Proposed methodology
- Replacing from coal boiler to high-efficient gas boiler, Version.01.0

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1-1. Outline of the project

Project Name: “Fuel Conversion by Introduction of LPG Boilers to Beverage Factory”

https://gec.jp/jcm/projects/19pro_mng_01/

Project participants and their main role	**Saisan Co.,Ltd:** Project Management, Introducing Technology, Supporting MRV
	MCS International LLC: - Selling LPG gas **MCS Coca Cola LLC:** - Installation of re-boiler - Conducting MRV
Project site	**MCS Coca Cola LLC** (Gachuurt Road 104 Amgalan 13260, Bayanzurkh district, Ulaanbaatar)
Rough estimation of Emission Reductions	**APR. 4,000 t-CO_2/year**

1-2. Outline of the technology/facility applied

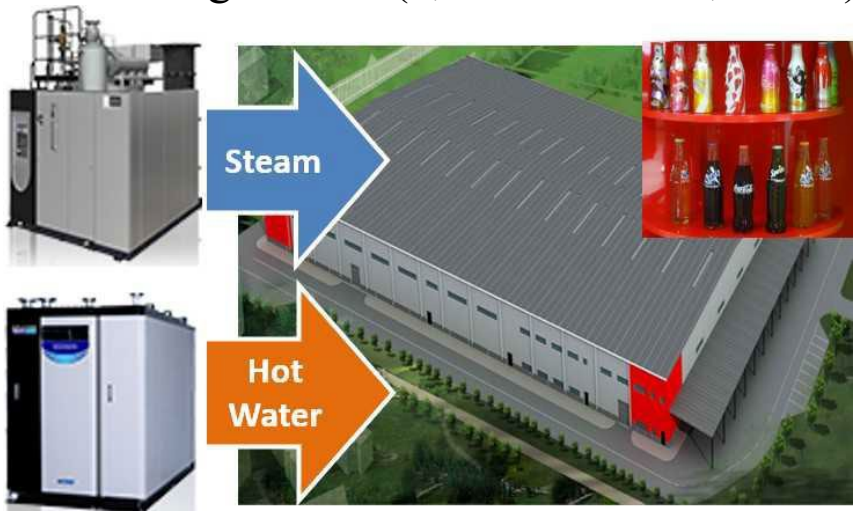
■The project installs 12 LPG boilers (4 Once-through boilers for steam supply and 8 Vacuum type water heaters for hot water supply) replacing 3 existing coal boilers

- Boiler efficiency for maker specification value : **99%** (for without blow drainage)
- **Blow drainage is implemented**.(Blowdown rate: Apr. 4 %)

LPG fired Once-through boiler (2,990kW/unit 4,000t/h) : 4 units

3 existing **coal fired** boiler
(6 ton/h x 2units,
4 ton/h x 1unit)

Replace



LPG fired Vacuum type water heater (733kW/unit): 8 units

- Boiler efficiency for maker specification value: **95%** (for without blow drainage)
- **Blow drainage is not implemented.**

2. Eligibility criteria

Criterion 1	The project installs high-efficient gas (natural gas or LPG (Liquefied Petroleum Gases)) boiler (s) replacing existing coal boiler (s). Project boiler is limited to vacuum type water heater in case of generating hot-water and/or once-through boiler in case of generating steam.
Criterion 2	Periodical check and maintenance by the manufacturer of boiler, authorized agent or inside responsible personnel is implemented at least once a year.

⇦ Criterion for proposed project activity / installed facility

⇦ Criterion to ensure effectiveness for actual emission reductions

3-1. Calculation of reference emissions (1)

Calculation equations of reference emissions

In case that fuel consumption is monitored for each project boiler

Brue font parameters : Monitoring parameters
Red font parameters : Parameters fixed ex ante

Option 1

$$RE_p = \sum_i FC_{PJ,i,p} \times NCV_{gas,PJ} \times \eta_{PJ,i} / \eta_{RE} \times EF_{fuel,RE}$$

- $FC_{PJ,i,p}$: Amount of gas fuel consumed by project boiler i [t/p or Nm^3/p]
- $NCV_{gas,PJ}$: Net calorific value of gas fuel [(GJ/t or GJ/ Nm^3]
- $\eta_{PJ,i}$: Efficiency of project boiler i [−]
- η_{RE}: Efficiency of reference boiler [−]
- $EF_{fuel,RE}$: CO_2 emission factor of the fossil fuel for reference boiler [(tCO$_2$/GJ]

Total amount of gas fuel consumed by project boiler (s) [t/p or Nm^3/p]

$$TFC_{PJ,p} = \sum_i FC_{PJ,i,p}$$

Option 2

$$RE_p = TFC_{PJ,p} \times NCV_{gas,PJ} \times \eta_{PJ,lowest} / \eta_{RE} \times EF_{fuel,RE}$$

