1. Input from Monitoring after the Project

Data	Value	Unit	Parameter
Net heat quantity supplied by the Project HOB during the monitoring period	56	GJ/t	PH_t
Electricity consumption of the project HOB during the monitoring period	0.161	MWh/t	EC_t
Total hours during the monitoring period	201	hours/t	HMP_t

2. In the planning stage, enter the data to determine the reference and the project emissions

Data	Value	Unit	Parameter
CO_2 Emission Factor of grid	1.103	tCO_2/MWh	$EF_{CO2,grid}$
*Needed parameters in case that Electricity consumption of the project HOB is not monitored			
Required electric performance maximum of the Project HOB	800	W	$EMP_{PJ\ HOB}$

3. CO_2 Emission Reduction

CO_2 Emission Reduction	Unit
1	tCO_2/t

The details of this investigation are shown on the following page.

title MRV Demonstration Study using a model project
Upgrading and Installation of High-Efficiency Heat Only Boilers
year FY 2012

The results of real monitoring regarding the "Net Heat Quantity" are "56 (GJ/time).
The time is "201 (hours/time)".

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

「Upgrading and Installation of High-Efficiency Heat Only Boilers (HOBs)」

(implemented by SUURI-KEIKAKU CO., LTD.)

Study Partners	Climate Experts Corp. Japan Quality Organization (JQA) JFE Techno Research Co., Ltd. Osumi Co., Ltd. EEC (Demonstration Body of Project Participants of Host Country) NREC (National Renewable Energy Centre) (Demonstration Verification Body of Host Country)
Location of Project/Activity	Mongolia
Category of Project/Activity	Energy Efficiency Improvement
Description of Project/Activity	The Project/Activity is to upgrade inefficient boilers to the latest efficient boilers or to newly install the latest boilers. The target facility is a boiler dedicated to heat supply (HOB) with a capacity of "0.10 to 3.15 MW" based on the Mongolian standard (MNS5043). The improved boilers consume less coal for HOBs and, as a result, reduce the emissions of greenhouse gases (GHG).
Eligibility Criteria	Case 1: The project activity is to -switch from old type coal HOBs (of low energy efficiency) to new type ones (of high energy efficiency) in existing Heat Water Supply Systems in Districts and/or -to introduce new type ones in association with new construction of Heat Water Supply Systems in Districts. (Upgrading or installation of HOBs for steam supply do not fall into the project/ activity) Case 2: The HOB to be targeted for the Project/Activity is defined as a boiler used for heat supply which has capacity of 0.10MW – 3.15MW. Case 3: Objective HOBs are limited to coal-fired boilers for hot water supply. Case 4: The HOBs to be introduced shall have the performance specifications including the boiler efficiency higher than 75% as the manufacturer's catalog value. Case 5: The HOBs to be introduced shall have a dust collector. In case of a HOB which dust collector is not set up, dust collector shall be additionally installed with the installed HOB for pollution-abatement measure.
Reference Scenario and Project/Activity Boundary	In the reference scenario, the low-energy-efficiency old HOBs will be continuously used even after upgrading if no foreign aid can be obtained and, in the case of the construction of new systems, the same-type boilers will be introduced as those for the upgrading if no foreign aid can be obtained. The same benchmark value for the boiler efficiency in the reference scenario will be adopted for both the upgrading and the new installation. In the reference scenario, the Project/Activity Boundary is the CO_2 emissions concerning the coal consumption at the boilers. In the Project, the Boundary is the CO_2 emissions concerning the coal consumption and electricity consumption at the boiler. The other GHGs and their emission sources are excluded from the items to be calculated due to simplification, to secure the conservativeness and their slight amounts.
Calculation	The calculation method option is:

Method Options	GHG emission reductions amount=(1/boiler efficiency of reference boiler-1/boiler efficiency of project boiler) × **heat amount supplied to buildings** × emission factor, and the Monitoring Methods for the heat amount supplied to buildings are classified as follows: Monitoring Method 1-1: Heat meter Directly measure the heat amount supplied to the buildings using a heat meter. Monitoring Method 1-2: Calculation using a flow meter and thermometer. Obtain the heat amount supplied to the buildings by calculation using the measurements of the temperature of the heat water supplied to the project HOB (inlet), the temperature of the circulating water supplied by the project HOB (outlet), and the Volume flow rate of the circulating water of the project HOB. Monitoring Method 2-1: Preliminary flow measurement Estimate the heat amounts supplied to the buildings using the temperature of the heat water supplied to the project HOB (inlet) and the temperature of the circulating water supplied by the project HOB (outlet), which are measured on the pipe surfaces and the flow, which is the minimal value of those measured in advance for one week. Monitoring Method 2-2: The rated pump capacity Estimate the heat amount supplied to the buildings using the temperature of the hot water entering and the temperature of the hot water exiting, which are measured on the pipe surfaces and the flow, which is the pump capacity. Monitoring Method 3-1: Specific value of the building specific heat loss coefficient. Estimate the heat amount supplied to the buildings using the building volume, the outdoor temperature, and the indoor temperature. The building specific heat loss coefficient is a specific value for the project. Monitoring Method 3-2: The heat loss coefficient for the building in the supply destination is default value. This option is almost the same as Monitoring Method 3-1 and the building specific heat loss coefficient is the default value.
Default Values set in Methodology	【Default Value】 Project Boiler Efficiency: 67% (set based on the study by actual measurement) Reference Scenario Boiler Efficiency: 50% (the result of the study by actual measurement is 44%. Since the reference scenario should become more conservative than BaU scenario, the boiler efficiency of the reference scenario is set up to 50%.) CO_2 emission factor: 0.096 [tCO_2/GJ]: according to the averages value of 17 sampling surveys based on laboratory analysis of the consumed coal. Heat Loss Coefficient for the Building in the supply destination: 0.20: This value is conservatively set based on the values of 79 schools with high heat insulating effects. Discount Rate obtained When the “Heat Loss Coefficient for the Building in the supply destination” is used: 20%. This value was set based on the study by actual measurement so that ore than 95% of the estimated value should be more conservative than actual values. 【Project-Specific Values】 Heat Loss Coefficient for the Building in the supply destination: Design value of each building Pump Capacity: Name plate of the pump Required electric performance maximum of the project HOB according to the Manufacturer’s manual value
Monitoring Method	Monitoring activity was implemented. The following two options will be described. Monitoring Method 1-1: Directly measure the heat amount supplied to the buildings using the heat meter. The monitoring parameter was the heat amount supplied and it was

