	(4) Support the creation of operating regulations to manage the stack emission sources							o	o	o	o	o	o

3.4 Policy-level Feasibility

3.4.1 Conformance with the UN SDGs (UN Sustainable Development Goals) Index

The ultimate goal of this project, the improvement of ambient air quality, will reduce the rate of diseases and death due to air pollution and is in conformance with SDG-3, “Ensure healthy lives and promote well-being for all at all ages (Good Health and Well-Being).”

Recently, environmental problems (air, water quality, waste, etc.) due to cities' growth and the resulting population concentration have intensified. In particular, about 46% of Mongolia's total population lives in Ulaanbaatar, Mongolia, and due to its fast population concentration, the Ger area, a large residential village, has serious environmental problems. Therefore, the improvement of air pollution resulting from this project is conform with the SDG-11, “Make cities and human settlements inclusive, safe, resilient and sustainable (Sustainable Cities and Communities).”

3.4.2 Conformance with Korea’s Strategic Plan for International Development Cooperation

This project conforms with Korea's Strategic Plan for International Development Cooperation and the resulting 2021 plan's goal of “Maintenance of a Priority Support Basis for Asia Focused on New Northern Countries.”

Mongolia is included in the 44 countries of KOICA's country support plans, and this project conforms with the “Sustainable City Development and Dynamic Stability” program among the four goal programs of the plans.

3.4.3 Conformance with Mongolia's ambient air quality improvement policies

Mongolia is implementing a long-term development policy, Vision 2050, through National Assembly approval. This includes a plan to reduce air pollution as one method of creating a livable and hygienic environment for people. A pollutant reduction and management program for ambient air quality and the environment is set to be executed, and ambient air monitoring system of this project conforms to Vision 2050's goals.

The Action Plan (2020-2024) prepared in accordance with Vision 2050 provides energy production policies to reduce air pollution as well as policies for the reduction of various other types of environmental pollution to promote green development. A monitoring method is needed to judge the performance of policies created through air pollution reductions and status investigations, and the air pollution monitoring system of this project corresponds to this purpose.

3.5 Technical Feasibility

Following the installation of five new automatic air pollution monitoring stations in the regions with the largest concentration of citizens in Ulaanbaatar, the total number of stations will be twenty (including 15 existing stations). This will make ambient air quality measurements that are representative of Ulaanbaatar possible.

For locations that require measurement and lie outside the areas where the stations will be installed, a mobile monitoring station can be operated for frequent measuring emissions, making efficient ambient air quality measurement in Ulaanbaatar possible.

In order to enhance the utilization of the existing management system for the collection, saving, and publishing of measured data, a new data management system (NAMIS Mongolia) will be built, increasing the utilization of collected/saved data. Relevant procedures for increasing the quality of measured data will also be recorded.

Policymakers will be able to log in to the website and use the rights granted them to ascertain ambient air quality information (concentration, trends, monitoring station information, equipment data, inspection dates, inspection results, etc.).

Monitoring station administrators or website logins can be used to search for real-time data from relevant monitoring stations and determine abnormal data. Confirmation rights can be granted for increased data quality. In addition, monitoring station inspection results can be registered on the website, allowing relevant public officials to easily access ambient air quality information.

Because ensuring the reliability of the expanded air pollution monitoring stations and the measured data is essential, apparatuses can be purchased for the QA/QC of the measuring devices and operational method education and relevant operational guidelines can be prepared to increase the reliability of ambient air quality data measured in Ulaanbaatar.

Planning has been completed for the increase in the number of short-term air pollution monitoring stations and the creation of a long-term air pollution monitoring network operational plan. In the short term, measurements for reduced concentrations will be performed, while with regard to the long term, a foundation will be created for monitoring of external pollutants and ambient air quality monitoring for local aimags.

The new monitoring stations and systems are similar to the existing ones, and by enhancing competence through training of operators with relevant experience, concerns regarding reduced utilization arising from lack of familiarity with the new systems can be minimized.

3.6 Economic Feasibility

Mongolia has striven to improve and expand its ambient air quality monitoring system through the NPRAEP and Vision 2050, etc.

Ambient air quality improvement cannot be expected from establishing an ambient air quality monitoring system and real-time stack monitoring system. However, the reliable data is a critical factor in ambient air quality improvement policies, can result in more efficient policies.

Monitoring systems are not created for profit and thus the direct economic feasibility cannot be analyzed; however, as this system will be used to create ambient air quality improvement policies, the performance of such policies was estimated to analyze the economic feasibility. The data used to analyze economic performance are shown below.