- $\eta_{PJ,lowest}$: The lowest value of all efficiencies of project boiler (s) [−]

In case that total amount of gas fuel consumed by all project boilers is monitored

3-1. Calculation of reference emissions (2)

Boiler efficiency & Boiler blow rate

Option i: In case that the project boiler efficiency is identified based on the maker specification value of the project boiler

$$\eta_{PJ,i} = \eta_{Spec,PJ,i} \times (1 - BR_{PJ,i})$$

Efficiency of project boiler i according to the specification value by the manufacturer [−]

Boiler blowdown rate of project boiler i [dimensionless [−]

Source

In order of preference:
- Vendor specification
- Setting value for operation manual on the site.
- The upper value of historical monthly data in a moment for existing boiler before validation.
- Estimation value according to water analysis of boiler feed water and boiler compound

Option ii: $\eta_{PJ,i} = 0.92$ [−]

A default value of 0.92 is applied according to the default value provided as "Natural gas without condenser" in table 1 (Default efficiency factor for thermal applications) of CDM Methodological tool 09 "Determining the baseline efficiency of thermal or electric energy generation systems" Version 03.0

Table 1. Default efficiency factor for thermal applications

Technology of the energy generation system	Default efficiency
Natural gas fired boiler (w/o condenser)	92%
Oil fired boilers adapted as Natural gas fired boiler (w/o condenser)	87%
Oil fired boiler	90%
Biomass fired boiler (on dry biomass basis)	85%

3-2. Calculation of project emissions (1)

Calculation equations of project emissions (1)

$$PE_p = PE_{FC,p} + PE_{EC,p}$$

PE_p : Project emissions during the period p [tCO_2/p]

$PE_{FC,p}$: Project emissions from consumed gas fuel by project boiler (s) during the period p [tCO_2/p]

$PE_{EC,p}$: Project emissions from consumed electricity by vaporizer (s) transforming from liquefied gas to gas one during the period p [tCO_2/p]

3-2. Calculation of project emissions (2)

Calculation equations of project emissions from consumed gas fuel by project boiler (s)

Brue font parameters : Monitoring parameters
Red font parameters : Parameters fixed ex ante

In case that gas fuel consumption is monitored for each project boiler

Option 1

$$RE_p = \sum_i FC_{PJ,i,p} \times NCV_{gas,PJ} \times EF_{gas,PJ}$$

- $FC_{PJ,i,p}$: Amount of gas fuel consumed by project boiler *i* [t/p or Nm^3/p]
- $NCV_{gas,PJ}$: Net calorific value of gas fuel [(GJ/t or GJ/ Nm^3]
- $EF_{gas,PJ}$: CO_2 emission factor of gas fuel [(tCO_2/GJ]
- $TFC_{PJ,p}$: Total amount of gas fuel consumed by project boiler (s) [t/p or Nm^3/p]

$$TFC_{PJ,p} = \sum_i FC_{PJ,i,p}$$

Option 2

$$RE_p = TFC_{PJ,p} \times NCV_{gas,PJ} \times\times EF_{gas,PJ}$$

In case that total amount of gas fuel consumed by all project boilers is monitored

3-2. Calculation of project emissions (3)

Calculation equations of Project emissions from consumed electricity by vaporizer (s) (3)

Brue font parameters : Monitoring parameters
Red font parameters : Parameters fixed ex ante

Total amount of electricity consumed by vaporizer (s) [MWh/p]

CO_2 emission factor for consumed electricity [(tCO_2/MWh]

$$PE_{EC,p} = TEC_{PJ,p} \times EF_{elec}$$

Option A ← *Monitored*

Not monitored →

Option B

$$EC_{PJ,p} = \sum_j EC_{PJ,j,p}$$

Amount of electricity consumed by vaporizer j [MWh/p]

$$EC_{PJ,j,p} = RC_{vp,j} \times OH_{vp,j,p}/1000$$

Operating hours of vaporizer j [hours/p]

Rated capacity of vaporizer j [kW]