	continuously measured and recorded in every hour. Monitoring Method 3-1: Estimate the heat amount supplied to the buildings using the building volume, the outdoor temperature, and the indoor temperature. Also, enable acquisition of the specific value of the building specific heat loss coefficient. The outdoor temperature and the indoor temperature are monitored, and continuously measured and recorded in every hour.
Result of Monitoring Activity	The two options according to which the monitoring activity was implemented will be described. For Monitoring Method 1-1, a monitoring plan was formulated, monitoring was implemented, and a monitoring report was produced according to the monitoring plan. The data collection and the data analysis for making default values were required in the Monitoring method 3-1. Then, the Monitoring Plan was reconstructed, and the Monitoring Report was made according to the Monitoring Plan.
GHG Emissions and its Reductions	Monitoring method 1-1: 1 [tCO_2/t] (t=201 [hour]) Monitoring method 3-1: 2 [tCO_2/t] (t=443[hour]) Since the monitoring time is very short and the values are rounded up and rounded down for the purpose of the conservativeness, the values of GHG Emission Reduction are still smaller. Based on the annual operating time of the HOB, which is 5000 to 6000 hours, the annual emission reductions are estimated to be about 100 [tCO_2/y].
Method and Result of Verification	For Monitoring Method 1-1, verification was implemented on the monitoring report and a verification report was produced. As a result, the MRV activity was practically verified in Mongolia. Verification activities were difficult for the monitoring method 3-1. However, the default values of the discount rate were set up from the actual measurement, and the verification activities were limited only with the monitoring data of thermometers. As a result, the verification activities were implemented.
Environmental Impacts	The coal consumption was also reduced through the Project/Activity and, therefore, no adverse influence on the environment is especially observed.
Promotion of Japanese Technology	The policies are advanced including the one to consolidate the HOBs and the possibility of introducing Japanese technology in the future is getting higher.
Sustainable Development in Host Country	The effect of reducing air pollution on human health is estimated to correspond to US$ 12 million. The policies are advanced including the one to consolidate the HOBs and the Project/Activity match the development policy and the development strategy of the host country.

Study Title: MRV Demonstration Study using a Model Project "Upgrading and Installation of High-Efficiency Heat Only Boilers (HOBs)"

Study Entity: SUURI-KEIKAKU CO.,LTD.

1. Study Implementation Scheme

- Climate Experts Ltd.: Production of MRV methodology, support for producing the monitoring implementation guidelines, the monitoring plan, the monitoring report, the verification report, etc., for the verification.
- JAPAN QUALITY ASSURANCE ORGANIZATION (JQA): Support for constructing the system for MRV, check on the validity of draft verification criterion, and support for constructing the system for the on-site verification institutions.
- JFE Techno-Research Corporation.: On-site measurement for obtaining default values, and development of technical capacity of the monitoring for implementing JCM/BOCM.
- OSUMI Co., Ltd.: Data analysis for obtaining default values such as the boiler efficiency, the completeness of the environment, and research for facilitating introduction of Japanese technology.
- Project Participants (Monitoring Implementing Institution of host country) (EEC): Production of the monitoring plan, implementation of monitoring according to the monitoring plan, and production of the monitoring report.
- Third Party Verification Institution of host country (NREC; National Renewable Energy Center): Implementation of the verification, production of the verification report, and research on the system of standards for weighing and measurement of Mongolia.

2. Overview of Project/Activity

(1) Description of Project/Activity Contents:

The host country and the area for the implementation are Mongolia and Ulaanbaatar City. The Project/Activity is to upgrade the boilers with relatively low boiler efficiency to the latest boilers with high boiler efficiency or installation of the latest boilers. The requirement facility is a boiler dedicated to heat supply (heat only boiler: HOB) and "HOB" is defined as a boiler for heating with a heating capacity of "0.10 to 3.15 MW" according to the Mongolian standard (MNS5043).

The HOBs in Ulaanbaatar City annually operate from October 1st to May 1st. However, the HOBs may start operating in September depending on the outdoor temperature. The owner of the Project/Activity is the managers of the boilers who are the ULAANBAATAR CITY HEATING STOVES REGULATORY AUTHORITY and the schools in the city.

The Project/Activity is an activity to upgrade the boilers with relatively low boiler efficiency to the latest boilers with high boiler efficiency utilizing the two-step loan of JICA, which aims at promoting small- and medium-sized businesses and conservation of the environment. The improvement of the boiler efficiency will reduce the coal consumption by the HOBs and, as a result, will reduce the emissions of the greenhouse gas (GHG).

(2) Situations of Host Country:

On December 6, 2012, Mr. Nagahama, the Minister of Environment, Japan, and Ms. Oyun, the Minister of Environment and Green Development, Mongolia, had a meeting in Doha in Qatar and, during the term of the Conference of the Parties 18th (COP18) of the UN Framework Convention on Climate Change (UNFCCC), had a meeting on the Environmental

Cooperation and Climate Change Bilateral Off-Set Credit Mechanism and signed a "Joint Statement by Minister for the Environment of Japan and Minister for Environment and Green Development of Mongolia on Environmental Cooperation, Climate Change and the Joint Crediting Mechanism". On January 8, 2013, in Ulaanbaatar in Mongolia, Mr. Takenori Shimizu, Japanese Ambassador Extraordinary and plenipotentiary in Mongolia, and Ms. Oyun Sanjaasuren, the Mongolian Minister of Environment and Green Develop, signed a Japan and Mongolia bilateral document concerning a Joint Crediting Mechanism (hereinafter referred to as the JCM/BOCM). Thereby, the JCM/BOCM was officially started.

The relevant authority of HOBs was unclear at the start of this MRV-DS. However, when a visiting survey was made to the Heat Technology Section of the Energy Ministry, a comment was obtained stating that the section had started to supervise HOBs. Therefore, various policies and countermeasures are likely to be advanced from now on.

In the Nationally Appropriate Mitigation Actions (NAMA) of Mongolia, the following action is planned.

Energy Supply: Improvement of Efficiency of Heating Boilers:
Improvement of the efficiency of the existing heating boilers and installation of new highly energy-efficient boilers

Therefore, this Project/Activity is in line with the climate change policy for this field. The high-efficiency boilers are introduced through the two-step loan, etc., and the Project/Activity is in line with Mongolian policy.

The HOBs at each aimag capital city in Mongolia have been consolidated and the capacities of these HOBs have been increased. A plan has been formulated according to which a large-scale heat station of a 300-MW class will be constructed in the eastern part of Ulaanbaatar City. As above, the project is advanced to upgrade small-scale HOBs, which adversely influence the air environment to the new large-scale HOBs, which have high environmental performance.

(3) Complementarity of the CDM:

The coal consumption of HOBs in Ulaanbaatar City in Mongolia is not generally measured. Measurement is not easy to conduct and even the fuel expense slip issued when the coal is purchased is unlikely to be useful as evidence. There are no actual measurements of the temperature of the heat water supplied to the project HOB (inlet), the temperature of the circulating water supplied by the project HOB (outlet), and the Volume flow rate of the circulating water of the project HOB. Also, no actual measurements of the heat supplied by the HOBs are implemented.

