Survey on co-benefits approach to preventing environmental pollution in Mongolia

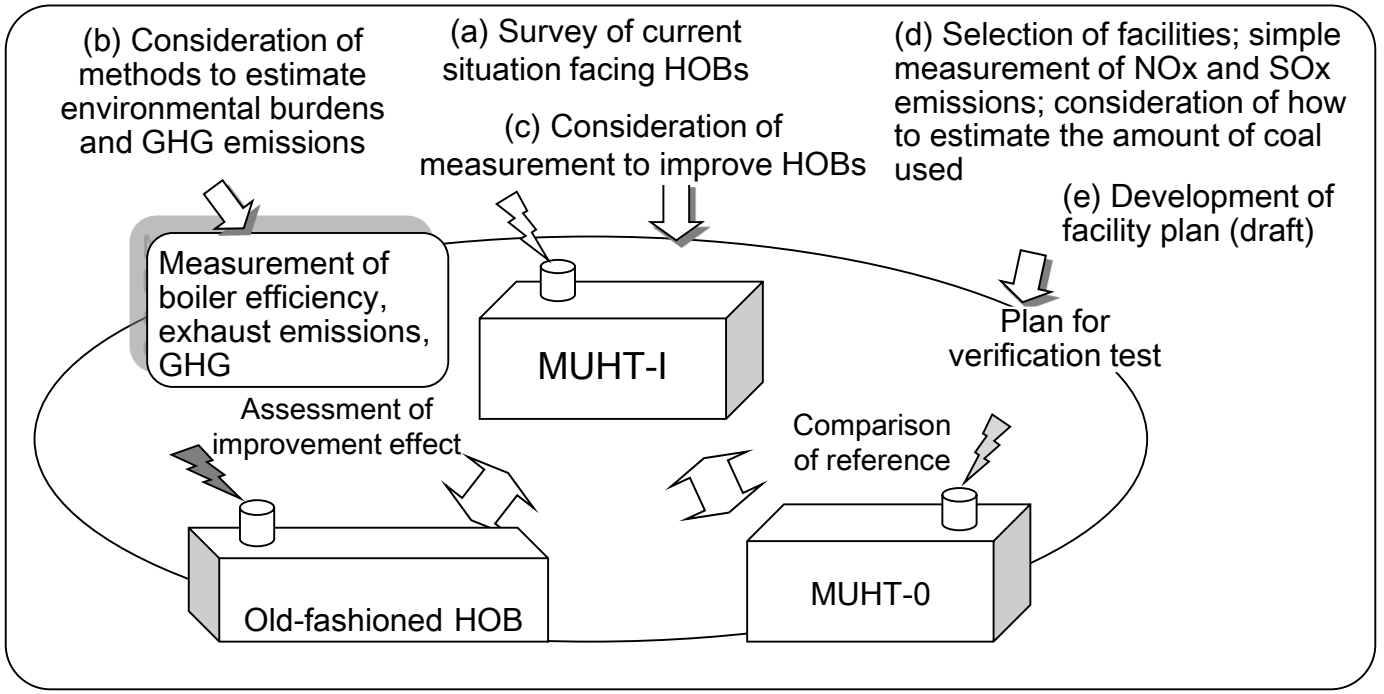
Summary of the survey

■ Purpose of the survey

Contribute to the enhancement of Mongolia's environmental policy by applying co-benefits approach, which helps prevent environmental pollution and reduce greenhouse gas (GHG) emissions simultaneously and effectively, by the use of coal boilers specially designed for heating (heat only boiler [HOB])

■ Measures implemented during FY2013

Taking into account the HOB registration system and targeting HOBs set up in public facilities, we have surveyed the feasibility of improving air pollution and reducing GHG emissions in Ulan Bator. (See (a) to (e) below)