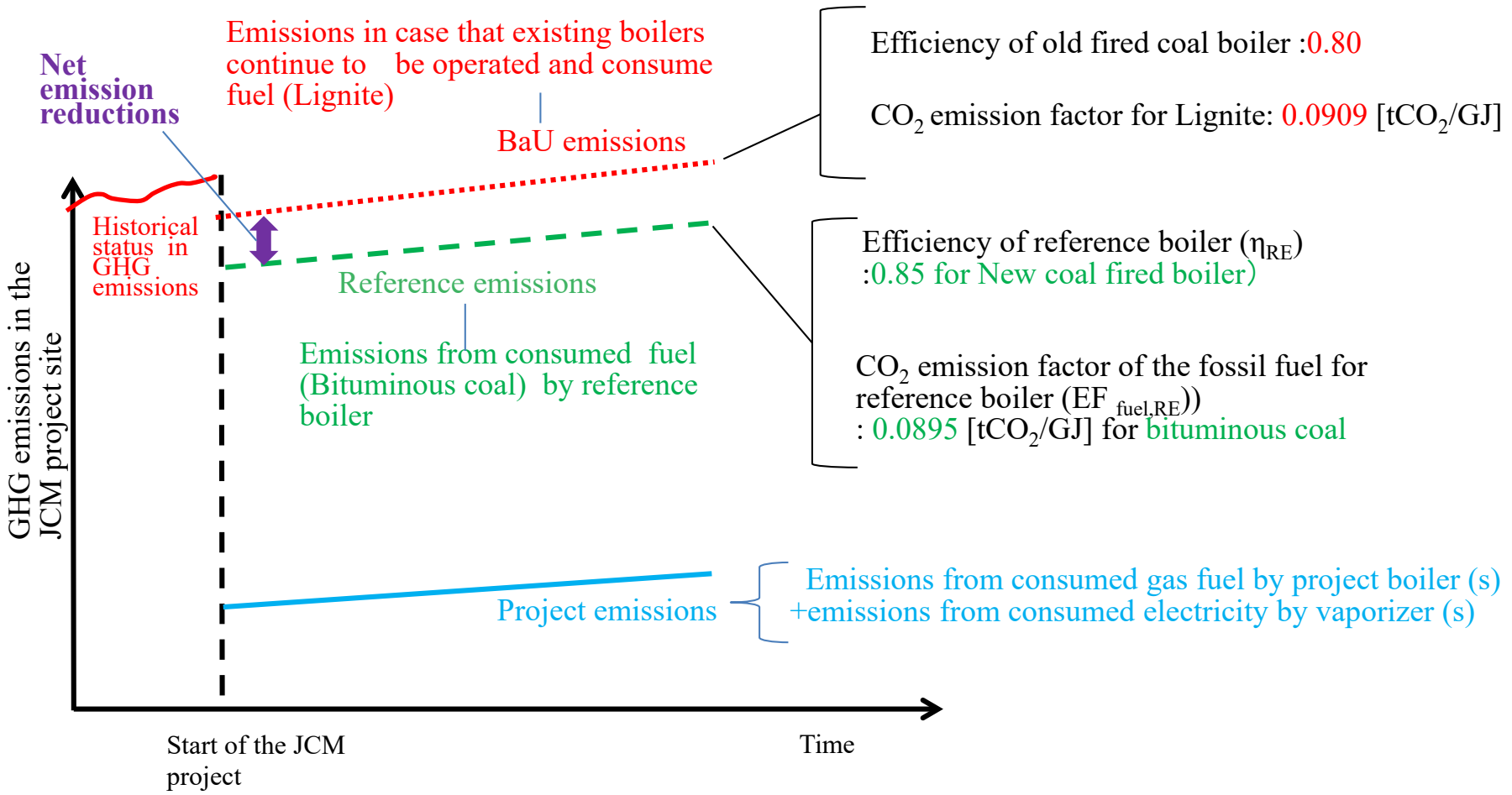
Not monitored →

$$OH_{vp,j,p} = D_{vp,p} \times 24$$

The number of days operation hours of vaporizer (s) [hours/p]

4. Means to achieve net emission reductions (1)

Securing conservativeness in reference emissions



4. Means to achieve net emission reductions (2)

Securing conservativeness in reference emissions

■ A default value for efficiency of reference boiler (η_{RE}): Conservatively set to **0.85**[−]

According to table 3 (Default baseline efficiency for different boilers) of ACM0009" Fuel switching from coal or petroleum fuel to natural gas", CDM consolidated methodology, 0.8 is applied to "Old coal fired boiler" and 0.85 is applied to "New coal fired boiler". This methodology is applied to only replacing from existing coal boiler to gas boiler but is not applied to new and additional installations. Therefore, 0.85 is a conservative value for this activity.

Table 3. Default baseline efficiency for different boilers in ACM0009

Heat supply technology	Default efficiency
New oil fired boiler	90%
New coal fired boiler	85%
Old oil fired boiler	85%
Old coal fired boiler	80%

4. Means to achieve net emission reductions (3)

Securing conservativeness in reference emissions

■ A default value for CO_2 emission factor of the fossil fuel for reference boiler ($EF_{fuel,RE}$) : Conservatively set to **0.0895** [tCO_2/GJ]

The most major species in Mongolia is lignite. According to IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories, the lower value for lignite is 0.0909 [tCO2/GJ]. However, in this methodology, the lower value for other bituminous coal is applied to the parameter in conservative manner.

