MRV Demonstration Study (DS) using a Model Project 2012
Final Report

Replacement of Coal-Fired Boiler

by Geo-Thermal Heat Pump for Heating

implemented by Shimizu Corporation

Study Partners	✓ National Renewable Energy Centre (NREC) ✓ Polytech ADD. Inc. ✓ Japan Consulting Institute (JCI) ✓ Building Energy Efficiency Centre (BEEC) ✓ Japan Industrial Testing Co., Ltd. ✓ AX Limited
Location of Project/Activity	Mongolia
Category of Project/Activity	Renewable energy
Description of Project/Activity	The project aims to conduct heating for public buildings (kindergarten, school) in the center of Zuunmod Aimag district through utilizing geothermal heat pump.
Eligibility Criteria	Eligibility criteria have been set as follows. (The methodology is not restricted to geothermal heat pumps, however, explanations in the report are mainly predicated on geothermal heat pumps.) ✓ Existing heating water boilers are replaced with hot water heat pumps for heating following project implementation. ✓ All the boiler fuel used in existing boilers before project implementation consists of fossil fuel. ✓ Existing secondary air conditioning equipment such as radiators, etc. continues to be used without change after project implementation. ✓ The separately indicated check list (used for identifying the reference scenario) is passed. ✓ The following formula is satisfied: “Annual mean COP of heat pumps > Boiler efficiency ÷ Boiler fuel emission factor ÷ 3.6 x Grid emission factor. Moreover, in order to establish this condition, the boiler efficiency, boiler fuel emission factor and grid emission factor are clarified. ✓ Indoor heating is conducted. ✓ In the case of geothermal heat pumps, soft side support concerning design and execution can be received from advanced countries.
Reference Scenario and Project/ Activity Boundary	✓ Reference scenario: Identification was conducted using the checklist. Specifically, the reference scenario refers to the case where current inefficient coal-fired boilers continue to be used. ✓ Boundary: This encompasses the target heat pump system and the power plants on the grid.
Calculation	Two calculation options have been prepared:

Method Options	✓ Calculation method 1: This is selected if any one of the following cases is applicable: [1] It is the first project in this climate zone, [2] Air source heat pumps are used, [3] Water source heat pumps are used, [4] A solar system is incorporated into the heat pump system, or [5] Electric heaters are incorporated into the heat pump system. ✓ Calculation method 2: In cases other than the above, calculation method 2 that enables basic monitoring can be selected.
Default Values set in Methodology	There are no default values set in the methodology, however, if project-specific values are set in the registration stage, the pre-set project specific values that require no monitoring will be as follows: ✓ Emission coefficient of boiler fuel ✓ Boiler efficiency ✓ Heating indoor temperature ✓ Standard meteorological data (mean outside temperature)
Monitoring Method	The main monitoring parameters and monitoring frequency are as follows: ✓ Amount of heat supplied by heat pumps (in case of calculation method 1): 2 times - at the start and completion of monitoring ✓ Electric power consumed by heat pumps (in case of calculation method 1): 2 times - at the start and completion of monitoring ✓ Grid emission coefficient: 1 time – at the completion of monitoring ✓ Outside temperature: On every hour or a daily set time ✓ Conservativeness factor)(in case of calculation method 2): 1 time – at the completion of monitoring
Result of Monitoring Activity	At kindergartens and school in Zuunmod, monitoring was implemented without a problem based on the Methodology (Ver. 1.0). The monitoring period is as follows: ✓ Kindergarten: 47 days from September 15 to October 31, 2012 ✓ School: 36 days from September 26 to October 31, 2012
GHG Emissions and its Reductions	The calculated emission reductions are as follows: ✓ Kindergarten: 9 tCO_2 ✓ School: 14 tCO_2
Method and Result of Verification	Japan Consulting Institute (Japanese DOE) and BEEC (verification agency in Mongolia) implemented the verification and completed it without any problem. The on-site investigation was implemented from November 27 to 29.
Environmental Impacts	As the environmental impacts of the project, noise, vibration, leakage of coolant, and changes in the underground thermal environment can be considered, however, these can be kept to a minimum.
Promotion of Japanese Technology	It is possible that hard technology (heat pumps and underground heat exchangers) and soft technology (design and execution know-how) will be introduced from Japan.
Sustainable Development in Host Country	From the viewpoints of conserving energy, utilizing renewable energy and preventing air pollution, etc., the project activity can make a contribution to sustainable development in the host country.

Study Title: MRV Demonstration Study using a Model Project "Replacement of Coal-Fired Boiler by Geo-Thermal Heat Pump for Heating"

Study Entity: Shimizu Corporation

1. Study Implementation Scheme

In addition to Shimizu Corporation, the following entities in Japan and Mongolia played a part in study implementation in the manner described.

- ✓ **National Renewable Energy Centre (NREC)** [Counterpart, Contractor]: This is the state-owned enterprise that conducted design and works supervision in this undertaking (the first national pilot project for geothermal heat pumps in Mongolia), and it is counterpart in the Study. In addition to this project, it has been involved in numerous other state projects concerning renewable energy. In the Study, it was responsible for the monitoring and information collection, etc. in the field.
- ✓ **Polytech ADD, INC.** [Contractor]: Polytech ADD is an environmental consultant with experience of conducting environmental assessments and PDD for CDM projects, etc. In the Study, it assisted preparation of the MRV methodology and preparation of the monitoring report and offered guidance on handling the monitoring instruments and so on.
- ✓ **Japan Consulting Institute (JCI)** [Contractor]: As a representative DOE of Japan, JCI verified the monitoring report and implemented capacity building for the verification agency in Mongolia.
- ✓ **Building Energy Efficiency Centre (BEEC)** [Contractor]: A candidate as the verification agency in Mongolia, BEEC conducted verification of the monitoring report.
- ✓ **Japan Industrial Testing Co., Ltd** [Contractor]: It conducted the heat load calculation and heat pump simulation, etc. necessary for applying the MRV methodology.
- ✓ **AXE Corporation** [Contractor]: It conducted the tracing of drawings.

2. Overview of Project/Activity

(1) Description of Project/Activity Contents:

Host country and project activity implementation area

Mongolia, Zuunmod District

Project/Activity contents

The project aims to conduct heating for public buildings (kindergarten, school) in the center of Zuunmod Aimag district through utilizing geothermal heat pump.

Scale of equipment

Heat pump capacity in kindergarten: 93.9 kW x 1 unit

Heat pump capacity in school: 170.7 kW (2 units of 93.9 kW＋76.8 kW)

Note: Both cases assume the conditions of B2W65 (temperature at water inlet to heat source 2°C, temperature at hot water outlet 65°C).

Technology to be adopted in the project activity

Geothermal heat pump-related hard and soft technology

Anticipated project activity counterparts and partners

Mongolian Ministry of Energy, the Renewable Energy Center (state-owned enterprise under jurisdiction of the Ministry)

Outline of the project activity

This project has been implemented by the Ministry of Energy (previously the Ministry of Mineral Resources and Energy) in Zuunmod since 2010 as a pilot project utilizing geothermal heat pumps. There are three target facilities, i.e. a kindergarten, school and hospital, in Zuunmod. The kindergarten heat pump started operation in autumn 2010, the school heat pump in autumn 2011, and the hospital heat pump in autumn 2012.

How will the project activity contribute to reducing emissions?

