



Proposed standardized baseline submission form (Version 04.0)

To be used by a designated national authority (DNA) when submitting a proposed standardized baseline in accordance with the "Procedure: Development, revision, clarification and update of standardized baselines" (CDM-EB63-A28-PROC).

INFORMATION TO BE COMPLETED BY THE DNA

Title of the proposed standardized baseline:	Standardized Baseline for Energy Efficiency Measures in the Building Sector in Mongolia
Name(s) of the Party or Parties to which the proposed standardized baseline applies:	Mongolia
DNA submitting this form:	Ministry of Environment and Tourism of Mongolia
Is the proposed standardized baseline submitted by a single Party or group of Parties?	<input checked="" type="checkbox"/> √ Single Party <input type="checkbox"/> Group of Parties
Attachments:	
<ul style="list-style-type: none"> ✓ A spreadsheet containing all data used and the calculations performed for the establishment of the standardized baseline, where applicable ✓ A quality control report prepared in accordance with the "Guideline: Quality assurance and quality control of data used in the establishment of standardized baselines", where applicable <input type="checkbox"/> An assessment report prepared by a designated operational entity (DOE), where applicable <input type="checkbox"/> Additional documentation supporting the submission (e.g. statistics and/or, studies, etc.), where applicable (Please specify: _____) <input type="checkbox"/> Letters of approval on the proposed standardized baseline from all the DNAs of the Parties to which it applies (excluding the letter of the DNA submitting this proposed standardized baseline) 	
Name of authorized officer signing for the DNA:	Ms. Anand Tsog Officer of the International Cooperation Division, Ministry of Environment and Tourism of Mongolia
Date (DD/MM/YY) and signature for the DNA:	2nd June 2020.
Contact information of the focal point(s) of the DNA: <i>(Names, e-mail addresses and phone contacts for procedural and technical communication on the submission)</i>	Name: Ms. Anand Tsog Title: Officer of the International Cooperation Division Email: anand@mne.gov.mn Organization: Ministry of Environment and Tourism of Mongolia Phone: +976-11-263341 Fax: +976-51-264711
Name(s) of the proponent(s) of the proposed standardized baseline:	Ministry of Environment and Tourism of Mongolia

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Affiliation of the proponent(s): <i>(The definition of "admitted observer organization" can be found at https://cdm.unfccc.int/Reference/Guidclarif/glos_CD M.pdf)</i>	<input type="checkbox"/> √ Party <input type="checkbox"/> Project Participant (PP) <input type="checkbox"/> International Industry Organization <input type="checkbox"/> Admitted Observer Organization
Contact information of the focal point(s) of the proponent(s): <i>(Names, e-mail addresses and phone contacts for procedural and technical communication on the submission. This section does not need to be completed if the DNA(s) is(are) the proponent(s) of the proposed standardized baseline.)</i>	

FINDINGS AND RESOLUTIONS			
Reference number of the proposed standardized baseline:			
<i>To be used when requesting further input or providing the requested input in accordance with the "Procedure: Development, revision, clarification and update of standardized baselines" (CDM-EB63-A28PROC)</i>			
No.	Request for Input <i>(To be filled by the secretariat, two selected members of the panel/working group or the panel/working group)</i>	Response <i>(To be filled by the DNA and proponent)</i>	Assessment of the response <i>(To be filled by the secretariat, two selected members of the panel/working group or the panel/working group)</i>
1.	Date – (DD/MM/YYYY) Request for input –	Date – (DD/MM/YYYY) Response from DNA –	Date – (DD/MM/YYYY) Assessment of DNA's response –
2.	Date – (DD/MM/YYYY) Request for input –	Date – (DD/MM/YYYY) Response from DNA –	Date – (DD/MM/YYYY) Assessment of DNA's response –
3.	Date – (DD/MM/YYYY) Request for input –	Date – (DD/MM/YYYY) Response from DNA –	Date – (DD/MM/YYYY) Assessment of DNA's response –

Add rows to the tables as needed.

**Proposed standardized baseline submission form
CDM-PSB-FORM (Version 04.0)**

Title: Standardized Baseline for Energy Efficiency Measures in the Building Sector in Mongolia

Submission date (dd/mm/yyyy): 06/06/2020

Version number: 01

Approaches

Check below all the approaches used to develop the proposed standardized baseline and state the version and/or the reference (number, title, version) if applicable.