[Reference] Data used for economic performance analysis

- The age-standardized mortality rate based on ambient air quality and indoor air pollution was 132 for every 100,000 people
  ※ Source: WHO. Global Health Observatory. Household air pollution burden of disease by country, 2012; World Health Organization, 2015
- 2,424 Mongolian children died due to air pollution in 2013 (Economic loss of USD 2.1 billion)
- If nothing is done regarding air pollution, USD 9.8 million will be required for medical treatment of children in 2025.
- 18.4 million USD in economic costs from medical care of children
  ※ Source: MONGOLIA'S AIR POLLUTION CRISIS: 2018
  A 10 ㎍/㎥ increase in M2.5 concentrations results in a 6-13% increase in deaths due to heart and lung disease.
  ※ Source: WHO Regional Office for Europe, 2013 Health effects of particulate matter
- Even an increase of 10㎍/㎥ in PM 10 concentrations results in a 1.1% increase in the death rate
  ※ Source: Korea Disease Control and Prevention Agency. Developmental study on recommended guidelines for the prevention and management of adverse health effects from particulate matter and yellow dust (2014)
- Rate of early death due to fine dust (Korea) 1,109 for every million
  ※ Source: OECD, 2016. The economic consequence of outdoor air pollution
- Ulaanbaatar population: 1,490,000 (2018)
- Mongolia’s GDP per capita: USD 3,735

The economic loss calculated with this data is as follows.

- Application of a death rate of 132 people for every 100,000 results in the deaths of 1,967 people
- A loss of USD 7.34 million to Mongolia's domestic GDP
- Costs related to diseases in children caused by air pollution (deaths, medical treatment, etc.): USD 2,128,200,000

If the Mongolian government manages to enhance ambient air quality to Korea’s levels in the future, the death rate is projected to decrease by at least 17%, from 132 to 110. This will result in an economic benefit of at least USD 37.43 million.

3.7 Environmental Impact Assessment

3.7.1 Environmental Impact Assessment Law (EIA Law)

The Environmental Impact Assessment Law (EIA Law) was enacted on Jan 22, 1998, and was most recently amended on Feb 2, 2017. The law has as its goals the protection of the environment; prevention of ecological imbalances due to human activities; usage of natural resources with little environmental impact; and, for the execution of regional and sector policies, management of project development planning, impacts, etc., regarding preparations and decisions made by interested parties, and the performance of environmental impact assessments.

※ Reference: Environmental Protection Law (EPL)

- Environmental impact assessment is stipulated in Mongolia's environmental laws.

Mongolia’s basic environmental law is the Environmental Protectiont Law (EPL) enacted in 1995. It sets forth a framework for environmental management and the responsibilities of relevant institutions. The managing body for this law is the Ministry of Environment and Energy. This law stipulates that the right for Mongolia’s citizens to live in a healthy and safe environment should be guaranteed, social and economic development should be harmonized with environmental balance, the environment should be protected, and natural resources should be restored for the benefit of current and future generations. It also stipulates the relationships between businesses and organizations.

Article 7 of Chapter 2 of the EPL sets forth regulations regarding the environmental assessments for natural resources assessments and environmental impact assessments, while Article 8 does so for natural resource assessments and Article 9 for environmental impact assessments. Article 10 sets forth standards for the monitoring of environmental conditions, and there is a separate chapter (Chapter 5) on environmental monitoring that provides detailed regulations (Articles 26-29). Mongolia has a financially supported national environment protection and ecological safety program. This law was last amended on December 7, 2017.

3.7.2 The Expected Potential Environmental Impact and Assessment

A large-scale combined heat and power plant's existing aged facilities were arranged to be replaced to reduce ultrafine dust (PM2.5). As this involves the supplementation of ambient air quality equipment within an existing combined heat and power plant, no additional environmental impact assessment is deemed necessary.