TABLE 1.4
DEFAULT CO_2 EMISSION FACTORS FOR COMBUSTION [1]

Fuel type English description	Default carbon content (kg/GJ)	Default carbon oxidation factor	Effective CO_2 emission factor (kg/TJ) [2]		
			Default value [3]	95% confidence interval	
	A	B	C=A*B*44/12*1000	Lower	Upper
Other Bituminous Coal	25.8	1	94 600	89 500	99 700
Sub-Bituminous Coal	26.2	1	96 100	92 800	100 000
Lignite	27.6	1	101 000	90 900	115 000

5.1. Parameters to be monitored ex post

Parameter		Measurement methods and procedures
(1) $FC_{PJ,i,p}$	Amount of gas fuel consumed by project boiler *i*	Data is measured by measuring equipment in the factory. - Measuring and recording: 1) Measured data is recorded and stored electronically or manually ~~in the measuring equipments~~. 2) Recorded data is checked its integrity once a month by responsible staff. - Calibration: The measuring equipment is replaced or calibrated at an interval following the regulations in the country in which the measuring equipment is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring equipment has been prepared by the time of installation.
(2) $TFC_{PJ,p}$	Total amount of gas fuel consumed by project boiler (s)	
(3) $TEC_{PJ,p}$	Amount of electricity consumed by vaporizer (s) from transforming liquefied gas to gas one	
(4) $OH_{vp,j,p}$	Operating hours of vaporizer *j*	Monitored data of $FC_{PJ,i,p}$ or $TFC_{PJ,i,p}$, or operation daily report at the project site
(5) $D_{vp,p}$	The number of days operation hours of vaporizer *j* (were not monitored)	Identified by the starting date and the ending date of the monitoring period.

5.2. Data and parameter fixed ex ante (1)

Parameter	Description of data	Source
$NCV_{gas,PJ}$	Net calorific value of gas fuel used by project boiler [GJ/mass or volume unit]	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. **Lower value** is applied.

Used in common for both of Reference emissions and Project emissions

TABLE 1.2
DEFAULT NET CALORIFIC VALUES (NCVS) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALS [1]

Fuel type English description	Net calorific value (TJ/Gg)	Lower	Upper
Natural Gas	48.0	46.5	50.4
Natural Gas Liquids	44.2	40.9	46.9
Liquefied Petroleum Gases	47.3	44.8	52.2

5.2. Data and parameter fixed ex ante (2)

Parameter	Description of data	Source
$EF_{gas,PJ}$	CO_2 emission factor of gas fuel used by project boiler (s) [tCO_2/GJ]	In order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. **Upper value** is applied.

Used in common for only Project emissions

TABLE 1.4 (CONTINUED)
DEFAULT CO_2 EMISSION FACTORS FOR COMBUSTION [1]

Fuel type English description	Default carbon content (kg/GJ)	Default carbon oxidation Factor	Effective CO_2 emission factor (kg/TJ) [2]		
			Default value	95% confidence interval	
	A	B	C=A*B*44/ 12*1000	Lower	Upper
Natural Gas	15.3	1	56 100	54 300	58 300
Natural Gas Liquids	17.5	1	64 200	58 300	70 400
Liquefied Petroleum Gases	17.2	1	63 100	61 600	65 600

5.2. Data and parameter fixed ex ante (3)

Parameter	Description of data
EF_{elec}	CO_2 emission factor of consumed electricity [tCO_2/MWh]. When vaporizer (s) transforming from liquefied gas to gas one consumes only grid electricity or captive electricity, the project participant applies the CO_2 emission factor respectively. When both grid electricity and captive electricity may be consumed by vaporizer (s) transforming from liquefied gas to gas one, the project participant applies the CO_2 emission factor with higher value. [CO_2 emission factor] **For grid electricity:** The most recent value available from the source stated in this table at the time of validation. **For captive electricity:** a) Calculated from its power generation efficiency (η_{cap} [%]) obtained from manufacturer's specification b) Calculated from measured data c) Conservative default value: A value of 1.3 tCO_2/MWh may be applied.

Grid electricity:

The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from CDM Mongolia unless otherwise instructed by the Joint Committee.

The latest value for now : 0.859 tCO_2/MWh

A value of 1.3 tCO_2/MWh

CDM methodological tool "TOOL 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation, version 03.0"

Thank you so much for your attention!