AM0044 is one methodology of the CDM in which the HOBs in Mongolia are assumed. However, according to this methodology, not only the monitoring of the coal consumptions and the amounts of heat supplied after the implementation of the project but also the past data for these items are required. Therefore, this methodology cannot substantially be applied to Mongolia and is not a methodology that reflects the actual status.

The Project/Activity is for saving energy and its additionality is highly likely to be required in CDM. Basically, the coal is inexpensive and, therefore, the economic merit due to the saving of coal is poor and the initial cost of the high-efficiency boiler is high. For these reasons, some additionality can be assumed. However, proving the additionality is considered to be difficult because sufficient evidences cannot be obtained for the purchase of the coal as above and due to other reasons.

According to the Project Participants (EEC), and the third party verification institution (NREC), in CDM, the transaction fee is the bottleneck and it is getting difficult to

implement feasible projects in Mongolia for this reason. For this reason, it is necessary for JCM/BOCM to construct a scheme that is in line with the status of Mongolia. For CDM, the scheme was determined under the UN and it was difficult to match the scheme with the status of Mongolia. Therefore, Mongolia needs to match itself to the scheme of CDM. This is also one of the causes of the stagnation of the implementation of the CDM in Mongolia.

From the above, this Project/Activity should be implemented under JCM/BOCM expected to have a scheme in line with the status of Mongolia. As a result, it is judged that this Project/Activity has the complementary for CDM.

3. Contents of the Study

(1) Issues to be Addressed in the Study:

The following items were not grasped before the start of the demonstration study and need to be clarified in the demonstration study.

- For the HOBs in Mongolia, the coal consumptions and the amounts of heat supplied are not monitored in general. Therefore, it is necessary to implement the monitoring activity of some items to grasp the amounts of their operation to calculate the GHG emission reductions.
- From the viewpoint of energy management in the heat supply project, grasping the boiler efficiency is the basis for evaluating a boiler. However, no approach has been established that is authorized in Mongolia for calculating the boiler efficiency of HOBs.
- In Mongolia, except hydroelectric power generation for which monitoring and evidence acquisition are easy, even a project registered with the UN has no actual CERs and only slight CERs of CDM has actually been issued. Therefore, the host country has poor experience in monitoring based on verification for creation of emission credits. Therefore, implementation of capacity building is necessary for the monitoring plan and the monitoring report.
- For the MRV demonstration study, verification conducted by a third party verification institution is indispensable. However, Mongolia has no verification institution for DOE of CDM and ISO and, therefore, it is necessary to implement the demonstration study implementing capacity building for local organizations that have no experience of verification.

The following problems were clarified at and after the start of the demonstration study.

- At some of the HOBs, the boilers were upgraded. Therefore, the reference boilers which were assumed to be the actual measurement target needed to have been reselected.
- The Mongolian administration was renewed after the national election and it was determined that the governmental agencies were to be reorganized. At the same time, revision was expected to be facilitated for the laws concerning the air pollution related to HOBs and the legislative bills concerning energy saving.
- The business agent of the heat meter did not know anything about the data collection system of the data logger of the heat meter and, therefore, EEC had to create the data collection system from scratch.
- There are some heat meters which are produced by factory approval in Mongolia, while the business agency, etc., of the heat meter do not grasp the information on the official verification of each heat meter and, therefore, collection of evidence was difficult for the demonstration study.
- It is difficult in Mongolia to obtain the thermometers with the official verification and with a data-logger function and, therefore, it is difficult to select monitoring devices for the outdoor temperature and indoor temperature.

- Although the measurement law is being improved in Mongolia, the connection to international traceability is not satisfactory. Therefore, it is not easy to get some monitoring equipment for which traceability is ensured.

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

In JCM/BOCM, the local project participants (PPs) who play the main role in implementing the emission reductions should independently implement the monitoring and the verification institution should concentrate on playing its own role in giving official endorsement to the monitoring results as a third party. Based on the issues of CDM, the development of "the Monitoring Plan based on the Verification" is most important and this was demonstrated in this "MRV-DS".

In the first field survey, the following items were implemented: selection of the monitoring implementing institution (EEC) and the verification implementation institution (National Renewable Energy Centre: NREC); arrangement of the HOBs to be studied; etc.

In the second field survey, the following items were implemented: introduction of JCM/BOCM to the monitoring implementing institution and the verification implementing institution; support for the production of the overview of the MRV activity and the monitoring plan; etc. As a result, a monitoring plan was formulated whose level was higher than that of the monitoring plan formulated by CDM.

In the third field study, the following items were implemented: responses to the committee of the host country; preparation for installing the heat meter; etc.

In the fourth field survey, the following items were implemented: support for implementation of validation of the monitoring plan; support for implementation of the monitoring; the study by actual measurement of the boiler efficiency in autumn; etc. The validation did not need so much time because a precise monitoring plan had been formulated.

In the fifth field study, visiting researches were made on the boiler manufacturers and the boiler owners and, thereby, efforts were made to collect information and to clarify the actual status of the operation of the HOBs in order to set the reference scenario.

In the sixth field survey, the following items were implemented: support for the monitoring activity, support for production of the monitoring report in line with the monitoring plan, support for the implementation of the verification on the monitoring report, support for the production of the verification report, and the research of the boiler efficiency by actual measurement. It demonstrated that the verification should be performed quickly, within several days, because the monitoring report and the verification report in line with the precise monitoring plan had to be produced.

In the seventh field survey, about the indirect measurement method, after setting the fixing default values, such as a discount rate, the verification activities of NREC to the Monitoring Reports of the indirect measurement method were supported.

In order to issue high quality credit of JCM/BOCM, it is necessary to monitor the Project/Activity. It turned out for the HOBs in Mongolia that monitoring the amount of heat supplied using the heat meter was the most precise calculation approach. For the boiler efficiency: a spring scale calibrated in Japan was brought to the site; the entering heat amount and the exiting heat amount of the boiler were measured using "the heat meter" or "the thermocouple and the ultrasonic flow meter"; and, thereby, the boiler efficiency was researched by actual measurement. Capacity building was implemented for EEC and NREC for two weeks in the second demonstration study, for about one week in the fourth demonstration study, and for a little longer than two weeks in the sixth demonstration study and support was implemented for formulating the monitoring plan and producing the monitoring report and the verification report.