MUHT made by Dorniin-Ilch

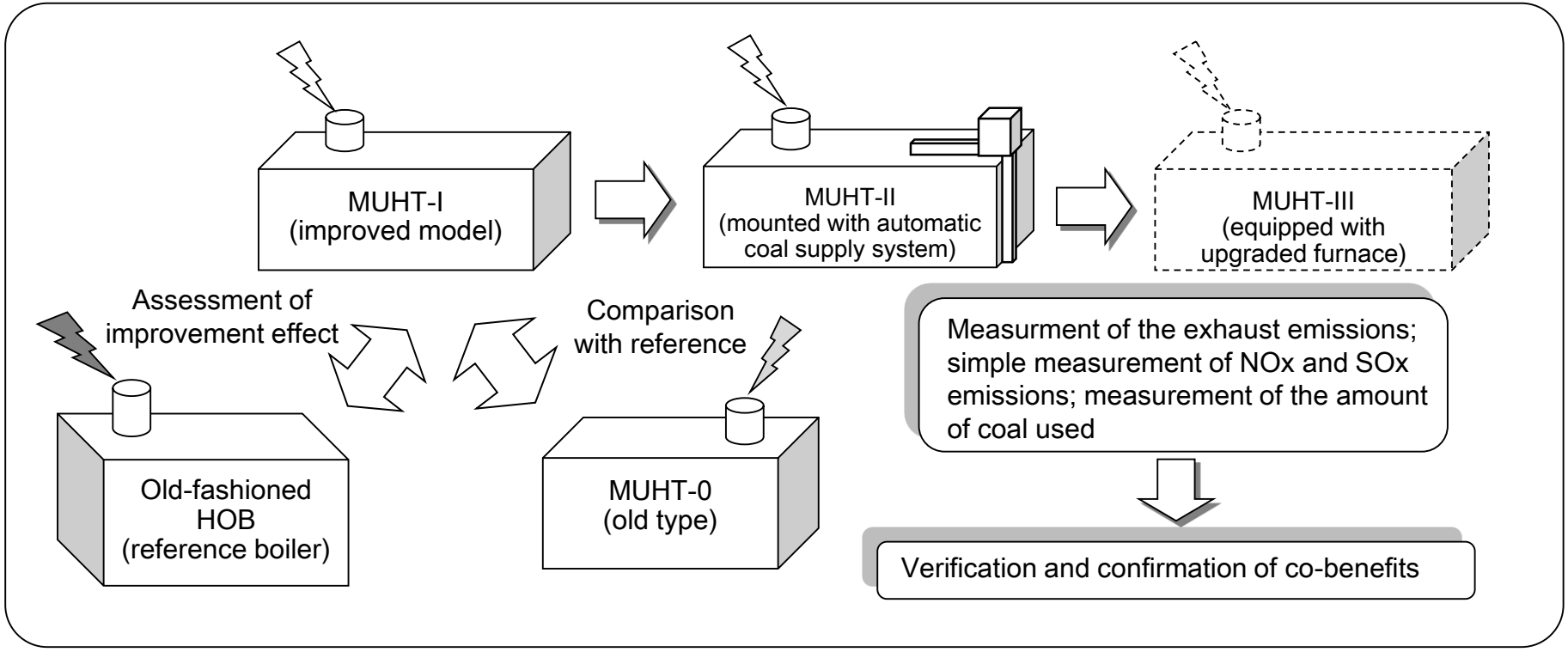
Summary of the survey

■ Measures implemented during FY2014

The MUHT-I boiler - a new HOB whose components related to smoke extraction have been improved - was developed to measure exhaust emissions and to estimate the co-benefits, so that emissions reduction of air pollutants and carbon dioxide (CO2) have been confirmed. A draft guideline on operation and maintenance of HOBs were also compiled, while guidance and training were provided for HOB operators.

■ Measures implemented during FY2015

An automatic coal supply system was fitted to the improved HOB (MUHT-I) to enhance the combustion efficiency of coal. We are to conduct verification tests for the upgraded HOB - MUHT-II - to examine the co-benefits by measuring exhaust emissions.



How HOB has been improved

(FY2014 FY2015)

■ Aim

- Stable combustion
- Reduction of water content in coal
- Improvement of heat exchange efficiency and corrosion resistance
- Improvement of facility environment (reduction of room dust)

Site of coal storage

⑤ Area of coal storage

Roof set up to prevent rainwater from seeping into coal

③ Cyclone

Improvement to enhance filtering efficiency

⑥ HOB building upgraded

Coincidence with remodeling of improved HOB and addition of coal supply system

② Air heater

(heat exchanger for combustion air and exhaust fumes)

Improvement of tube for heat exchange

Body of HOB

① Coal supply system

Automatic, continuous coal supply system installed after classification by particle size

④ Fan for combustion air, induced draft fan

Optimization of the amount of air, adoption of corrosion-resistant material

Chimney

Details and results of the survey in FY2014 (Part 1)

1. **Improvement and assessment of components related to smoke extraction (in February 2015)**
   - Upgrading of the air heater (fin-equipped tube adopted)
   - Improvement of the cyclone (single cyclone system)
   - Upgrading of the blast fan and induced draft fan
     (blast performance optimized, corrosion-resistant material adopted)
   - Installation of an inverter (to control negative pressure inside furnace)

   ⇒ Boiler efficiency improved; dust concentration lowered; working conditions improved
   It has turned out that further improvements are needed to raise the temperatures of exhaust fumes

MUHT-0

Outside of MUHT-I

Blast fan

Worker supplies coal

Fin-equipped tube used for air heater

Air heater, left, and cyclone, right

Induced draft fan

Worker levels ashes

Details and results of the survey in FY2014 (Part 2)

2. Measurement of exhaust emissions and estimation of effect on co-benefits (between January and March 2015)

- Measurement conducted for reference HOB once, for MUHT-0 twice and for MUHT-I twice

⇒ NOx, sulfur dioxide (SO2), CO2, dust, boiler efficiency and other indicators were measured. The dust concentration has been reduced to one-eighth to one-fourth of that in MUHT-0. In addition to the improvement of boiler efficiency, we also confirmed that the emissions of NOx, SO2 and CO2 were also reduced after estimating total emissions in boiler's operation period (Sept. 15 through May 15 next year).