<Table 137> Evaluation of the potential environmental impact of the project

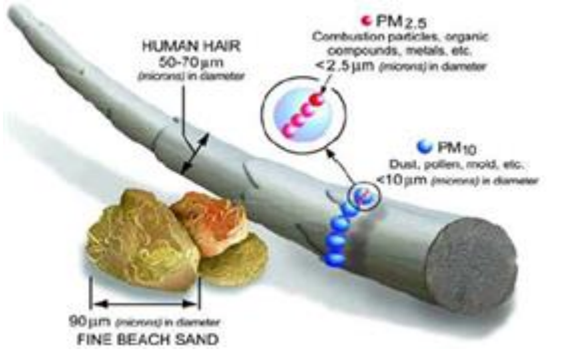
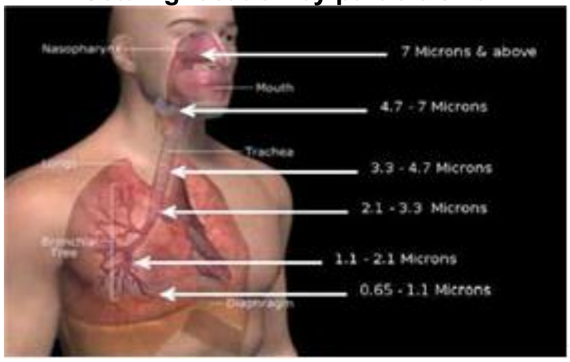
Item	Expected impact	Stage	Contents
Ambient air	The potential impact of equipment such as vehicles and generators on ambient air quality	Monitoring station installation	Transport of supplies, etc., are required for the installation of the stations, but few vehicles will be used for a short duration, making the impact likely minimal.
Water quality	The potential impact of leaks/flowing water on surface and underground water	Monitoring station installation	Foundation work necessary for installation will be executed (resulting in excavation), but the scale will be small and the duration short, making the impact likely minimal.
Noise	The potential impact of noise and vibrations from supply transport vehicles and equipment such as cranes	Monitoring station installation	The scale of the planned work is small, and there is expected to be limited impact (lasting 1-2 days) when the stations are installed.
Waste	Impact of ordinary waste and small-scale construction waste when monitoring stations are installed	Monitoring station installation	The scale of the planned work is small, and no waste will be produced from existing facilities as this involves new installations; the impact is expected to be minimal.
Soil	The potential impact on soil from chemicals or leaks/flowing water during installation	Monitoring station installation	No hazardous chemicals are planned for use during installation, so there will be no impact.

※ Reference: The harmful effects of fine dust on health

Fine dust (PM10, PM2.5) has been designated by the International Agency for Research on Cancer (under the World Health Organization) as a Group 1 carcinogen (confirmed to cause cancer in humans). It can be fatal to humans.

Among the 6.1 million global deaths caused by air pollution in 2016, 4.1 million were caused by external air pollution from fine dust (vehicles, power plants, etc.). (IHME, 2018)

[Figure 92] Fine dust particle size and settling location by size

<table>
<tr><th>Fine dust and ultrafine dust size</th><th>Settling location by particle size</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>• PM10 particles have 1/5-1/7 of the diameter of a human hair (50-70 ㎛)
• PM2.5 particles have only 1/20-1/30 of the diameter of a human hair</td><td>• Causes inflammation and diseases in various organs of the human body
• Eyes: allergic eye inflammation, corneitis
• Nose: allergic rhinitis
• Bronchial tubes: bronchitis, pulmonary emphysema, asthma
• Lungs: damage to cell lungs</td></tr>
</table>

In order to reduce the dangers of fine dust, emissions volumes and sources of fine dust must be urgently ascertained. This requires that monitoring systems be enhanced.

3.8 Performance Utilization

3.8.1 Utilization by Recipient Country

Increased measurement data through the expansion of monitoring stations will allow the data to approach proper representation of ambient air quality in Ulaanbaatar, and the establishment of a quality control system will enhance the reliability of the measurement data. This will make setting goals for ambient air quality improvement policies based on scientific and objective data possible.

In addition, a quality control system can be utilized to monitor and evaluate the performance of current Mongolian ambient air quality improvement policies. In particular, the enhancement of the quality and reliability of the measurement data allows it to be used for objective policymaking that takes the current situation in Mongolia into account. The ambient air quality monitoring system can be utilized for the selection of emissions standards when regulation policies for air pollution emission sources are created.

Real-time air pollution data can be provided to the public in various formats, enabling preparations for sudden ambient air quality deterioration and contributing to citizen health. The collected ambient air quality data can be provided to researchers, allowing it to be used as base data for the development of various ambient air quality improvement policies through public-private partnerships.

The demand for ambient air quality monitoring will inevitably increase as the national economy and cities grow. In the future, it will be necessary to expand the ambient air quality monitoring system from Ulaanbaatar to the smaller cities of local aimags. This means growth in a new area, and it also can serve as the basis for the creation of new jobs. More jobs for majors of relevant fields, the manufacture/supply of apparatuses for the operation of ambient air quality monitoring systems, etc., can lead to the growth of relevant industries.

3.8.2 Potential for Linkage with Follow-up Projects

In terms of the basic ambient air quality monitoring cycle of "measurement-analysis-policy," the recent projects being undertaken by Mongolia are at the "analysis" stage. The main contents of Korea’s EDCF project, “Mongolia National Environmental Research Institute (CLEM),” is to establish an analysis system of air pollutants indicated by WHO, such as SOx, NOx, O_3, CO, PM10, PM2.5, etc., as well as hazardous air pollutants such as PAHs and VOCs.

Hazardous air pollutants are different from general substances in that precision analysis devices must be employed in a separate lab after sampling. Therefore, such precision devices should be installed within the monitoring stations. As such, a project to expand the hazardous air pollutant monitoring network for the measurement of concentrations of hazardous air pollutants in the ambient air is necessary.

The building of an ICT-based integrated ambient air quality management system and its successful operation can contribute to the future improvement of management systems in other areas. The basic system of measurement-collection-saving-utilization can also be used similarly for vehicle emissions, gas station fuel management, etc.