In the summer of 2012, the upgrading of the HOBs by foreign donors was mostly

implemented. Therefore, Ulaanbaatar City was scanned and the arrangement was implemented for the HOBs for which the research by actual measurement was to be implemented. For the issuance of high quality credit based on the heat meter, it is indispensable to construct a data collection system for the data logger, to qualify the heat meter and, to collect the evidence for it. Japanese Team supported these activities. As a result, the following outcomes were obtained: construction of the every minute value data collection system, which was the first one in Mongolia; construction of the data collection system using the portable telephone system (remote data collection system), which was the first one in Mongolia; implementation of the full-scale verification activity by NREC, which was the first one in Mongolia; organization of the conference about ISO14065 in the national government, which was the first one in Mongolia; close investigation on the metrological system; and construction of the approach for obtaining evidence on metrology.

4. Results of MRV Demonstration Study

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

The Project/Activity as the target of the MRV demonstration study is to upgrade boilers whose boiler efficiency is relatively low to boilers whose boiler efficiency is relatively high. The improvement of the boiler efficiency will result in the emission reductions of green house gas (GHG) because coal consumption will be reduced.

The MRV methodology is constructed based on the following background.

- The HOBs in Mongolia are relatively small coal-fired boilers that supply hot water.
- The fuel consumption is monitored in general for boilers that use liquid fuel or gas fuel. On the other hand, for boilers that use solid fuel such as coal, the characteristics of the fuel such as coal significantly variability and it is difficult to accurately grasp its amounts. Therefore, it is difficult to monitor the fuel consumption. The consumption can often be more accurately grasped using the amount of heat supplied.
- For the HOBs in Mongolia, measurements of coal consumption are not easy and even the fuel expense slip for purchasing the coal is unlikely to be useful as evidence. Therefore, a calculation option is necessary to calculate the emission reductions of GHG by measuring only the amounts of heat supplied from the project boiler.
- For the HOBs in Mongolia, the flow of hot water is not measured in general and the hot water temperature and the supplied water temperature are only measured by analog water thermometers for the operation but are also not monitored. A method will be considered that can calculate the emission reductions of GHG even in this situation.
- For the HOBs in Mongolia, the coal consumption and the amounts of heat supplied are not monitored in general and, therefore, the development of default values should be implemented not only for the project boilers but also for the reference boilers.
- To avoid individual differences in interpreting the monitoring approach, a monitoring implementation guideline, a general monitoring guideline, and a monitoring plan for each project case, should be developed and these guidelines and plans should be reflected in the MRV methodology.

(2) Eligibility Criteria for MRV Methodology Application:

Based on the field surveys, such as the visiting survey for the Ministry of Energy, the visiting survey of HOB makers, the understanding of actual HOB operation conditions, the Eligibility Criteria are as follows;

Case 1 The project activity is to
-switch from old type coal HOBs (of low energy efficiency) to new type ones (of high energy efficiency) in existing Heat Water Supply Systems in Districts and/or
-to introduce new type ones in association with new construction of Heat Water

Supply Systems in Districts.
(Upgrading or installation of HOBs for steam supply do not fall into the project/ activity)

Case 2 The HOB to be targeted for the Project/Activity is defined as a boiler used for heat supply which has capacity of 0.10MW – 3.15MW.

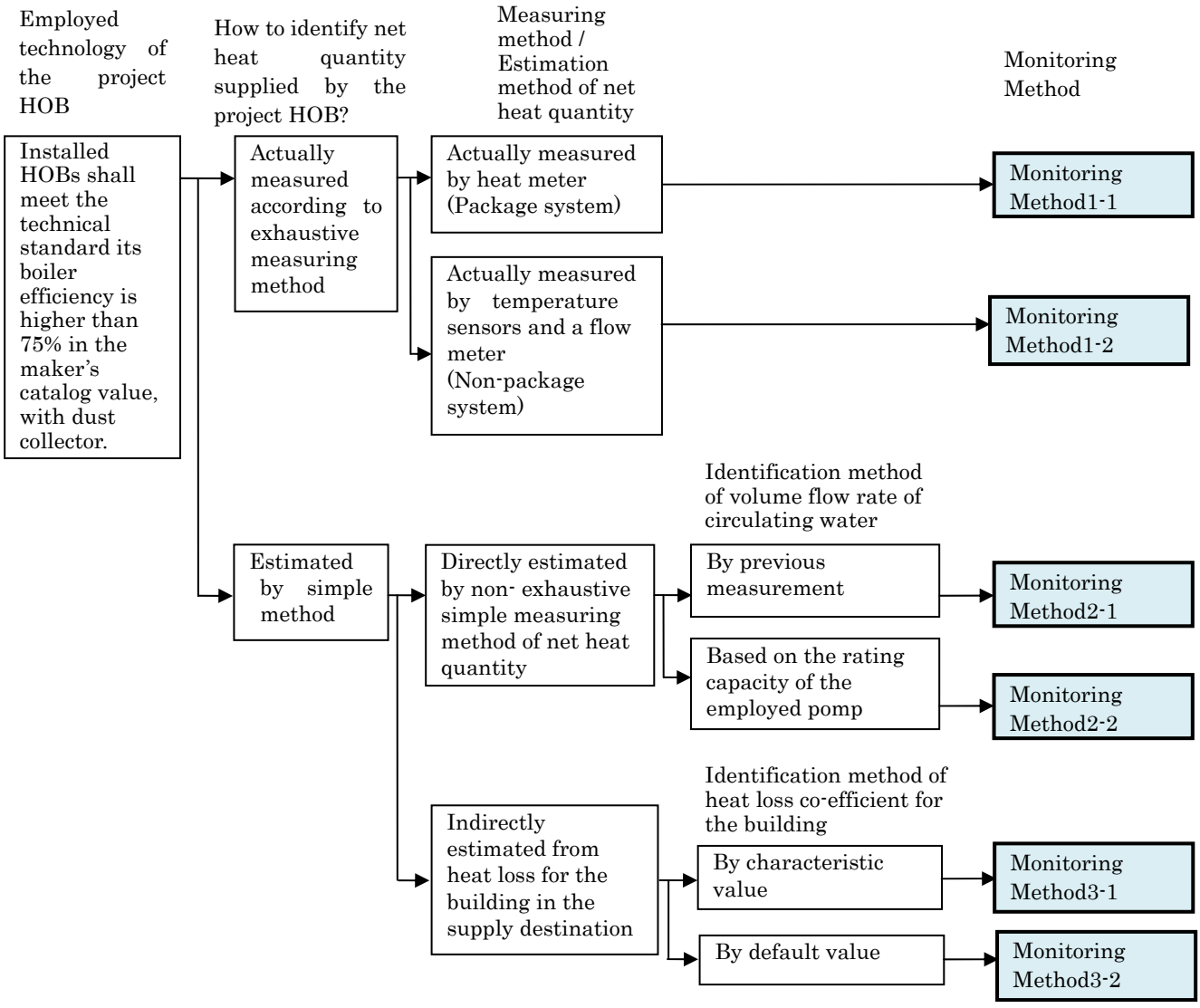
Case 3 Objective HOBs are limited to coal-fired boilers for hot water supply.