Through replacing existing coal-fired heating boilers with geothermal heat pumps, thereby enabling coal usage to be reduced, the project will make a contribution to reducing emissions.

(2) Situations of Host Country:

Information concerning policy and other conditions in the host country in the target field (sector) of the project activity

Coal is the core element in Mongolia's energy policy. Mongolia has abundant reserves of coal, and more than 90% of its generated electricity is derived from coal-fired thermal power. Moreover, heating in Mongolia is provided either by combined heat and power from coal-fired thermal power plants or by coal-fired boilers. In cases where there is no coal-fired boiler, coal stoves in which coal is directly combusted are used. Therefore, measures to address atmospheric pollution caused by coal combustion form the core of environmental policy in Mongolia. It is estimated that coal reserves in Mongolia are sufficient to last for at least another 100 years, so it is fairly certain that coal will continue to be used and Mongolian energy policy and environmental policy will be based around coal for the next century to come.

Relation of the target field (and this project activity and similar project activities) to climate change in terms of policy

In these circumstances, the emphasis of climate change policy in Mongolia concerns how to use coal in a clean manner or how to not depend on coal, in other words, how to use clean energy that doesn't bring about air pollution. In specific terms, priority is given to the policies of improving the efficiency of coal burning equipment, energy saving in buildings, introduction of renewable energies and so on. Accordingly, utilization of heat pumps, which are a type of renewable energy, is consistent with the climate change policy of the Mongolian authorities.

However, winter temperatures in Mongolia are extremely cold and can fall as low as minus 50℃. Since the operating threshold of air-source heat pumps that are generally used in Japan is only minus 20~25℃, they cannot be used in Mongolia. Accordingly, attention is being directed to geothermal heat pumps. In Mongolia, the Renewable Energy Center has taken the initiative in implementing a pilot project on geothermal heat pumps using government funding. This is proof that the Mongolian government is interested in this technology.

(3) Complementarity of the CDM:

Difficulties confronting implementation of the project activity as a CDM

There are roughly 300 regional cities in Mongolia that have the kinds of public buildings that are targeted by the project. Thus, it is unfeasible in terms of time and cost to handle each case as a separate small-scale CDM project. Program CDM is also applicable, however, it is still necessary to implement strict monitoring and to conform with other CDM rules and it isn't profitable to use expensive monitoring devices in small-scale projects. Therefore, it is desirable that the project be implemented under the JCM/BOCM which allows for more flexible monitoring.

Significance of implementation under the Bilateral Offset Credit Mechanism (JCM/BOCM)

There are advantages to applying the Bilateral Offset Credit Mechanism (JCM/BOCM: Joint Crediting Mechanism / Bilateral Offset Credit Mechanism) because more flexible and simplified monitoring can be adopted. In the case where the project is implemented under the CDM, there is little likelihood that Japanese technology will be adopted. Geothermal heat pump technology is more widely available in Europe and America rather than Japan, and there is also a wider variety of models. In this sense too, there is great significance in implementing the project under the JCM/BOCM, which offers greater possibility of Japanese technology being adopted.

(4) Initial Investment for the Model Project:

According to the Renewable Energy Center, initial investment for the geothermal heat pump system introduced to the kindergarten in Zuunmod is approximately 29 million JPY. This cost includes the heat pump, geothermal exchanger and works cost, however, it doesn't include the cost of secondary side air conditioning equipment such as radiators, etc. that do not need rehabilitation.

3. Contents of the Study

(1) Issues to be Addressed in the Study:

- ✓ Eligibility criteria for application of the MRV methodology
- ✓ Calculation method options
- ✓ Information and data for implementing calculation
- ✓ Project activity boundary
- ✓ Reference scenario
- ✓ Monitoring implementation and monitoring methods
- ✓ Defaulting of parameters
- ✓ Quantification of the emissions reduction effect
- ✓ Implementation of study and verification of the reduction in emissions
- ✓ Securing of environmental integrity
- ✓ Measures to promote introduction of Japanese technology
- ✓ Contribution to sustainable development in the host country

(2) Process to Solve the Issues in the Study:

- ✓ **Eligibility criteria for application of the MRV methodology:** The eligibility criteria for the MRV methodology were set upon conducting detailed investigation in light of the local conditions. Also, examination was conducted in order to enhance the general versatility of the methodology. In specific terms, application of heat pumps other than the geothermal type is possible.
- ✓ **Calculation method options:** In this MRV methodology, two calculation methods, i.e. the highly accurate calculation method 1, and the more basic calculation method 2 that applies degree days, have been set. These methods have been arranged so that they can be used in all the cases that pass the eligibility criteria.
- ✓ **Information and data for implementing calculation:** All the data required in the project planning stage and post-implementation stage was identified, and survey was conducted on the availability of that data. Survey was conducted concerning the possibility of setting soil-related data (physical properties such as heat conductivity, specific heat and density, etc.) based on literature before conducting the heat response test, however, no appropriate literature data could be found. Therefore, it is deemed essential to implement heat response test, however, if the data needs to be set in advance, the only option will be to use the results of the survey conducted in fiscal 2011.
- ✓ **Project activity boundary:** Upon carefully investigating whether the survey findings from fiscal 2011 were adequate or require updating, there was deemed to be no particular need for changing the survey findings from 2011. Specifically, the boundary is set so that it encompasses the target heat pump systems and grid power plants.

- ✓ **Reference scenario**: Investigation was conducted to determine the adequacy of the 2011 survey findings, implement any necessary updates and reflect the outcome. Specifically, it was made possible to identify the reference scenario by means of the checklist in the eligibility criteria.
- ✓ **Monitoring implementation and monitoring methods**: The two calculation methods, i.e. the highly accurate calculation method 1, and the more basic calculation method 2 that applies degree days, were applied and the results were compared with a view to demonstrating the validity of the basic calculation method. The monitoring instruments were installed by the Renewable Energy Center in August. Monitoring was commenced on September 15, when the heating season begins (the school opened on September 26). In consideration of the verification schedule, data from up to October 31 was reflected in the monitoring report.
- ✓ **Defaulting of parameters**: Survey was conducted to confirm that, in light of the study findings during fiscal 2011, there is sufficient data to default the parameters and where necessary to update the data. In the case where it is considered irrational to clarify parameters for which default values can be set, to demonstrate that conservative calculation results are obtained or to derive conservative calculation results, examination was conducted on a methodology that doesn't entail defaulting. Specifically, four project-specific default values (fuel emission coefficient, boiler efficiency, average year outside temperature, indoor heating temperature) were set (as project-specific values) even though there are no default values that can be incorporated into the methodology.
- ✓ **Quantification of the emissions reduction effect**: In light of the results of monitoring on the demonstration model site, confirmation was implemented to determine how far the raw results of using calculation method 2 that applies degree days (not taking the conservativeness coefficient into account) can be approximated to the results of using calculation method 1. As a result, the results from calculation method 1 (9 tCO_2 in the kindergarten, 14 tCO_2 in the school) were roughly 59~65% of the raw results obtained from calculation method 2. In other words, the conservativeness coefficient was roughly 0.59~0.65, far removed from 1. Possible reasons for this are that, [1] the monitoring period was too short, [2] there were a lot of rooms where the heating was turned off, [3] it wasn't possible to accurately calculate the thermal load from the floor, and [4] there was impact from solar radiation. However, thanks to the conservativeness coefficient, it was demonstrated that a conservative calculation can be made using calculation method 2.
- ✓ **Implementation of study and verification of the reduction in emissions**: As a result of the study, it was found that there is no appropriate verification agency Mongolia. Accordingly, upon discussing with GEC, it was decided to request the Japanese DOE to implement verification and to allow the Mongolian verification agency conduct some of the work while implementing capacity building for it. Specifically, Japan Consulting

Institute and BEEC implemented verification in their capacities as the Japanese DOE and the Mongolian verification agency respectively. The field survey was implemented from November 27 to 29, 2011. As a result of the verification, there was no major problem.