3.9 Financial Planning

The government needs to reflect the air pollutant monitoring system of Monoglia in its budget, but it is suggested that external economic cooperation funds be used in part. For this, the utilization of OECD funding from the Korean government, the GCF Fund, etc., should be actively considered.

Annex

Ⅰ. Establishment of an Air Pollution Monitoring Network in Ulaanbaatar (Proposal)

1. Characteristics by Air Pollutant Source in Ulaanbaatar

The main sources of air pollution in Ulaanbaatar are coal-fueled combined heat and power plants, heat-only boilers, and gases generated from combustion of energy sources used at home, such as coal and firewood. These are the main sources of stationary pollution. Exhaust from car operation is considered the main source of mobile pollution.

In Ulaanbaatar City, winter air pollution caused by coal combustion has a serious impact on citizens' health. The main sources of air pollution are three thermal power plants, about 200 heat-only boilers (HOBs), about 1,000 coal-fired water heaters (CFWHs), and about 140,000 Ger stoves.

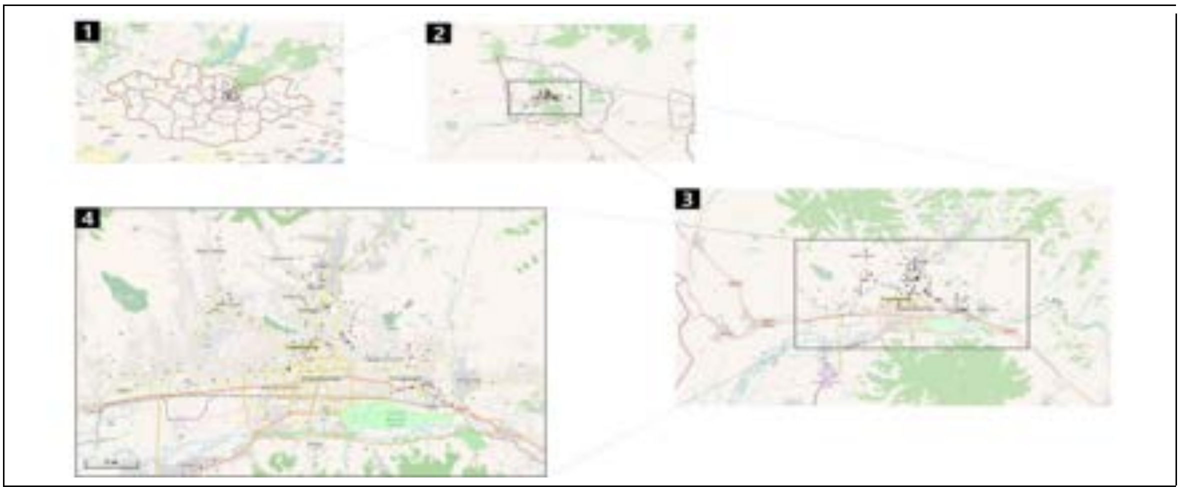
<Table> List of major air pollutants in Ulaanbaatar City

Air pollutant source	Volatile substance	Gaseous substance
Combined heat and power plant, steam heater	Cinder, soot	Organic acids, NO_2, SO_2, CO, CO_2
Automatic engine	Soot	NOx, CO, CO_2, CFC, coal, Benzene, lead
Traditional stoves in the Ger region	Dust, cinder, soot	SO_2, H_2S, NOx, CO, CO_2, coal, toxic substance
Chemical plants	Dust, chemical oxides	N_2S, CS_2, CO, NH_3, organic acids, disulfates
Metal coke plant	Dust, saturated iron	NO_2, SO_2, NH_3, NO, cyanide

Source: Ministry of Environment and Tourism of Mongolia

The major air pollutant sources in Ulaanbaatar are distributed mainly in downtown areas.

[Figure] Distribution chart of major air pollutant sources in Ulaanbaatar region



Source: http://www.eic.mn/airpollution/)

※ Due to the difficulty of collecting emission data available for each pollutant source, relevant sites were consulted. Thus, it was impossible to distinguish the degree of contribution of each pollutant source to emissions.

2. Evaluation of the location of the monitoring station through atmospheric diffusion modeling

(1) HOTMAC model

The HOTMAC program is a three-dimensional modeling tool mainly used to predict wind direction, wind speed, temperature, air turbulence, etc., under complex terrain conditions, and predicts the movement and the spread of pollutants using the predicted weather field from the RAPTAD program built into HOTMAC. Also, HOTMAC is a hybrid modeling program designed by combining a Lagrangian diffusion model and CFD model to predict and analyze air flow and pollutant movement in urban areas where many buildings are located.