Case 4 The HOBs to be introduced shall have the performance specifications including the boiler efficiency higher than 75% as the manufacturer's catalog value.

Case 5 The HOBs to be introduced shall have a dust collector. In case of a HOB which dust collector is not set up, dust collector shall be additionally installed with the installed HOB for pollution-abatement measure.

(3) Calculation Method Options:

There is only one calculation option and its approach for monitoring the amount of heat supplied to buildings is different.



Exhaustive measuring method of net heat quantity: Method which measures directly net heat quantities of circulating water at inlet and outlet points of the water piping of the HOB, inserting temperature sensors into inside of the water piping. For measuring of water flow rate, the exclusive use water pipe which inside cross section area/or caliber is stereotyped in

advance is applied. Pipe laying work is required for setting the measuring equipment.
Non-exhaustive simple measuring method of net heat quantity: Method which measures circulating water temperatures at inlet and outlet points of the water piping of the HOB from outside of the water piping of the HOB, lagging the water piping with heat insulation material to help minimize measuring error. Pipe laying work is not required for setting the measuring equipment.

(4) Necessary Data for Calculation:

The information and data necessary for calculating the GHG emission reductions can be classified into default values, project-specific values, and items to be monitored, and can be clarified as follows. The default values are determined in the methodology and these values are determined at the responsibility of the scheme owner. The project-specific values are the information and data having been set (ex-ante setting) after measuring and checking these values once prior to the implementation of the Project/Activity. The items to be monitored will be monitored after the project has been implemented.

Information and Data	Monitoring (M)/ Project-Specific Value Setting (S)/ Default Value Setting (D)	Status of Improvement in the Project and Activity	Remarks
Net heat quantity supplied by the Project HOB	M (Measurement Op.1-1)	No heat meter is introduced into most of the HOBs.	Introduction of heat meters that comply with the Mongolian standard.
Temperature of the circulating water by the project HOB (outlet)	M (Measurement Op.1-2) M (Measurement Op.2-1) M (Measurement Op.2-2)	Many of the HOBs are operated checking the hot water temperature (analog value) while no data is stored, etc., and no monitoring is implemented.	The monitoring frequency is continuous measurement and the recording frequency is assumed to be hourly recording. The amount of heat is calculated from the hot water temperature, the supplied water temperature, and the water flow.
Temperature of heat water supplied to the project HOB (inlet)	M (Measurement Op.1-2) M (Measurement Op.2-1) M (Measurement Op.2-2)	Not monitored at most of the HOBs.	The monitoring frequency is continuous measurement and the recording frequency is assumed to be hourly recording. The amount of heat is calculated from the hot water temperature, the supplied water temperature, and the water flow.
Volume flow rate of circulating water of the project HOB	M (Measurement Op.1-2) S (Measurement Op.2-1) S (Measurement Op.2-2)	Not monitored at most of the HOBs. When the pump capacity is taken as the water flow, the capacity is grasped ex-ante from the name plate, etc., of the pump	The monitoring frequency is continuous measurement and the recording frequency is assumed to be hourly recording. The amount of heat is calculated from the hot water temperature, the supplied water temperature, and the water flow.
Boiler Efficiency	D (Measurement Op.1-1) D (Measurement Op.1-2) D (Measurement Op.2-1) D (Measurement Op.2-2) D (Measurement Op.3-1) D (Measurement Op.3-2)	Although the manufacturer's manual values are available, the results of actual researches are scarce and, therefore, research by actual measurement was implemented in this MRV-DS.	The ratio of the amount of heat generated to the amount of heat of the coal put in.
Required	S (Measurement Op.1-1)	This value is grasped	The maker's catalog values

electric performance maximum of the project HOB	S (Measurement Op.1-2) S (Measurement Op.2-1) S (Measurement Op.2-2) S (Measurement Op.3-1) S (Measurement Op.3-2)	ex-ante from the manufacturer's manual value. The status of improvement is checked by a visiting researcher to the boiler manufacturers in this MRV-DS.	
Total hours during the monitoring period t	M (Measurement Op.1-1) M (Measurement Op.1-2) M (Measurement Op.2-1) M (Measurement Op.2-2) M (Measurement Op.3-1) M (Measurement Op.3-2)	In 79th school (Project site), the boiler man has been reporting the operation status of the boiler using a handwritten note.	Aggregated daily, weekly, and/or monthly report during monitoring period
Building Volume for the supply destination	S (Measurement Op.3-1) S (Measurement Op.3-2)	In an ordinary manner, the building volume of the heat supply destination is grasped ex-ante using the building passport. In general, the building volume is often not grasped.	In the MRV-DS, the building volume was measured using the laser height indicator for each of the buildings whose volumes are unknown.
Average Indoor Air Temperature	M (Measurement Op.3-1) M (Measurement Op.3-2)	The indoor temperature is not grasped for each of the many buildings.	
Outdoor Air Temperature	M (Measurement Op.3-1) M (Measurement Op.3-2)	The HOBs are operated based on the hot water temperature and no outdoor temperature is monitored.	In general, modal operation is conducted based on the outdoor temperature. However, the feeling of the boiler operators or the value from the weather forecast is actually used as the outdoor temperature and no monitoring is implemented.
Heat loss co-efficient for the building	S (Measurement Op.3-1) D (Measurement Op.3-2)	The amount of heat required for buildings is grasped as a design value in Mongolia. This is a value calculated from the building volume, the design outdoor temperature, and the design indoor temperature.	It is often difficult to grasp the amount of heat required for old buildings.
CO_2 Emission Factor	D (Measurement Op.1-1) D (Measurement Op.1-2) D (Measurement Op.2-1) D (Measurement Op.2-2) D (Measurement Op.3-1) D (Measurement Op.3-2)	The coal analysis was implemented on the coal used for the HOBs in the MRV-DS and the emission factor was obtained.	The emission factor was that of average of 17 sample of this MRV-DS.

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

In the demonstration study, the items for which default values were set, and their values are as follows:

Item	Value	Content of Demonstration study
Boiler Efficiency of Project Boiler	67% (Average values)	Research by actual measurement was implemented at five project boilers and three reference boilers. Heat Input (the total supply heating value): The amount of coal put in was measured using a spring scale. The amount of heat generated was measured in the coal analysis. Heat Output (the total absorption heating value of outlet hot water): The amount of heat supplied was measured by the heat meter, or the thermocouple and the ultrasonic flow meter. From the above, the boiler efficiency was evaluated using the
Boiler Efficiency of Reference Boiler	50% (Setting value)	

		equation: "the Boiler Efficiency=Heat Output / Heat Input." Although the average value of Reference Boiler is 44%, the setting value is 50% because Reference Scenario is not equal to the BaU (Business as Usual) (because of conservativeness and Global net emission reduction).
CO_2 emission factor	0. 096 (tCO_2/GJ)	From the results of the coal analysis on 17 coal samples that were used for the HOBs, the average value of the emission factor was 0.0957[tCO_2/GJ].