- ✓ **Securing of environmental integrity**: Upon investigating whether there were any problems in the 2011 survey results and whether updating was required, there was deemed to be no particular need to alter the 2011 survey results. Concerning the results of implementing environmental impact assessment ahead of project implementation on the demonstration site, according to the Renewable Energy Center, "Assessment hasn't been implemented because this is a national project."
- ✓ **Measures to promote introduction of Japanese technology**: Upon investigating whether there were any problems in the 2011 survey results and whether updating was required, examination was conducted into measures for promoting the introduction of Japanese heat pumps. As a result, the Japanese technology was found to have no superiority to European or American technology in terms of hard performance, and it was concluded that adoption of Japanese products cannot be encouraged even if performance requirements are incorporated into the eligibility criteria. Also, it was concluded that soft-side support by advanced countries should be incorporated into the eligibility criteria.
- ✓ **Contribution to sustainable development in the host country**: Upon investigating whether there were any problems in the 2011 survey results and whether updating was required, examination was deepened to include opinions, etc. on the Mongolian side. As a result, it was concluded that there was no particular need to alter the 2011 survey results.

4. Results of MRV Demonstration Study

(1) GHG Emission Reduction Effects by the Implementation of Project/Activity:

Reasons and basis for the greenhouse gas (GHG) emissions reduction effect of project activity implementation

Heating of public buildings in regional cities of Mongolia is generally conducted by supplying hot water from coal-fired boilers, however, the efficiency of such boilers is extremely low, usually just 40%. Coal-fired boilers in Mongolia have extremely primitive structures comprising water pipes assembled from steel pipes surrounded by brick enclosures. Moreover, coal is manually inserted by the boiler men and the boilers are not equipped with any equipment for enhancing efficiency. In the project, consideration is given to the possibility of replacing this inefficient heating system with high-efficiency geothermal heat pumps. Since heat pumps do not possess combustion equipment, they have no direct discharge of greenhouse gases, however, the drive power is mainly derived from coal thermal power. Therefore, although there would be emissions from the coal-fired thermal power plants, these would be smaller than the emissions from coal-fired boilers, and project implementation would bring about an emissions reduction effect.

Contents of the MRV methodology for quantifiably assessing the emissions reduction effect

In this MRV methodology, two calculation methods are envisaged, namely the highly accurate calculation method 1, and the more basic calculation method 2 that applies degree days.

Calculation method 1 is a stringent method applicable to the CDM. Calorimeters and electricity meters are installed, and the measurements from these instruments are used to calculate reference emissions and project emissions. However, because there are so many public buildings (hundreds of locations) in regional cities of the type targeted in the project in Mongolia, it is not feasible to install and control such expensive instruments in all sites.

On the other hand, in calculation method 2, calorimeters and electricity meters are not installed, however, adjustments have been made so that it is possible to calculate reference emissions and project emissions simply by grasping the representative outside temperature in each climate zone. This approach is based on applying the degree day theory whereby reference emissions and project emissions are determined by the thermal load and the thermal load is determined by outside temperature.

In concrete terms, a preliminary simulation is conducted to calculate the standard degree day, reference standard emissions and project standard emissions on the standard degree day under standard weather conditions. During the monitoring period, outside temperature data is obtained from the meteorological agency and used to compute the degree day. Through multiplying the ratio of this degree day to the standard degree day by the reference standard emissions and project standard emissions, the reference emissions and project emissions during the monitoring period are calculated.

Calculation method 2 is a basic approach, however, it is inferior to calculation method 1 in terms of accuracy. Accordingly, steps are also taken with a view to securing conservativeness. If there are multiple projects taking place in the same climate zone, monitoring based on both calculation method 1 and 2 is implemented only on the project that was implemented first (referred to as the “reference project”) and the conservativeness coefficient (Emissions reduction according to calculation method 1 ÷ Emissions reduction according to calculation method 2) is calculated. The remaining projects are then monitored using only calculation method 2, and the emissions reduction based on the results is multiplied by the said conservativeness coefficient in order to secure conservativeness.

(2) Eligibility Criteria for MRV Methodology Application:

Applicable criteria to the target project activity (and similar project activities)

The eligibility criteria for this methodology are as follows. In other words, this methodology can be applied to projects that satisfy all these requirements.

Condition 1	Existing heating water boilers are replaced with heating water heat pumps following project implementation.
Condition 2	All fuel used in existing boilers before project implementation is fossil fuel.
Condition 3	Secondary side air conditioning equipment such as radiators, etc. continues to be used without change after project implementation.
Condition 4	The separately indicated checklist (used for identifying the reference scenario) is passed.
Condition 5	The following formula is satisfied: Annual mean COP of heat pumps > Boiler efficiency ÷ Boiler fuel emission factor ÷ 3.6 x Grid emission factor. Moreover, in order to establish this condition, the boiler efficiency, boiler fuel emission factor and grid emission factor are clarified.
Condition 6	Indoor heating is conducted.
Condition 7	In the case of geothermal heat pumps, soft side support concerning design and execution can be received from advanced countries.

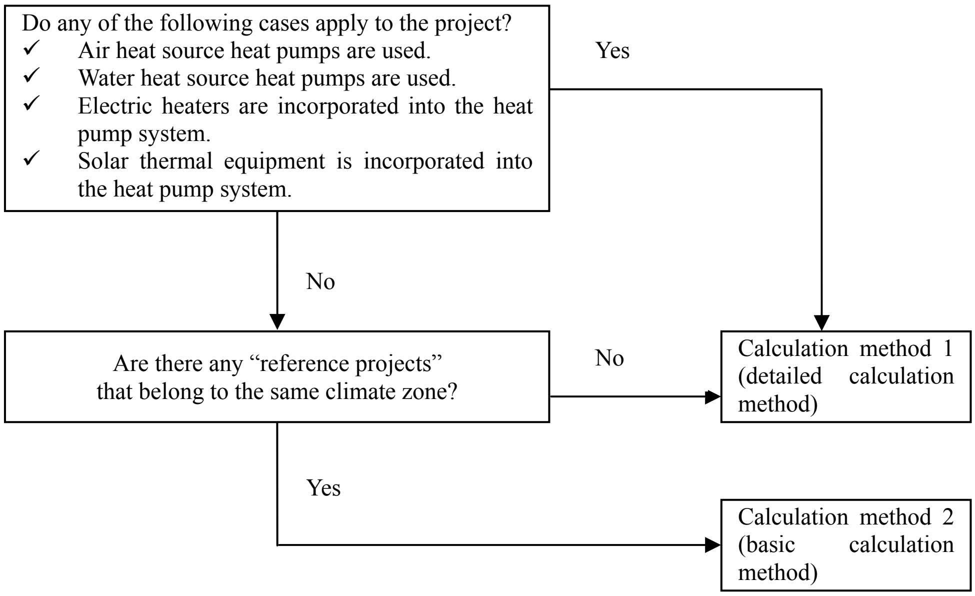
Explanation that additional emission reductions are imparted by the eligibility criteria (in other words, that the project is automatically eligible if it satisfies all the eligibility criteria)

Additional emission reduction effect cannot be grasped unless the reference scenario is identified. In the eligibility criteria, Condition 4 requires that a checklist for identifying the reference scenario be prepared, and that the project implementer only needs to follow this. If the reference scenario is identified and the relationship between heat pump efficiency and boiler efficiency satisfies the necessary requirements according to Condition 5, it may be said that additional emissions reduction will be imparted.