Considering the geographical characteristics of basins surrounded by mountains, such as Ulaanbaatar, Mongolia's capital, HOTMAC can be applied to certain small areas to predict changes in ambient airflow and their effects. Therefore, creating weather fields based on topography and land use around the point where the monitoring station is located, and the diffusion pattern of air pollutants discharged from the basin, that is, the city, is analyzed.

(2) Weather field analysis in the Ulaanbaatar region

The Ulaanbaatar region is basin-shaped due to mountain ranges formed from north to south, and under the topographical conditions of this characteristic, the local wind field greatly contributes to ambient air quality. In other words, in this case, the impact of the topography is generally more important than the environment due to buildings located in the city center.

Mountain wind mainly occurs in basins and valley-type cities, and the role of wind is particularly important at this time, and mountain wind is generated by the density of air adjacent to the ground, which is influenced by the temperature change of the ground surface.

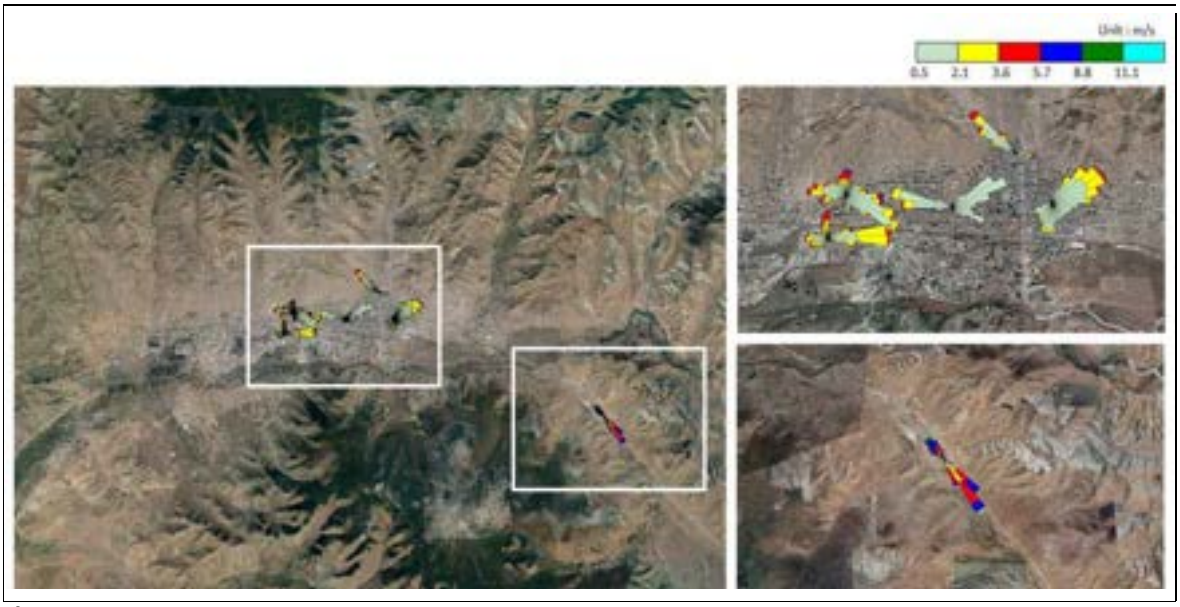
When the ground surface cools down at night, the air adjacent to the ground loses heat and cools down, and cold air is formed along the mountain slope. Cold air is heavier than warm air, thus low-temperature air located at high altitude descends in the downward direction.

During the day when the sun is up, the temperature at high altitude near the summit of the mountain rises rapidly, thereby causing an updraft, and the air in the area below the basin rises along the mountain slope, resulting in a mountain wind cycle every day.

In order to contrast with the results of the wind field simulation, data on the average wind direction and wind speed for one year in 2020 of six air pollution monitoring networks in Ulaanbaatar were expressed as wind roses and analyzed.

Data on the average wind direction and wind speed in 2020 measured at six air pollution monitoring stations in Ulaanbaatar

[Figure] Wind roses at air pollutant monitoring stations in Ulaanbaatar (2020)



Source: Incheon National University research data

Therefore, air pollutants emitted from the city center are expected to spread in the east-west direction where the city is distributed rather than in the north-south direction where the mountains are located, and since the wind speed is low, they are expected to remain stagnant above the city center rather than spread.