- ☐ The approach contained in the "Guidelines for the establishment of sector specific standardized baselines"
- ☐ A methodological approach contained in an approved, proposed new or revised baseline and monitoring methodology
- ☒ A methodological approach contained in an approved, proposed, new or revised methodological tool (reference: **TOOL31 Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings Version 01.0**)
- ☐ The approach contained in the "Guideline: Establishment of standardized baselines for afforestation and reforestation project activities under the CDM" (version: _____)

Combination of the approaches (if applicable)

Provide a justification for the necessity and the appropriateness of the combination if more than one approach was used for the development of the proposed standardized baseline.

New or revised methodology or methodological tool (if applicable)

This section is applicable to the following situations:

- 1. If there is no approved methodology or methodological tool available that can be used for the development of the proposed standardized baseline, and if the proponent wishes develop a new methodological approach by submitting a new methodology or methodological tool or revise the approach contained in an approved methodology or methodological tool, and/or*
- 2. If there is no approved methodology available to be used together with the proposed standardized baseline for the estimation of emission reductions, and the proponents wishes to develop new methodology or revise the existing approved methodology.*

Check below how the new or revised methodology or methodological tool is/was submitted for approval by the CDM Executive Board and for what purpose in accordance with the "Procedure: development, revision and clarification of baseline and monitoring methodologies and

methodological tools". In this case, indicate below the title of the new or revised methodology or methodological tool if applicable:

- New or revised methodology or methodological tool¹:
 - ☐ New methodology (title: _____)
 - ☐ Revised methodology (title: _____)
 - ☐ New methodological tool (title: _____)
 - ☐ Revised methodological tool (title: _____)
- Purpose:
 - ☐ For using the methodological approach in new/revised methodology/methodological tool for development of the proposed standardized baseline
 - ☐ For using the new/revised methodology together with the proposed standardized baseline to estimate emission reductions
- Process:
 - ☐ Methodology(ies)/methodological tool is/was proposed through the bottom-up process
 - ☐ Request the secretariat to seek a mandate from the CDM Executive Board for its top-down development (if this option is selected, provide justification below)
 - ☐ (Justification: _____)

Elements to be standardized

Check below all the elements to be standardized by the proposed standardized baseline:

- ☐ Additionality
- ☐ Baseline/baseline land-use scenario
- ☒ Baseline emission/removal parameter
- ☐ Land eligibility (applicable only to afforestation and reforestation project activities)

¹ The proposed new or revised methodology or methodological tool for the purpose of developing a proposed standardized baseline, or the proposed new or revised methodology or methodological tool that will be used together with the proposed standardized baseline, may be submitted to the secretariat at the same time with the proposed standardized baseline in accordance with the "Procedure: development, revision and clarification of baseline and monitoring methodologies and methodological tools".

SECTION A: PROPOSED STANDARDIZED BASELINE DEVELOPED USING THE APPROACH CONTAINED IN THE "GUIDELINES FOR THE ESTABLISHMENT OF SECTOR SPECIFIC STANDARDIZES BASELINES"

Complete this section only when the proposed standardized baseline is developed using the approach contained in the "Guidelines for the establishment of sector specific standardized baselines".

Applicability of the proposed standardized baseline

Provide the following information:

- *The host country(ies) or region(s) within a host country to which the proposed standardized baseline is applicable.*
- *Other factors for disaggregation (e.g. output capacity, age of facilities) relating to the applicability of the proposed standardized baseline, if applicable.*
- *The sector to which the proposed standardized baselines is applied.*
- *The output to which the proposed baseline is applied, i.e., the goods or services with comparable quality, properties, and application areas.*
- *The measure(s) to which the proposed standardized baseline is applicable is/are:*
 - ☐ *Fuel and feedstock switch*
 - ☐ *Switch of technology with or without change of energy source (including energy efficiency improvement)*
 - ☐ *Methane destruction*
 - ☐ *Methane formation avoidance*

Additionality standardization

Explain how the "Guidelines for the establishment of sector specific standardized baselines" were applied to standardize the additionality criterion of project activities or programmes of activities that are deemed additional. Document all underlying data, data sources, assumptions, steps and outcomes in a clear and transparent manner.

Baseline identification

Explain how the "Guidelines for the establishment of sector specific standardized baselines" were applied to identify the baseline. Document all underlying data, data sources, assumptions, steps and outcomes in a clear and transparent manner.

Baseline parameter standardization

Explain how the "Guidelines for the establishment of sector specific standardized baselines" were applied to standardize a baseline parameter (e.g. baseline specific energy consumption, baseline fuel emission factor, baseline emission factor). Document all underlying data, data sources, assumptions, calculation steps and outcomes in a clear and transparent manner.