(3) Calculation Method Options:

Two calculation method options have been prepared as follows.

- ✓ Calculation method 1 is used when any of the following cases exists: [1] This is the first project in the climate zone (there are no reference projects in the climate zone), [2] Air heat source heat pumps are used, [3] Water heat source heat pumps are used, [4] Solar thermal equipment is incorporated into the heat pump system, and [5] Electric heaters are incorporated into the heat pump system.
- ✓ Calculation method 2: In any other cases, calculation method 2 which enables simple monitoring can be selected.



Calculation Options

(4) Necessary Data for Calculation:

Case of calculation method 1

Data that needs to be set in advance in the Project Registration Stage

Classification	Explanation of Data	Symbol	Unit	D, S, M or C Classification	Availability
Essential data for the project	Reference scenario boiler efficiency	EF	—	S	This can be obtained by interviewing experts.
	Reference scenario boiler fuel emission coefficient	FEF	tCO_2/GJ	S	According to the Mongolian DNA, it is OK to use the IPCC default value.
	Indoor temperature	RT	degree C	S	This can be obtained by interviewing experts.
Data needed so that the project can be referred to in other projects	Standard meteorological data (outside temperature)	SOTi	degree C	S (MA)	This can be obtained from the meteorological agency.
	Thermal load of buildings under standard meteorological conditions	SQ	GJ	C1	Conduct general thermal load calculation. It is scheduled to compile a basic calculation tool.
	Heat pump mean COP under standard meteorological conditions	SCOP	—	C1	This can be calculated by means of a commercially available heat pump simulation.

Data that needs to be monitored following Project Implementation

Classification	Explanation of Data	Symbol	Unit	D, S, M or C Classification	Availability
Essential data for the project	Quantity of heat supplied by the heat pump	Q	GJ	MC	This can be obtained by installing an instrument and monitoring.
	Amount of electricity consumed by the heat pump (including the amount of power consumed by the heating source water pump)	W	MWh	MC	This can be obtained by installing an instrument and monitoring.
	Grid emission coefficient	GEF	tCO_2/MWh	MA	This can be obtained by monitoring. According to the Mongolian DNA, emission coefficient on the central grid is posted on the DNA website and can be used.
Data needed so that the project can be referred to in other projects	Meteorological data (outside temperature)	OTi	Degree C	MA	This can be obtained from the meteorological agency.
	Conservativeness coefficient	C	—	C2	This can be calculated from the results of monitoring.

Case of calculation method 2

Data that needs to be set in advance in the Project Registration Stage

Classification	Explanation of Data	Symbol	Unit	D, S, M or C Classification	Availability
Data that should be acquired in the project	Reference scenario boiler efficiency	EF	—	S	This can be obtained by interviewing experts.
	Reference scenario boiler fuel emission coefficient	FEF	tCO_2/GJ	S	According to the Mongolian DNA, it is OK to use the IPCC default value.
	Standard meteorological data (outside temperature)	SOTi	degree C	S(MA)	This can be obtained from the meteorological agency.
	Indoor temperature	RT	degree C	S	This can be obtained by interviewing experts.
	Thermal load of buildings under standard meteorological conditions	SQ	GJ	C1	Conduct general thermal load calculation. It is scheduled to compile a basic calculation tool.
	Heat pump mean COP under standard meteorological conditions	SCOP	—	C1	This can be calculated by means of a commercially available heat pump simulation.

Data that needs to be monitored following Project Implementation

Classification	Explanation of Data	Symbol	Unit	D, S, M or C Classification	Availability
Data that should be acquired in the project	Grid emission coefficient	GEF	tCO_2/MWh	MA	This can be obtained by monitoring. According to the Mongolian DNA, emission coefficient on the central grid is posted on the DNA website and can be used.
	Meteorological data (outside temperature)	OTi	℃	MA	This can be obtained from the meteorological agency.
Data that should be acquired from reference projects	Conservativeness coefficient	C	—	MA	This can be obtained from the reference project.

Legend

D: Default value that is stated in the methodology but doesn't require monitoring.
S: Default value that isn't stated in the methodology but is included in the PDD as a project-specific value and must be monitored following project implementation if the project is registered (project-specific value)
MA: Out of the items that require periodic monitoring following project implementation, this is categorized under pattern A (official data).
MB: Out of the items that require periodic monitoring following project implementation, this is categorized under pattern B (transaction data).
MC: Out of the items that require periodic monitoring following project implementation, this is categorized under pattern C (other than A or B).
C1: Items that are calculated in advance based on default values, etc. at the time of project registration.
C2: Items calculated based on the results of monitoring at the time of project implementation.

(5) Default Value(s) Set in MRV Methodology:

Considering the general applicability of the methodology to countries apart from Mongolia, default values (D) that should be stated in the methodology are not envisaged, however, the following four project-specific values (S) are projected. All values are figures used in the project registration stage.

Item	Symbol	Unit	D and S Classification	Value	Study Contents Setting Basis	Reason for Deriving Conservative Calculation Results
Reference scenario boiler efficiency	EF	—	S	40%	This was obtained by interviewing experts.	A conservative value can be obtained from the expert.
Reference scenario boiler fuel emission coefficient	FEF	tCO_2/GJ	S	0.0258 tonC/GJ	According to the Mongolian DNA, it is OK to use the IPCC default value.	This is the IPCC default value and is transparent.
Standard meteorological data (outside temperature)	SOTi	degree C	S(MA)	(Omitted here due to the sheer quantity of data)	This was obtained from the meteorological agency.	This is official observation data of the meteorological agency and is transparent.
Indoor temperature	RT	degree C	S	18℃	This was obtained by interviewing experts.	A conservative value can be obtained from the expert.

(6) Setting of Reference Scenario and Project/Activity Boundary:

Reference scenario and its validity in the project activity

The reference scenario is identified upon preparing a checklist of eligibility criteria. This method applies the CDM methods of scenario analysis and additionality demonstration tool, etc. Important points in this approach are that there is no need to independently consider the candidate scenario, and that the judgment criteria are clearly prepared. The checklist is outlined below.