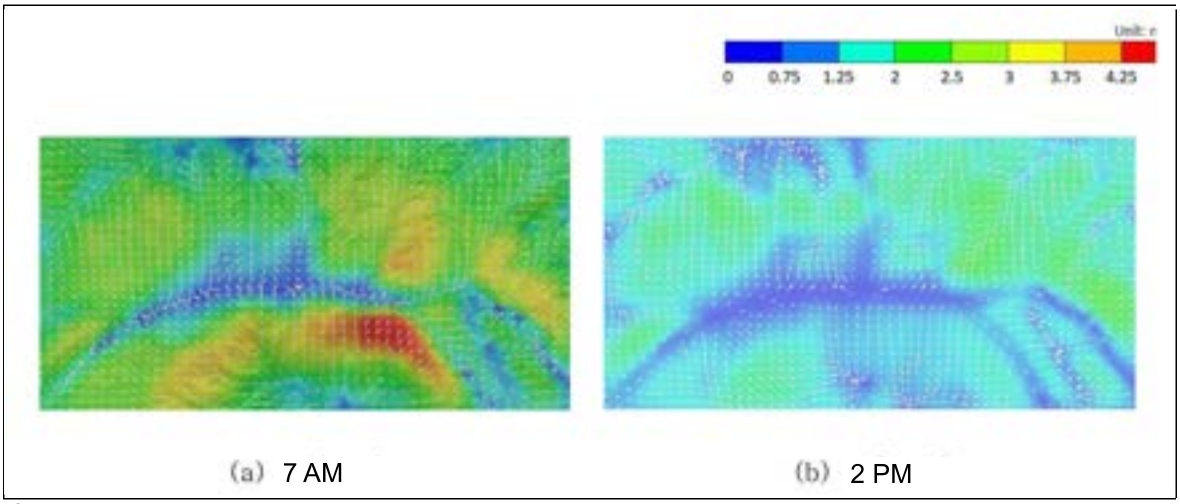
(3) Analysis of the diffusion pattern of air pollutants in Ulaanbaatar

Wind field simulation results showed that the air rises along the hillside during the day due to the mountains located south-north of downtown Ulaanbaatar, and the air descends along the hillside at night, showing a pattern of air circulation every day.

In order to simulate the air diffusion pattern in downtown Ulaanbaatar, where the concentration of fine dust is very high in winter due to the operation of power plants due to winter heating, the modeling period selected was a week in January 2020.

The figure below is the result of the wind field simulation at the time when the wind influence by the mountain wind is the strongest. The mountain wind is the strongest around 6 a.m. just before sunrise, and the valley wind is the strongest around 12-13 a.m. when the sun shines the strongest. In the case of wind speed, similar to the actual weather, wind speed between 0 and 1.9 m/s consistently occurred in the area below the basin.

[Figure] Results of wind field simulation according to the topography and land use of Ulaanbaatar

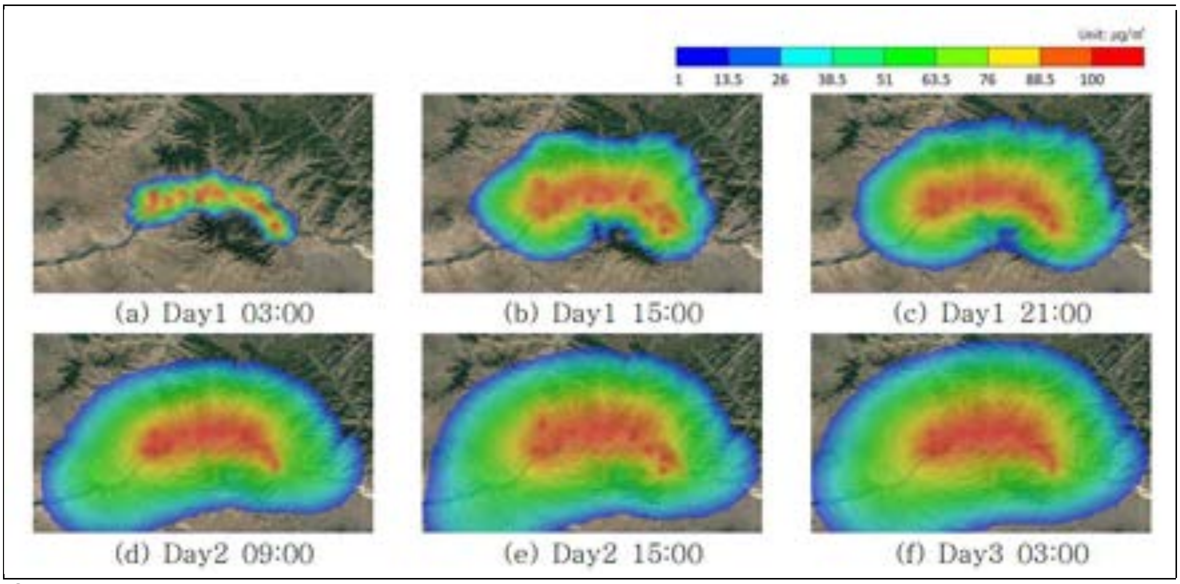


Source: Incheon National University research data

The high altitude of approximately 700 to 900 m in the mountain range surrounding downtown Ulaanbaatar in the north and south hinders the development of a valley wind along the mountain slope, resulting in stagnation of air pollutants discharged during the day.