The items for which the project-specific values are set in the demonstration study, and their values are as follows:

Item	Value	Content of Demonstration study
q0 Value	0.20	Each building has a design value. When the design value was not available, 0.20 (cal/hour m^3 degree C) was used.
Discount Rate	20%	Because the actual heat amount was not measured but was estimated, it was necessary to adopt a conservative value.
Project Boiler Electric Consumption	The manufacturer's manual value is used.	The manufacturer's manual of each boiler model was collected. The research was implemented by interviewing the boiler business agents and the boiler manufacturers.
Building Volume	Value Specific to Each Building	This value was grasped using the building passport or the research by measurement.
Pump Capacity	Value Specific to Each HOB	This value was grasped from the name plate.

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

In Mongolia, the old HOBs (with low energy efficiency) are continuously used except the case where the HOBs are upgraded by the aid from foreign donors. These HOBs are very inexpensive and are easy to handle for the boiler operators. Therefore, the current status and the current performance will continue. Therefore, during the project term, the boiler efficiency of the HOBs before implementing the improvement of the performance of the existing HOBs will continuously maintain the same level. The boiler efficiency in the reference scenario obtained after the new HOBs are installed will be the same as the boiler efficiency obtained after the upgrading of the HOBs.

Therefore, the same benchmark value is set for the boiler efficiency in the reference scenario for both the upgrading and the new installation.

The following is the boundary (the kind of GHG to be calculated and its emission sources) of the Project/Activity.

- The CO_2 emissions due to the coal consumption for supply heat
- The CO_2 emissions due to the electric power consumption by the project HOB

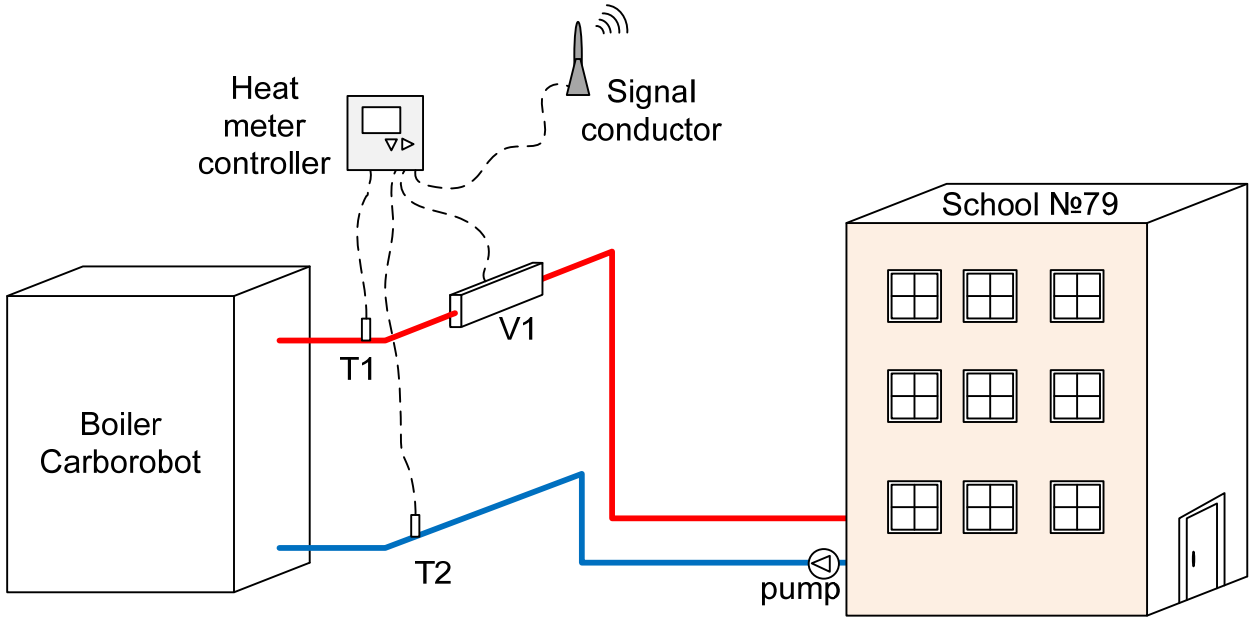
Items other than the above will be excluded from the calculation for simplification to secure conservativeness or due to their extremely small amount.

(7) Monitoring Methods:

In JCM/BOCM, it is necessary based on the issues of CDM to achieve the issuance of credit through one path without going back and forth among the verification process steps in order to shorten the term necessary for the third party verification institution. To do so, it is necessary: to regard the MRV not as independent processes such as M (measurement) alone, R (reporting) alone, and V (verification) alone but as one integrated process involving measurement, reporting, and verification; and to formulate the M (monitoring plan), which is the first process taking into consideration the V (verification), which is the final process. To do this, it is essential to formulate a detailed monitoring plan as shown in the attached reference.

The following is the Monitoring Method 1-1.

Monitored Item	Measurement Position	Measurement Frequency	Recording Frequency
Net heat quantity supplied by the Project HOB	---	Continuous measurement	One hour
Temperature of the circulating water by the project HOB (outlet)	Around the boiler outlet of the water supply pipe	Continuous measurement	One hour
Temperature of the heat water to the project HOB (inlet)	Around the boiler inlet of the water supply pipe	Continuous measurement	One hour
Volume flow rate of circulating water of the project HOB	Around the boiler inlet or outlet of the water supply pipe	Continuous measurement	One hour
Total hours during the monitoring period	---	Every hour check	daily