Check No.	Check Contents	Conclusion from the Check Results
1	Is it possible to improve the efficiency of current boilers? [1] It is possible. [2] Since there is no obligatory legal regulation and the IRR is lower than the loan interest rate over 15 years of the project, it is impossible. [3] Other	If [2] is applicable, efficiency improvement is not possible in the reference scenario. → Go to check 2
2	Is it possible to switch current boilers to other heat supply? [1] It is possible. [2] Since there is no obligatory legal regulation and there are no other heat suppliers, it is impossible. [3] Since there is no obligatory legal regulation and the IRR is lower than the loan interest rate over 15 years of the project, it is impossible. [4] Others	If [2] or [3] is applicable, switching to other heat is not possible in the reference scenario. → Go to check 3.
3	Is it possible to replace current boilers with electric heaters? [1] It is possible. [2] Since there is no obligatory legal regulation and lighting and heating costs would rise, it is impossible. [3] Since there is no obligatory legal regulation and the IRR is lower than the loan interest rate over 15 years of the project, it is impossible. [4] Since no power can be obtained for electric heaters, this is impossible. [5] Other	If [2] or [3] or [4] is applicable, replacing with electric heaters is not possible in the reference scenario. → Go to check 4.
4	Is it possible to replace current boilers with fossil fuel-burning boilers that have lower emission coefficient? [1] It is possible. [2] Since there is no obligatory legal regulation and lighting and heating costs would rise, it is impossible. [3] Since there is no obligatory legal regulation and the IRR is lower than the loan interest rate over 15 years of the project, it is impossible. [4] Since there is no obligatory legal regulation and other fossil fuels cannot be obtained, this is impossible. [5] Other	If [2] or [3] or [4] is applicable, replacing with fossil fuel-burning boilers that have lower emission coefficient is not possible in the reference scenario. → Go to check 5.
5	Is it possible to replace current boilers with biomass boilers or solar thermal equipment? [1] It is possible. [2] Since there is no obligatory legal regulation and lighting and heating costs would rise, it is impossible. [3] Since there is no obligatory legal regulation and the IRR is lower than the loan interest rate over 15 years of the project, it is impossible. [4] Since there is no obligatory legal regulation and biomass cannot be obtained, this is impossible. [5] Since solar heat is insufficient, this is impossible. [6] Other	If [2] or [3] or [4] or [5] is applicable, replacing with biomass boilers or solar thermal equipment is not possible in the reference scenario. →Go to check 6.
6	Is it possible to replace current boilers with heat pumps? [1] It is possible. [2] Since there is no obligatory legal regulation and lighting and heating	If [2] or [3] is applicable, replacing with heat pumps is not the reference scenario but this

	costs would rise, it is impossible. [3] Since there is no obligatory legal regulation and the IRR is lower than the loan interest rate over 15 years of the project, it is impossible. [4] Other	methodology can be applied, while the reference scenario can be identified as continued use of the existing boilers.

Boundary of the Project Activity

The project boundary includes the following GHG emission sources and GHG emissions.

- ✓ CO_2 emitted in line with fuel combustion in boilers installed in the reference scenario
- ✓ CO_2 emitted in generation of power for driving heat pumps installed in the project scenario

Leakage

No leakage is envisaged.

(7) Monitoring Methods:

Monitoring method in the project activity, and basis for believing the monitoring method can be applied to the host country

In case of calculation method 1

Data that needs to be set in advance in the Project Registration Stage

Classification	Explanation of Data	Symbol	Unit	D, S, M or C Classification	Monitoring Method (source of information or data, etc.)	Monitoring Frequency	Basis for Believing the Monitoring Method can be Applied to the Host Country
Essential data for the project	Reference scenario boiler efficiency	EF	—	S	Expert	At the time of project registration	It can be acquired in hearings.
	Reference scenario boiler fuel emission coefficient	FEF	tCO_2/GJ	S	Host country's government(Ministry of Environment and Green Development)	At the time of project registration	It can be acquired in hearings.
	Indoor temperature	RT	degree C	S	Expert	At the time of project registration	It can be acquired in hearings.
Data needed so that the project can be referred to in other projects	Standard meteorological data (outside temperature)	SOTi	degree C	S(MA)	Host country's government (meteorological agency)	On every hour or at a daily set time, at the time of project registration	Data can be purchased from the meteorological agency.
	Thermal load of buildings under standard meteorological conditions	SQ	GJ	C1	Use of simulation	At the time of project registration	An air conditioning engineer can calculate this, however, a tool will be prepared so that simpler calculation can

							be performed in this demonstration study.
	Heat pump mean COP under standard meteorological conditions	SCOP	—	C1	Use of simulation	At the time of project registration	An air conditioning engineer can calculate this if using a commercially available heat pump simulation.

Data that needs to be monitored following Project Implementation

Classification	Explanation of Data	Symbol	Unit	D, S, M or C Classification	Monitoring Method (source of information or data, etc.)	Monitoring Frequency	Basis for Believing the Monitoring Method can be Applied to the Host Country
Essential data for the project	Heating quantity of hot water supplied by the heat pump	Q	GJ	MC	Calorimeter	At start and completion of monitoring	Data can be obtained by taking instrument readings.
	Amount of electric power consumed by the heat pump (including power consumption by the heat source water pump)	W	MWh	MC	Electricity meter	At start and completion of monitoring	Data can be obtained by taking instrument readings.
	Grid emission coefficient	GEF	tCO_2/MWh	MA	Host country's government(Ministry of Environment and Green Development)	On completion of the monitoring period	Data can be obtained from the Mongolian DNA website.
Data needed so that the project can be referred to in other projects	Meteorological data (outside temperature)	OTi	degree C	MA	Host country's government (meteorological agency)	On every hour or at a daily set time, at the time of project completion	Data can be purchased from the meteorological agency.
	Conservativeness coefficient	C	—	C2	Calculation	On completion of the monitoring period	Data can be calculated by using the calculation tool.

In case of calculation method 2

Data that needs to be set in advance in the Project Registration Stage

Classification	Explanation of Data	Symbol	Unit	D, S, M or C Classification	Monitoring Method (source of information or data, etc.)	Monitoring Frequency	Basis for Believing the Monitoring Method can be Applied to the Host Country
Data that should be acquired in the project	Reference scenario boiler efficiency	EF	—	S	Expert	At the time of project registration	It can be acquired in hearings.
	Reference scenario boiler fuel emission coefficient	FEF	tCO_2/GJ	S	Host country's government(Ministry of Environment and Green Development)	At the time of project registration	It can be acquired in hearings.
	Standard meteorological data (outside temperature)	SOTi	degree C	S(MA)	Host country's government (meteorological agency)	On every hour or at a daily set time, at the time of project registration	Data can be purchased from the meteorological agency.
	Indoor temperature	RT	degree C	S	Expert	At the time of project registration	It can be acquired in hearings.
	Thermal load of buildings under standard meteorological conditions	SQ	GJ	C1	Use of simulation	At the time of project registration	An air conditioning engineer can calculate it, however, a tool will be prepared so that simpler calculation can be performed in this demonstration study.
	Heat pump mean COP under standard meteorological conditions	SCOP	—	C1	Use of simulation	At the time of project registration	An air conditioning engineer can calculate this if using a commercially available heat pump simulation.

Data that needs to be monitored following Project Implementation

Classification	Explanation of Data	Symbol	Unit	D, S, M or C Classification	Monitoring Method (source of information or data, etc.)	Monitoring Frequency	Basis for Believing the Monitoring Method can be Applied to the Host Country
Data that should be acquired in the project	Grid emission coefficient	GEF	tCO_2/MWh	MA	Host country's government(Ministry of Environment and Green Development)	On completion of the monitoring period	It can be obtained from the Mongolia DNA's website.
	Meteorological data (outside temperature)	OTi	Degree C	MA	Host country's government (meteorological agency)	On every hour or at a daily set time, at the time of project completion	Data can be purchased from the meteorological agency.
Data that should be acquired from reference projects	Conservativeness coefficient	C	—	MA	Reference project	On completion of the monitoring period	This is simple because it can be acquired from reference projects

Legend

D: Default value that is stated in the methodology but doesn't require monitoring.
S: Default value that isn't stated in the methodology but is included in the PDD as a project-specific value and must be monitored following project implementation if the project is registered (project-specific value)
MA：Out of the items that require periodic monitoring following project implementation, this is categorized under pattern A (official data).
MB: Out of the items that require periodic monitoring following project implementation, this is categorized under pattern B (transaction data).
MC: Out of the items that require periodic monitoring following project implementation, this is categorized under pattern C (other than A or B).
C1: Items that are calculated in advance based on default values, etc. at the time of project registration.
C2: Items calculated based on the results of monitoring at the time of project implementation.