Use of the proposed standardized baseline with approved or proposed new or revised methodology(ies)

Explain how the proposed standardized baseline will be used together with the valid version(s) of a relevant approved methodology(ies) or proposed new/revised methodology(ies).² Describe how a standardized baseline derived from the "Guidelines for the establishment of sector specific standardized baselines" will replace the sections of demonstration of additionality, identification of the baseline scenario and/or the determination of baseline emissions in the methodology.

Validity of the proposed standardized baseline

State the period of time for which the proposed standardized baseline is valid taking into account the provisions of the "Standard for determining coverage of data and validity of standardized baselines" and Appendix I to the "Guidelines for the establishment of sector specific standardized baselines".

Deviations from the guidelines (if applicable)

Provide descriptions of and justifications for the necessity and the appropriateness of any deviations from the "Guidelines for the establishment of sector specific standardized baselines" to develop the proposed standardized baseline.

References and any other relevant information

² The "Guidelines for completing the proposed new baseline and monitoring methodologies form" provide guidance on the sections of the proposed new baseline and monitoring methodologies form that should be filled to develop a methodology that will only be used together with a standardized baseline.

SECTION B: PROPOSED STANDARDIZED BASELINES DEVELOPED USING A METHODOLOGICAL APPROACH CONTAINED IN AN APPROVED METHODOLOGY

Complete this section only when the proposed standardized baseline is developed using a methodological approach contained in the valid version of an approved methodology or in a proposed new or revised methodology(ies). An example of this is "AM0070: Manufacturing of energy efficient domestic refrigerators" to standardize the specific energy consumption of domestic refrigerators in the host country.

Applicability of the proposed standardized baseline

State the host country(ies) or region(s) within a host country to which the proposed standardized baseline is applicable. In case of region(s) within a host country, document transparently the geographical boundaries of the region (e.g. provinces, electric grids, etc.).

Additionality standardization (if applicable)

Explain how the methodological approach contained in the valid version of the approved methodology(ies) or in the proposed new or revised methodology(ies) was applied to standardize additionality criterion for project activities or programmes of activities using the methodology. Document all the underlying data, data sources, assumptions, steps and outcomes in a clear and transparent manner.

Baseline identification (if applicable)

Explain how the methodological approach contained in the valid version of the approved methodology(ies) or in the proposed new or revised methodology(ies) was applied to identify the baseline. Document all the underlying data, data sources, assumptions, steps and outcomes in a clear and transparent manner.

Baseline emission parameter standardization (if applicable)

Explain how the methodological approach contained in the valid version of the approved methodology or in the proposed new or revised methodology was applied to standardize the baseline emission parameter (e.g. baseline specific energy consumption, baseline emission factor) of a project activity or programme of activities. Document all underlying data, data sources, assumptions, calculation steps and outcomes in a clear and transparent manner.

Use of the proposed standardized baseline with the approved or proposed new or revised methodology

Explain how the proposed standardized baseline will be used with the valid version of the approved methodology(ies) or proposed new or revised methodology(ies) to estimate emission reductions. Explain which parts of the methodology(ies) are replaced by the proposed standardized baseline.

Validity of the proposed standardized baseline

State the period of time for which the proposed standardized baseline is valid in accordance with the requirements contained in the "Standard for determining coverage of data and validity of standardized baselines".

Deviations from the approved methodology (if applicable)

Provide a description of and justification for the necessity and the appropriateness of any deviation from the valid version of the approved methodology to develop the proposed standardized baseline. Also justify why a revision of the valid version of the approved methodology is not necessary.