Diffusion modeling was performed to analyze the diffusion pattern of air pollutants emitted from downtown Ulaanbaatar based on the simulated wind field. Due to the inability to secure actual emission data, diffusion modeling was performed by designating 12 random points in downtown Ulaanbaatar.

[Figure] Air pollutants diffusion patterns in Ulaanbaatar City



Source: Incheon National University research data

The figure above shows a concentration contour photograph of the HOTMAC diffusion modeling simulation results for 48 hours at 6-hour intervals after discharging air pollutants. It shows a widely spreading pattern of the discharged pollutants, but a high concentration stagnating over the city center under the basin.

As shown in the results of the wind field simulation, discharged pollutants are expected to remain in the air instead of spreading due to the valley wind weakened by the high altitude of the mountains, which is expected to have a greater impact on the residents.

In addition, there is a weak east-to-west wind blowing towards the western valley of the city center, and pollutants emitted from Nalaikh, a city located east of the center of Ulaanbaatar, are likely to flow into the city center of Ulaanbaatar through the valley.

(4) Review of the feasibility of the existing monitoring stations

In order to evaluate ambient air quality and manage and supervise specific pollutants, individual monitoring stations must have representation of the status of pollution in the region. In particular, since they are greatly influenced by physical environmental factors such as transportation, and land use in urban areas, selecting the location of the monitoring stations is very important.

In order to determine whether existing monitoring stations are suitable to reflect the characteristics of air pollution in the region, emission data for each major pollutant source by grid were databased and spatial data were generated using GIS software. The effect of air pollutants according to the main wind direction was predicted using the collected weather data or weather field model results, and the impact range was analyzed using the air diffusion model. The feasibility of the location of each monitoring station currently in operation can be analyzed by determining the degree of influence of surrounding buildings and the extent of influence of stationary pollutants located nearby.

However, under the current circumstances, in the absence of available information on various emission sources in Ulaanbaatar, there are major limitations in reviewing the appropriateness of the location of each existing monitoring station that produces pollutant concentration data every hour. (In-depth analysis is required after securing UB's local topographic map and emission data for each major pollutant source)

Due to the limitation of the data necessary for the feasibility review of the location of the existing monitoring station, grid locations that should be considered as additional installation points of the monitoring network shall be proposed while maintaining the existing monitoring station.

3. Selection of air pollution monitoring measurement points

In order to more accurately grasp the current status of air pollution, it would be desirable to select many measurement points, but an additional measurement consideration grid was selected in consideration of the infrastructure required for operation.

Measurement points were generally determined according to the degree of contamination in the target area by creating grids at regular intervals in consideration of the distribution and density of the population in the target area.

New measurement points for each purpose were selected according to the system in which existing measurement stations were classified in accordance with Korea’s example. It would have been appropriate to give priority to installing a monitoring station in the Ger region where a large population resides. However, in this project, it was difficult to secure emission data in the Ger region, so it was excluded from the measurement point priority.

(1) Criteria for general air pollution monitoring network selection

The four criteria for selecting measurement points according to the purpose of installation by classification of general air pollution monitoring networks can be defined as follows:

① Ambient air in the urban area: Cities with a population of 100,000 or more, and suitable for determining whether environmental standards are achieved by grasping the average ambient air quality concentration in urban areas.

② Ambient air in the suburban area: Monitoring stations on the outskirts of urban areas, where a certain distance from large emission sources or small- to medium-sized roads can be maintained so that measuring the ambient air quality in the suburban areas adjacent to urban areas would help to grasp the boundary conditions of an urban area and thus to indirectly evaluate the ambient air quality in urban areas

* Valley areas are not suitable. Areas near mountaintops and ridges or slopes of alpine regions are suitable, and places where the wind does not severely change the degree in pollution are considered first.

③ Background concentration: An area with minimal artificial effects discharged from the region or a place where pollutants flowing in and out of the region or from the outside can be measured. Places where there is no significant change in land use and alpine areas are considered as the priority points. Usually, the purpose is to grasp the national background concentration and identify the status of inflow and outflow of pollutants from foreign countries and the current status of long-distance movement.

④ Ambient air on the roadside: Roadsides with a large floating population and an appropriate traffic volume are selected to gain an understanding of the effect of air pollutants emitted from automobiles on ambient air quality.

The selection of supplementary points for air pollution measurement stations in the Ulaanbaatar region adhered to the standards for each purpose of installing a general air pollution monitoring network in Korea (Ministry of Environment, 2018). In addition, in the case of Mongolia, due to its cultural characteristics, the Ger region distributed outside the urban area of Ulaanbaatar is one of the important sources of pollution, and that it is necessary to first consider and select measurement points representing the air pollution emission characteristics of the Ger region. In addition to Ger, a grid was added to represent the characteristics of areas with a high concentration of urban commercial facilities, general residential areas, traffic-rich areas, areas with little influence from surrounding pollutants, and also pollutants with a large impact on the surrounding area, such as large thermal power plants identified within the range of available data.