Notes
"On every hour" refers to data obtained every hour at 0 minutes 0 seconds.
"Daily set time" refers to data at a set time every day. Hourly data is desirable.

Monitoring Implementation Setup

In the demonstration study, employees of the Renewable Energy Center (the counterpart agency) went to the demonstration sites, meteorological agency and other places in order to obtain the necessary data. Meanwhile, employees of Shimizu Corporation prepared the monitoring report.

Monitoring Period

The monitoring was started on September 15, 2012 (the school opened on September 26) and continued until October 31, and the results were reflected in the monitoring report.

Results of Actual Monitoring

The monitoring results are indicated below.

Explanation of Data	Symbol	Unit	Kindergarten	School
Reference scenario boiler efficiency	EF	-	0.4	Ditto
Reference scenario boiler fuel emission coefficient	FEF	tC/TJ	25.8	Ditto
Grid emission coefficient	GEF	tCO2/MWh	1.15	Ditto
Heating quantity of hot water supplied by the heat pump	Q	GJ	73.589	119.645
Amount of electric power consumed by the heat pump (including power consumption by the heat source water pump)	W	MWh	6.685	12.360
Standard meteorological data (outside temperature)	SOTi	℃	(Omitted here due to the sheer quantity of data)	Ditto
Meteorological data (outside temperature)	OTi	℃	(Omitted here due to the sheer quantity of data)	Ditto
Thermal load of buildings under standard meteorological conditions	SQ	GJ	153.5	226.2
Heat pump mean COP under standard meteorological conditions	SCOP	-	2.30	2.30

(8) Quantification of GHG Emissions and its Reductions:

Method for quantifying (calculating and estimating) reference emissions in the project activity and emissions (and leakage emissions) in project activity implementation

Reference emissions and their calculation

Calculation method 1

$$RE_y = Q \div EF \times FEF \qquad (1\text{-}1)$$

Where,

RE_y Reference CO_2 emissions (tCO_2)

Q Heating quantity of hot water supplied by the heat pump (GJ)

EF Reference scenario boiler efficiency (－)

FEF Reference scenario boiler fuel emission coefficient (tCO_2/GJ)

Calculation method 2

$$RE_y = DD \times SRE \div SDD \qquad (2\text{-}1)$$

Where,

RE_y	Reference CO2 emissions	(tCO_2)
DD	Degree day	(degree Cday)
SRE	Reference standard emissions	(tCO_2)
SDD	Standard degree day	(degree Cday)

$$DD = \sum (RT - OTi) \qquad (2\text{-}2)$$

Where,

DD	Degree day	(degree Cday)
RT	Indoor temperature	(degree C)
OTi	Outside temperature	(degree C)

$$SRE = SQ \div EF \times FEF \qquad (2\text{-}3)$$

Where,

SRE	Reference standard emissions	(tCO_2)
SQ	Thermal load of buildings under standard meteorological conditions	(GJ)
EF	Reference scenario boiler efficiency	(－)
FEF	Reference scenario boiler fuel emission coefficient	(tCO_2/GJ)

$$SDD = \sum (RT - SOTi) \qquad (2\text{-}4)$$

Where,

SDD	Standard degree day	(degree Cday)
RT	Indoor temperature	(degree C)
SOTi	Standard outside temperature	(degree C)

Project emissions and their calculation

Calculation method 1

$$PE_y = W \times GEF \qquad (1\text{-}2)$$

Where,

PE_y	Project CO2 emissions	(tCO_2)

W Amount of electric power consumed by the heat pump (MWh)
GEF Grid emission coefficient (tCO_2/MWh)

Calculation method 2

$$PE_y = DD \times SPE \div SDD \quad (2\text{-}5)$$

Where,
PE_y Project CO2 emissions (tCO_2)
DD Degree day (degree Cday)
SPE Project standard emissions (tCO_2)
SDD Standard degree day (degree Cday)

$$SPE = SQ \div 3.6 \div SCOP \times GEF \quad (2\text{-}6)$$

Where,
SPE Project standard emissions (tCO_2)
SQ Thermal load of buildings under standard meteorological conditions (GJ)
3.6 Conversion coefficient (GJ/MWh)
SCOP Heat pump mean COP under standard meteorological conditions (－)
GEF Grid emission coefficient (tCO_2/MWh)

Leakage emissions and their calculation

No leakage is envisaged in the project.

Calculation of emissions reduction

The amount of emissions reduction is calculated from the obtained reference CO2 emissions and project CO_2 emissions.

Calculation method 1

$$ER_y = RE_y - PE_y \quad (1\text{-}3)$$

Where,
ER_y CO_2 emissions reduction (tCO_2)
RE_y Reference CO2 emissions (tCO_2)
PE_y Project CO2 emissions (tCO_2)

calculation method 2

$$ER_y = C \times (RE_y - PE_y) \quad (2\text{-}8)$$

Where,

ER_y CO_2 emissions reduction (tCO_2)

C Conservativeness coefficient (−)

RE_y Reference CO2 emissions (tCO_2)

PE_y Project CO2 emissions (tCO_2)

$$C = ER1 \div ER2 \quad (2\text{-}9)$$

Where,

ER1 Emissions reduction according to calculation method 1 in the reference project (tCO_2)

ER2 Emissions reduction according to calculation method 2 in the reference project (tCO_2)

(It is necessary to use formula 2-8 when seeking ER2; in this case, assume C = 1).

Results of Calculating GHG Reduction in Light of the Monitoring Results

The results of calculation are indicated below.

Item	Kindergarten		School	
According to calculation method	Calculation method 1	Calculation method 2	Calculation method 1	Calculation method 2
Reference emissions (Monitoring results)	17.4 tCO2	36.0 tCO2	28.3 tCO2	57.3 tCO2
Project emissions (monitoring results)	7.7 tCO2	21.1 tCO2	14.2 tCO2	33.6 tCO2
Emissions reduction (monitoring results)	9.7 tCO2	Before considering the conservativeness coefficient 14.9 tCO2 After considering the conservativeness coefficient 9.7 tCO2 Conservativeness coefficient 0.6543	14.1 tCO2	Before considering the conservativeness coefficient 23.7 tCO2 After considering the conservativeness coefficient 14.1 tCO2 Conservativeness coefficient 0.5957

Results of estimating the emissions reduction potential in the entire host country (or entire sector) in the case where the project activity is disseminated

The emissions reduction potential in the entire host country is below calculated based on proportional distribution of area.