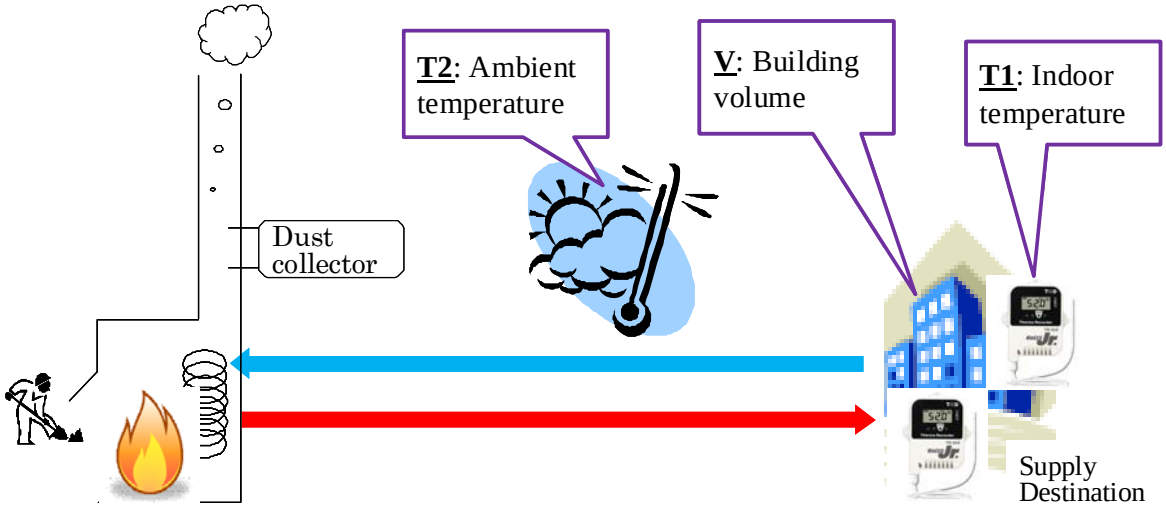


This monitoring method employs a heat meter that complies with the Mongolian standard and, therefore, this approach can be implemented. In the MRV-model demonstration study, the method could be implemented.

The EEC constructed the data collection system, which was the first one in Mongolia, for every minute values from the heat meter. Additionally, the EEC constructed the data collection system, which also the first one in Mongolia with using the portable telephone system (remote data collection system). As in the above, the monitoring method ensures high quality in "Upgrading and Installation of High-Efficient Heat Only Boilers for Heat Water Supply Systems in Districts" in Mongolia and which is most suitable for the issuance of credit for the emission reductions of GHG.

On the other hand, the Monitoring Method 3-1 is as follows:

Monitored Item	Measurement Position	Measurement Frequency	Recording Frequency
Building Volume	Items to be examined	Annually	Annually
Outdoor Air Temperature	Position in the breezy shade	Continuous measurement	One hour
Average Indoor Air Temperature	Plural positions in the building	Continuous measurement	One hour
Total hours during the monitoring period	---	Every hour check	daily



This monitoring method does not comply with the Mongolian standard and only gives the estimated values. A calculation approach feasible in Mongolia was constructed and this approach was also feasible in the MRV-model demonstration study. A thermometer was used that has a data logger attached thereto and, therefore, "Ondo-tori" was used (which is a product of T&D Corporation whose URL is: http://www.tandd.co.jp/). From now on, it is necessary in Mongolia to construct a similar temperature data collection system that employs a thermometer that is qualified in Mongolia.

(8) Amounts of GHG Emissions and GHG its Reductions:

The amounts of GHG emission at the time when the Project/Activity was implemented was obtained using the "project coal consumptions × emission factor". The project coal consumptions can be obtained using the "amounts of heat supplied to the building / boiler efficiency of the project boiler". The amounts of emissions of reference scenario are obtained using the "reference coal consumption × emission factor ". "The amounts of heat supplied to the building" are common (equal) to the project and the reference scenario. Therefore, the reference coal consumptions can be obtained using "the amount of heat supplied to the building / the boiler efficiency of the reference boiler" from the boiler efficiency of the reference boiler and the amounts of heat supplied to the building of the project.

From the above, calculation of the GHG emission reductions can be formulated as:

GHG Emission Reductions

= (reference coal consumption - project coal consumption) × emission factor

= (1 / "the boiler efficiency of the reference boiler" – 1 / "the boiler efficiency of the project boiler") × the amounts of heat supplied to the building × emission factor

The data collection system of every minute data of heat meter was first built up in Mongolia through this MRV Activity. And, the remote data collection system using the mobile phone system was first built up in Mongolia through this MRV Activity.

Since the start of monitoring activities was late for the assumed plan, the monitoring activities of this MRV Demonstration Study were implemented from 26th November (Monday) to 4th December (Tuesday). Since the monitoring time is very short and the values are rounded up and rounded down for the purpose of the conservativeness, the quantities of GHG Emission Reduction are 1 (tCO_2/201hour). Based on the annual operating time of the HOB, which is 5000 to 6000 hours, the annual emission reductions are estimated to be about 100 [tCO2/y].

When the Project/Activity is disseminated, the potential for emission reductions in the whole host country is estimated as follows. The number of HOBs and the actual status

of their use in the whole of Mongolia are unknown and, therefore, only the potential of Ulaanbaatar City is evaluated. The estimated value of the annual coal consumption of the HOBs in Ulaanbaatar City is about 0.2 million [t/year]. Assuming that the boiler efficiency of the HOBs in Ulaanbaatar City is improved by 10% on average, the reduced amount of coal consumption is estimated as 0.02 million [t/year]. Assuming that the CO_2 emission factor is 1.3 [tCO_2/t-coal], the potential for GHG emission reductions can be estimated as about 26,000 [t/year].

(9) Verification of GHG Emission Reductions:

As described in "(7) Monitoring Method," it is indispensable to regard the MRV (measurement, reporting, and verification) as one integrated process and to formulate the M (monitoring plan), which is the first process based on the V (verification), which is the final process. In this Demonstration Study, the monitoring plan was exhaustively formulated in advance. Therefore, the Verification on the Monitoring Report in line with the Monitoring Plan was able to be completed through one path without going back and forth among the processes, by implementing the Verification according to the Monitoring Plan.

The monitored items to be verified in Monitoring Method 1-1 are the amounts of heat supplied, the hot water temperature, the supplied water temperature, the supplied water (hot water) flow and total hours during the monitoring period. In the Verification activity according to Monitoring Method 1-1, the formulation of the Monitoring Plan based on the Verification was first emphasized and the Monitoring Plan was formulated, which took a long time. The actual Verification activity was implemented according to the Monitoring Plan and through desk reviews and on-site reviews. More specifically, the monitoring equipment is variously checked from its serial numbers for item such as its verification statuses, and the verification activity was implemented checking the documents (the evidence) of the data used for making the Monitoring Report. These activities were implemented with EEC, which is the PPs (Project Participants), and it was confirmed that a document that was able to pass the verification of the emission reductions was able to be prepared.

The items to be verified of Monitoring Method 3-1 are the supply destination building volume, the indoor temperature, the outdoor temperature and total hours during the monitoring period. For the verification activity of Monitoring Method 3-1, the building volume was grasped from the building passport and the outdoor temperature and the indoor temperature were checked for their raw data and were checked in the spread sheet (Excel) for input mistakes and calculation mistakes. The indirect measurement method only gave the estimated values and, therefore, it was simultaneously confirmed that the estimation needed to be conducted very conservatively.