Assessment category for co-benefits	Estimated emission reduction for HOB's operation period
CO2	259 tons
SO2	665 kg
NOx	415 kg
CO	36,549 g
Dust	1,603 kg

3. Guidance and training (in March 2015)

- Training tour held in Japan
- Training tools developed (draft guidelines on operations and maintenance)
- Training sessions targeting boiler operators held (programs provided on how to operate inverter panels and boilers)

References

Results of exhaust emissions measurement

Measurement point	Unit	No. 79 school	No. 65 school	No. 65 school	No. 65 school	No. 65 school
Type of HOB	—	HP10	MUHT-0	MUHT-0	MUHT-I	MUHT-I
Date of measurement	—	Jan. 13, 2015	Jan. 15, 2015	Jan. 16, 2015	Mar. 3, 2015	Mar. 4, 2015
Average temperature of exhaust fumes	℃	323	151	132	75	73
Water content of exhaust fumes	%	4.5	7.8	9.1	6.8	7.7
Average amount of dry exhaust	Nm3/h	264	1,347	1,409	2,742	2,191
Average amount of coal supplied	kg/h	96	198	134	122	122
O2 concentration (raw data)	%	10.4	12.9	15.2	15.5	14.9
CO2 concentration (raw data)	%	9.0	7.2	5.0	4.7	5.1
Dust concentration (see note) (limit value: 0.4)	g/Nm3	0.18	7.8	3.9	1.0	0.85
SO2 concentration (see note) (limit value: 280)	ppm	163	159	217	188	262
NOx concentration (see note) (limit value: 336)	ppm	133	135	156	132	144
CO concentration (see note) (limit value: 2,000)	ppm	1,191	1,081	2,427	6,682	3,856

Note: converted on 9.33% of O2 basis

Details and results of the survey in FY2015 (Part 1)

Consideration and installation of a roof for the coal storage site (in August 2015)

- A roof was set up over a location closer to the HOB building than the existing coal storage site (we gave consideration to the construction of additional buildings)
- Height of the roof: 6.5 m (high enough not to hamper the operations of a lift on the platform)
- The floor is paved with reinforced concrete (so that it can sustain the weight of the load of a 10-ton truck)
- The site is surrounded by 1.6-m block walls (to prevent coal from being blown away by wind)

Complete view of coal storage site (Upper photo taken in August, lower photo in December)

Construction of floor

Block wall (1.6 m tall)

Details and results of the survey for FY2015 (Part 2)

Automatic coal supply system (between October and November 2015)

- The coal crusher and the coal supply system arrived in Oct, and they have been installed. The installation was completed in November.
- The coal supply system had operated between Dec.18 and 22, and exhaust emissions were measured. The gathered data is now being analyzed.

Coal crusher

Coal supply system

Coal supply part

Control panel

Consideration of outline specifications for the furnace (between October 2015 and February 2016)

- A flue and water tube system is to be adopted.
- The burning part should be set up in a lower part of the furnace (whose interior is covered with fire-resistant bricks), while the heat exchanger should be installed in an upper part.
- Discuss details with engineers from the boiler manufacturer (Dorniin-Ilch) and the operating company (Khoyulaa-Khuu)

⇒ We will consider an optimal furnace structure so that we can mass-produce in Mongolia

References

Results of exhaust emissions measurement

Measurement point	Unit	No. 65 school	No. 65 school	No. 65 school	No. 65 school	No. 65 school
Type of HOB	—	MUHT-0	MUHT-I	MUHT-I	MUHT-II	MUHT-II
Date of measurement	—	Jan. 15, 2015	Mar. 4, 2015	Dec. 18, 2015	Dec. 19, 2015	Dec. 21, 2015
Temperature of exhaust fumes	℃	151	73	128	101	128
Water content of exhaust fumes	%	7.8	7.7	9.2	8.3	8.3
Average amount of dry exhaust	Nm3/h	1,347	2,191	756	558	688
Average amount of coal supplied	kg/h	198	122	160	122	151
O2 concentration (raw data)	%	12.9	14.9	10.3	11.3	11.6
CO2 concentration (raw data)	%	7.2	5.1	9.2	8.3	7.9
Dust concentration (see note) (limit value: 0.4)	g/Nm3	7.8	0.85	0.67	0.90	1.2
SO2 concentration (see note) (limit value: 280)	ppm	159	262	74	63	91
NOx concentration (see note) (limit value: 336)	ppm	135	144	113	112	113
CO concentration (see note) (limit value: 2,000)	ppm	1,081	3,856	1,500	1,373	2,357

Note: converted on 9.33% of O2 basis