✓ Annual thermal load in kindergarten = 384,032 kWh/year

- ✓ Boiler efficiency = 0.4
- ✓ Coal emission coefficient＝0.0258 tonC/GJ
- ✓ Reference emissions＝384,032 kWh/year÷0.4×0.0036 GJ/kWh×0.0258 tonC/GJ×44÷12 ＝327 tonCO_2/year
- ✓ Annual mean COP = 2.30
- ✓ Grid emission coefficient = 1.15 tonCO_2/MWh
- ✓ project emissions＝384,032 kWh/year÷2.3÷1,000×1.15 tonCO_2/MWh＝192 tonCO_2/year
- ✓ emissions reduction = 327 tonCO_2/year－192 tonCO_2/year＝135 tonCO_2/year
- ✓ Kindergarten floor area = 984m^2
- ✓ Total floor area of regional public buildings in Mongolia = 1,300,000m^2
- ✓ Emissions reduction potential = 135 tonCO_2/year÷984m2×1,300,000m^2 = 178,000 tonCO_2/year

(9) Verification of GHG Emission Reductions:

Monitoring items, etc. targeted for verification, and method for verifying them

The following table shows the monitoring items, etc. targeted for verification and the methods for verifying them.

Monitoring Item to be Verified	Symbol	Verification Method
Reference scenario boiler fuel emission coefficient	FEF	Hearing at the Ministry of Environment and Green Development (the DNA in Mongolia)
Reference scenario boiler efficiency	EF	Hearing with the expert who was introduced by the Renewable Energy Center that conducted monitoring
Standard meteorological data (outside temperature)	SOTi	Hearing at the observatory that provided the data. Also confirm the instrumentation at the observatory.
Meteorological data (outside temperature during the project)	OTi	Hearing at the observatory that provided the data. Also confirm the instrumentation at the observatory.
Thermal load of buildings under standard meteorological conditions	SQ	Hearing at Shimizu Corporation, which prepared the monitoring report and attached documents
Heat pump mean COP under standard meteorological conditions	SCOP	Hearing at Shimizu Corporation, which prepared the monitoring report and attached documents
Grid emission coefficient	GEF	Hearing at the Ministry of Environment and Green Development (the DNA in Mongolia)
Heating quantity of hot water supplied by the heat pump	Q	Hearing with the expert who was introduced by the Renewable Energy Center that conducted monitoring. Also, confirm instrumentation on the ground.
Amount of electric power consumed by the heat pump (including power consumption by the heat source water pump)	W	Hearing with the expert who was introduced by the Renewable Energy Center that conducted monitoring. Also, confirm instrumentation on the ground.
Indoor temperature	RT	Hearing with the expert who was introduced by the Renewable Energy Center that conducted monitoring.

Local third parties that implement the verification, and reason for their selection

As a result of discussing with GEC, it was decided to select a Japanese DOE (one company) and a Mongolian verification agency (one company) to implement verification. On the Japanese side, Japan Consulting Institute was selected as a result of price competition between three companies. On the

Mongolian side, out of five companies that were recommended by GEC and government agencies, price competition was conducted between the two that displayed the greatest willingness, and BEEC was selected.

Verification results

As a result of the verification, it was found that the prepared methodology can be applied, and the verification agency raised no major issues (CARs) concerning the monitoring report.

Issues confronted in verification

The issues are described below.

- ✓ **Verification capacity of the verification agency in Mongolia:** It has less capability than the DOE and is still at the learner level. If a verification agency that has low capability and no international qualification (ISO, etc.) is utilized in the JCM/BOCM, the international community may cast doubts about the transparency of the credit. The agency on the Mongolian side should be encouraged to acquire ISO certification and the Government of Japan should actively conduct capacity building for that purpose.
- ✓ **Deficiencies in the monitoring report format:** In this monitoring report format, it was found that verification cannot be fully verified. For example, the format doesn't contain sections for stating the project title, the applied methodology or the names of project participants.
- ✓ **Verification checklist:** A verification checklist was required and its preparation was consigned to the verification agency. In this state, it is likely that the verification check method will differ according to the verification agency. For example, the approach to dealing with absence of stated details in the manual may differ according to the verification agency. One verification agency may decide that nothing needs to be done about non-inclusion of items in the manual, whereas another agency may decide to implement stringent checks on the same level as CDM. Since verification agencies generally tend to be conservative, the latter case is more likely to be selected. Therefore, the manual should state: "Items not included in the manual do not need to be verified." Otherwise, simpler verification than the CDM cannot be realized.
- ✓ **Monitoring patterns:** Monitoring items are classified into three patterns, A, B and C, so the degree of necessity for each should have been differentiated when conducting verification. For example, Pattern A items could be differentiated by requiring presentation of basis document but no field survey.
- ✓ **Study implementation method:** In the Study, there were numerous inconsistencies between the manual requirements and reality, for example, the manual was published after the start of the study, implementation was predicated on the project and methodology already being approved, it wasn't necessary to prepare the PDD and so on. For example, concerning the instruments that are already installed, problems arose in that there was no way to confirm the accuracy stated in the manual. At the same time, the verification agency at one point said, "Since there is no PDD, this is a CAR." Also, even though the methodology needs to be updated in line with progression of the

study, in reality the monitoring has to be advanced using the old version.

Furthermore, the verification agency stated a number of opinions about the manual, and these have been included in the detailed version of the report.

(10) Ensuring Environmental Integrity:

Positive environmental impacts brought about by implementation and dissemination of the project activity

Positive environmental impacts of project implementation include: [1] reduction of greenhouse gas emissions, [2] reduction of air pollutant emissions, and [3] reduction of fossil fuel consumption.

Negative environmental impacts brought about by implementation and dissemination of the project activity

Negative environmental impacts of project implementation include: [1] generation of noise and vibration due to heat pump installation and operation, [2] leakage of heat pump cooling medium, [3] leakage of antifreeze solution on the heat source water side, and [4] alteration of the underground thermal environment.

Measures for guaranteeing positive impacts

In order to guarantee the positive environmental impacts, the introduced heat pumps need to have high efficiency as planned. In order to satisfy this requirement, a possible option is to require that only heat pumps with a certain level of efficiency be included in the positive list. Meanwhile, concerning emissions of air pollutants, it is necessary for emissions from use of coal heating boilers to be greater than emissions from coal-fired power plants. Since the base unit of emissions from use of coal heating boilers (16.20 kg PM10/ton coal, 9.72 kgPM2.5/ton coal) is greater than emissions from coal-fired power plants (1.87 kg PM10/ton coal, 0.75 kgPM2.5/ton coal), this requirement is guaranteed.

Measures for advertising negative impacts

Concerning the negative environmental impacts, noise and vibration can be averted through appropriately installing the heat pumps in machine rooms and taking noise and vibration control measures as needed. Concerning leakage of antifreeze solution, this can be addressed through using seamless pipes that have no joints and using low-toxicity antifreeze solution. Concerning the ground thermal environment, it is possible to conduct heat pump simulation and limit alteration to a manageable scope according to necessity. As for leakage of cooling medium, unfortunately this cannot be fully averted in Japan.

Relevance to the environmental impact assessment system in the host country

Mongolia has an environmental assessment law. According to this, “projects that entail construction, reform, extension or building of industrial facilities or service industry facilities, and projects that

entail use of natural resources" are targeted for "screening" to determine whether or not environmental assessment is necessary (Article 4.1 of the Environmental Assessment Law). Therefore, this project is eligible for screening. Projects that are targeted for screening are examined by experts to determine the need for environmental assessment, and if it is deemed necessary, environmental assessment is conducted (Article 4.6 of the Environmental Assessment Law). Therefore, whether or not the project is targeted for environmental assessment is contingent on the judgment of the experts, who will make a judgment based on the national guidelines (Article 4.5 of the Environmental Assessment Law).
Concerning the results of implementing environmental impact assessment when implementing the project on the model site, the Renewable Energy Center has indicated that, "Assessment hasn't been conducted because this is a national project."