The "National Renewable Energy Centre" was selected as the local third party verification institution to implement the verification in this demonstration study for the following reasons:

- There was no DOEs of CDM in Mongolia.
- There was also no ISO certification body in Mongolia.
- The third party verification institution was required to ensure fairness (an institution with a system that was able to monitor the direct concerns to the Project/Activity and that can cope with the concerns) and, therefore, it was considered that a private company was difficult to satisfy such a requirement.
- The institution understood well about the status of Mongolia and the HOBs.
- The institution was a Mongolian domestic institution that was listed as the candidates by Ms. Tsendsuren, DNA of Mongolia, based on the assumptions of the above requirements.

Monitoring Method 1-1 complies with the Mongolian standard. In addition, the

monitoring devices used comply with EN1434 and are qualified according to the official verification of the host country (Mongolia). Therefore, the validity was also ensured for the equipment and the Monitoring Plan was also easy to make. As a result, the verification institution was able to easily verify the Monitoring Report, which was in line with the Monitoring Plan and also able to facilitate reduction of the verification time. Actually, the substantial verification was completed in several days.

On the other hand, Monitoring Method 3-1 does not comply with the Mongolian standard and is an estimation method. In addition, though the monitoring equipment used was calibrated in Japan, no equipment complying with the Mongolian standard was able to be prepared. As a result, the development of the monitoring plan was difficult and the verification had to be variously interpreted. Therefore, the verification activity implemented in December was difficult to actually implement (not verified).

Then, it was determined that the difference was evaluated between the data actually measured using a heat meter that complied with the standard and the data obtained using "Ondo-tori" that did not comply with the standard and, thereby, a discount rate was set that was used in a measurement method not complying with the standard. In addition, "Ondo-tori" was calibrated and its uncertainty was also evaluated. These items were employed as the default values set in the methodology and were excluded from the items to be verified by the verification institution. Thereby, the highly troublesome verification of the simplified approach was enabled. In other words, the verification is enabled by implementing only the verification on the thermometers.

However, it was difficult to judge which point is the appropriate monitoring point of the indoor temperature. Monitoring points are provided in the Monitoring Plan, and the validation of the Monitoring Plan was implemented. The Monitoring Report was made from the result of the Monitoring Activity which was implemented according to the Monitoring Plan. Although the verification of the monitoring data itself was finished satisfactorily, the issue about monitoring point of thermometers remained. More specifically, the monitoring plan has to provide where to measure the indoor temperature and it is assumed that this is difficult to determine.

(10) Ensuring Environmental Integrity:

The Project/Activity will achieve favorable effects such as improving the efficiency of the HOBs and reducing the influence of the (tarnsboundary) air pollution concerning the use of coal, and will not have particularly adverse effects on the environment during their operation. According to the Environmental Impact Assessment Law of Mongolia, which was revised in May 2012, " Applications for a license for the use of natural resources, extraction of petroleum and minerals, and possession and use of land for business purposes and an approval for any other projects are subject to a prior general environmental impact assessment." and, therefore, the law is not applicable to the Project/Activity.

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

No Japanese technology is employed in the HOBs in Mongolia. Then, a measure can be considered according to which Japanese technology will be employed by ensuring the superiority of Japanese technology by: introducing the Japanese policy on the combustion technique (control of the number of units); implementing the improvement measure for the boiler efficiency by collecting the waste heat (the economizer and the recuperator); employing large-scale boilers due to consolidation; etc.

According to Mr. Batdondog of the Heat Technology Section of the Energy Ministry, an activity has started to consolidate the HOBs of the 0.7-to-1-MW class installed at the

capital city of each aimag and to newly install the HOBs of the 30-MW class. In addition, a large-scale heat supply facility of the 300-MW class (a heat station) is also planned to be constructed in the eastern part of Ulaanbaatar City and a feasibility study will soon be implemented. As above, for the HOBs in Mongolia, it is becoming more likely that Japanese technology will be introduced.

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

The following tasks need to be undertaken to implement under JCM/BOCM a Project/Activity similar to the Project/Activity that is the target of this demonstration study.

① The **Integration and Unification of the Monitoring Manual and Verification Manual** should be promoted.

② The **Form of the Verification Report** by which the **integrated MRV Activity can be operated** was proposed and implemented in this MRV-DS. By making the Form of the Verification Report, also contributes to the efficiency of the check of verification report by the administrator of JCM/BOCM.

③ For the Project/Activity, PPs are **independently** implementing continuously the monitoring activity using the heat meters also in 2013. To also support this activity, the flexibility in JCM/BOCM is desired such as **retrospective** recognition of the GHG emission reductions. Thereby, the activity of JCM/BOCM will be activated in Mongolia.

④ **Fund for implementing the project.** Currently, it is difficult to introduce high-efficiency boilers without funds from foreign donors.

⑤ **Development of the third party verification institution**. Currently, there is no organization such as DOE of CDM or ISO certification institution in Mongolia. In this demonstration study, capacity building as the Third Party Verification Institution was implemented for NREC. Therefore, it is desirable that NREC will obtain ISO14065 and will act as a third party verification institution.

⑥ As demonstrated in this MRV-DS, it is important to **produce the monitoring plan based on the verification** in order to tackle the tasks of the verification process to reduce the load on the project participants. To do this, it is necessary to clarify in the scheme of JCM/BOCM the processes of formulating and approving the Monitoring Plan.

⑦ JCM/BOCM is the scheme of Japan and the host country. However, the monitoring equipment used in the scheme is from other countries. JCM/BOCM has to be developed so that **the Japanese monitoring equipment** is actively used in it.

⑧ It is necessary to check **the certificate for each serial number** for the measuring equipment. In Mongolia, it was easy to check the type approval of equipment while it was difficult to check its certification. Therefore, care should be taken for this point when the system of JCM/BOCM is designed, including checks on the measurement system.

⑨ JCM/BOCM should clearly define **"calibration" and "verification,"** and should clearly distinguish them from each other.

⑩ It is necessary to make clear the scope of responsibilities, in the case that the intent or negligence by the Third Party Verification Institution is led to the **excess issuance of credits/offsets**. There are assumed to be the responsibilities for Project Participants, the responsibilities for Joint Committee which accepts the MRV methodology and the responsibilities for the Third Party Verification Institution. It is necessary to prepare the procedure which the verification institution can appeal the authorization result which Joint Committee makes the determination of. This trial organization should become independent from Joint Committee.

5. Contribution to Sustainable Development in Host Country

Improving the air environment is beneficial to human health, assuming that the old HOBs are upgraded to the new HOBs and the coal consumption by the HOBs is reduced by 20%. As a result, the evaluation shows that a benefit of about 12 million [US$] was obtained. As above, the effect of improving the air environment is very significant.

Currently, activity has started to consolidate the HOBs of the 0.7-to-1.0-MW class and to install HOBs of the 30-MW class instead. If these activities can be supported by the scheme of JCM/BOCM, the outcome of the Project/Activity can be utilized for this consolidation activity.