① Urban area: Areas with a high concentration of buildings and commercial facilities where it is judged that vehicles will pass frequently, so that the characteristics of urban areas where these elements are evenly mixed can be well reflected

② Ger region: Points that are widely distributed around the center of Ulaanbaatar City, and as shown from the results of weather field analysis, where air flow is mainly formed in the east-west direction, so the area is less affected by internal factors and can reflect the unique characteristics of the Ger region

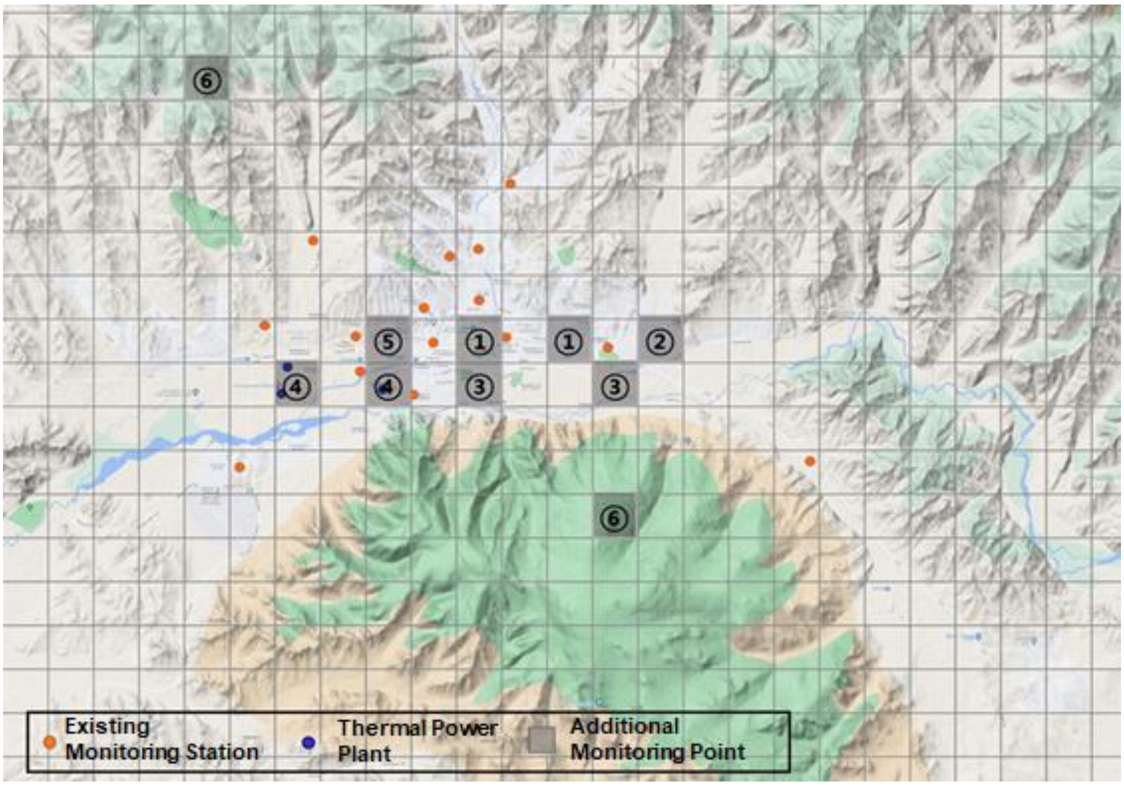
③ General residential area: Along with some commercial facilities, it is mainly a place where apartments are concentrated, reflecting the characteristics of general residential areas distinguished from Ger

④ Industrial area: A place adjacent to a large thermal power plant that is greatly influenced by industrial facilities

⑤ Roadside: A place with many convenience facilities, and thus intersections with a large amount of traffic

⑥ Ambient air in the suburb/outside the city: As a result of diffusion modeling, a location high in the mountains so that it is hardly affected by the source of occurrence inside the city center, considering the airflow flowing in from the southeast direction of downtown Ulaanbaatar and the airflow coming down the mountain north and south of the city

[Figure] Expansion of the air pollution monitoring network in Ulaanbaatar City (Proposal) (1 km × 1 km interval)



Source: Incheon National University

<Table> Expansion of the air pollution monitoring network in Ulaanbaatar (Proposal)

Item		In operation (number of stations)	Additionally installed (number of stations)
Ambient air in the urban area:	① City	2	2
	② Ger region	9	1
	③ General residential area	-	2
	④ Industrial area	2	2
Ambient air on the roadside	⑤ Road	2	1
Background concentration	⑥ Ambient air in the suburb/outside the city	1	2

Source: Reviewed and written by Incheon National University

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