(11) How to Promote the Dissemination of Japanese Technologies:

Scenario for adopting Japanese technologies in the project activity and introducing and disseminating them to the host country

The technologies likely to be adopted in the project activity include both hard and soft technologies. Hard technology refers to the heat pump units and underground heat exchangers, while soft technology refers to design know-how and execution know-how.
In the event where the project is implemented under a system other than the JCM/BOCM, unfortunately it has to be said that there is little likelihood that Japanese hard technology will be adopted. This is because geothermal heat pump technology is more widely adopted and there is greater diversity of models in Europe and America than in Japan. In order to adopt Japanese technology and introduce and disseminate it in Mongolia, it is first necessary to increase the variety of models, reduce delivery times and cut costs of Japanese technology.

Necessary measures for realizing the introduction and dissemination scenario (including batch introduction of soft technology for operation and control, etc.)

In order to increase the variety of models, reduce delivery times and cut costs of Japanese technology, it will be necessary for Japanese makers to prepare a number of model packages suited to the conditions of use in Mongolia, and for this purpose it will be necessary to issue a large volume of orders from Mongolia.

In the event where Japanese technology isn't adopted in the project activity, conditions for demonstrating that the technology is superior to Japanese technology and for adopting Japanese technology

Western technology is superior to Japanese technology in that it offers a greater variety of models. Japanese technology is dominated by air heat source systems and there is not such a high need for geothermal systems compared to Europe and America. Therefore, such systems are not well disseminated, and Japanese technology entails longer delivery times and higher costs. In order for

Japanese technology to be adopted, it is necessary to either specify that only Japanese technology can be used in JCM/BOCM projects or to reduce the delivery time and costs of Japanese technology. However, since obligating the adoption of Japanese technology in JCM/BOCM is an issue that concerns the entire foundation of the system, it is necessary to bring more officials into the discussion in order to determine whether or not merits exist for the Japanese and Mongolian sides. In terms of performance, there is no factual evidence to suggest that Japanese technology is inferior to Western technology, however, there is also no evidence to suggest it is superior.

(12) Prospects and Challenges for Similar Project/Activity Implementation:

The issues that need to be resolved assuming that a project activity similar to the one targeted in the demonstration study is implemented under the JCM/BOCM are described below.

- ✓ **Drastic reform of Mongolia's energy policy:** Unless the price of Mongolian coal, which is extremely cheap, is greatly raised (several fold), there will be no economic incentive for the private sector to introduce heat pumps. However, conversely, if prices are raised too much, there is risk that introduction of heat pumps will become the reference case.
- ✓ **Further promotion of air pollution countermeasures in Mongolia:** In Mongolia, where air pollution becomes very serious in the winter, it is necessary to boldly introduce heat pumps, strengthen grid power sources and implement environmental measures geared to limiting combustion of coal. However, if this policy goes too far, there is risk that introduction of heat pumps will become the reference case. Therefore, it is desirable for the Government of Mongolia to gradually increase the price of coal while bolstering environmental countermeasures over the long term, and to promote the introduction of heat pumps while utilizing subsidies and so on in the short term.
- ✓ **Clarification of the project implementing entity on the Mongolian side:** Upon clarifying the JCM/BOCM system itself, it must be specified whether the implementing body on the Mongolian side is the Renewable Energy Center, the Clean Air Fund or the Ministry of Energy. For this purpose, it is necessary for the Mongolian Ministry of Energy and Ministry of Environment and Green Development to display leadership.
- ✓ **Reduction of project costs:** In Mongolia, there is a growing feeling that "Heat pumps are good but expensive." High costs arise not only from the high price of the pump units but also the high price of constructing vertical wells as underground heat exchangers. Mongolia is now experiencing a scramble for natural resources and a shortage of boring machines, and this is causing boring costs to increase to a level on a par with Japan. On the other hand, since Mongolian regional cities have an abundance of land, there is a strong possibility that it will be far cheaper to manually construct underground heat exchangers in the horizontal direction rather than build vertical wells using boring machinery. However, so far the heat pump simulation technology for such cases hasn't been established in Japan. Because land is restricted in Japan, there are hardly any needs for horizontal underground heat exchangers. Therefore, it is first

necessary for the simulation technology for horizontal underground heat exchangers to be established.

- ✓ **Clarification of JCM/BOSM financers and the credit price:** It is necessary to determine who will finance (or purchase credit) for the JCM/BOCM project on the Japanese side, in other words clarify whether it will be the government or a private enterprise. If it is a private enterprise, the incentives and credit price must be clarified. In particular, if credits cannot be freely traded, it will be difficult for more private enterprises to take part.
- ✓ **Establishment of the JCM/BOCM system:** The system has still not been revealed in its entirety. It is necessary to clarify fundamental questions such as the following: How can a bilateral system be made strong enough to secure environmental integrity and to withstand the harsh scrutiny of the international community? What kind of system should be adopted to promote the adoption of Japanese technology? Will there be any inconvenience in adopting expensive Japanese technology? Should adoption of Japanese technology be omitted as a condition? How far should thinking on additional emissions reduction be unified or made more stringent? And, will making the reference case more conservative than the CDM baseline be acceptable to the project participants? Moreover, negotiations in the United Nations Framework Convention on Climate Change have not reached the stage where JCM/BOCM can be recognized and operated. Talks are still ongoing, however, there is still no clear schedule on when a conclusion can be reached. It is hoped that the Government of Japan reaches a conclusion on this matter soon.
- ✓ **Preparation of a positive list:** In the field of JCM/BOCM, it is strongly hoped that a positive list and incidental standardization reference scenario are prepared on the institutional side to ensure that the project can be implemented more easily. If it is necessary for the project participants to demonstrate additional emission reductions or specify the reference scenario, the amount of effort required will not differ much from that in the CDM. It is hoped that the Government of Japan and Government of Mongolia cooperate to realize the positive list and standardization reference scenario.
- ✓ **Capacity building on the Mongolian side:** In Mongolia and all developing countries targeted in the JM/BOCM, it is necessary to overcome the current shortage of human resources in verification agencies and in the area of monitoring and monitoring report preparation. This issue will take time to resolve, however, it will be necessary to improve the situation through a process of repeated trial and error.

5. Contribution to Sustainable Development in Host Country

Energy supply in Mongolia is centered on domestically produced coal. In these circumstances, the government compiled the National Renewable Energy Program geared to achieving sustainable development in 2005. This program aims to increase the share of renewable energy to 3~5% by 2010 and to 20~25% by 2020. According to the Ministry of Mineral Resources and Energy, which had jurisdiction at that time, the goal for 2010 has been achieved. The National Renewable Energy Program also mentions utilization of geothermal energy, and it is possible that energy saving based on geothermal energy use in buildings can make a contribution to achievement of the long-term goal by 2020 if dissemination progresses. Coal-fired boilers in the regional area of Som operate at an extremely low efficiency of 40%. If this project becomes disseminated, the inefficient consumption of coal resources will be reduced and coal reserves will be conserved, thereby making a contribution to sustainable economic development in the country.

Concerning the contribution to sustainable development that will be made by this project, the Mongolian Ministry of Energy and Ministry of Environment and Green Development have voiced favorable remarks. However, the high cost of heat pumps seems to be a stumbling block to introduction.