References and any other relevant information

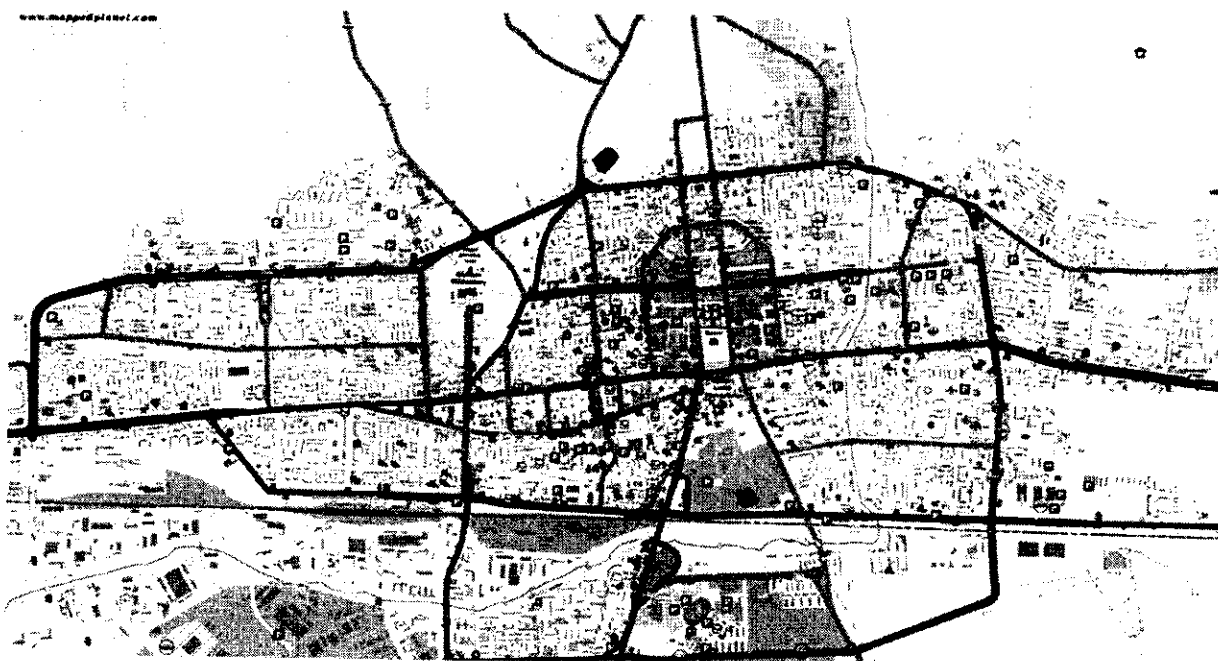
SECTION C: PROPOSED STANDARDIZED BASELINE DEVELOPED USING A METHODOLOGICAL APPROACH CONTAINED IN AN APPROVED OR PROPOSED NEW OR REVISED METHODOLOGICAL TOOL

Complete this section only when the proposed standardized baseline is developed using a methodological approach contained in the valid version of an approved methodological tool or in a proposed new or revised methodological tool (an example of this is the application of the "TOOL07: Tool to calculate the emission factor for an electricity system" to estimate the CO₂ emission factor of an electricity grid).

Applicability of the proposed standardized baseline

State the host country(ies) or region(s) within a host country to which the proposed standardized baseline is applicable. In case of region(s) within a host country, document transparently the geographical boundaries of the region (e.g. provinces, electric grids, etc.).

The proposed standardized baseline is applicable to the city of Ulaanbaatar in Mongolia. A map for the city is depicted below.



Baseline parameter standardization (if applicable)

Explain how the methodological approach contained in the valid version of the approved methodological tool or in the proposed new or revised methodological tool was applied to standardize the baseline parameter (e.g. baseline emission factor). Document all underlying data, data sources, assumptions, calculation steps and outcomes in a clear and transparent manner.

The methodological tool 31 "Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings" V 01.0 was used to determine the specific baseline emission factor tCO₂/m² in buildings associated with the consumption of

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electricity, fuel and hot water by buildings. Buildings are confined to the urban areas of Ulaanbaatar city.

This methodological tool also refers to the following latest approved versions of several methodologies:

1. AM0091 entitled "Energy efficiency technologies and fuel switching in new and existing buildings" Version 03.0
2. Guideline: Quality assurance and quality control of data used in the establishment of standardized baselines" Version 02.0
3. Guideline: Sampling and surveys for CDM project activities and programmes of activities 04.0
4. Tool 07 to calculate the emission factor for an electricity system, Version 07.0
5. Tool 03 to calculate project or leakage CO₂ emissions from fossil fuel combustion., Version 03.0

Underlying data and data sources

Fixed data/parameters

Data/parameter	Source of data
Specific heat capacity of the chilled/hot water (GJ/(kg. K))	https://www.engineeringtoolbox.com/water-thermal-properties-d_162.html
Density of the chilled/hot water kg/m ³	https://www.engineeringtoolbox.com/water-thermal-properties-d_162.html -

Monitored data/parameters

Data/parameter	Source of Data
Building category	Housing and Public Utilities Authority
Gross floor areas (GFA) per building unit per category	Housing and Public Utilities Authority
Monthly metered bills for electricity consumption for each building unit	Housing and Public Utilities Authority Private company "Ganbij" LLC.
Apportioning of fuel use for electricity and heat production in CHPs	Energy Regulatory Commission (ERC)
Fuel consumption data Monthly bills for each building unit (hot water production by stand-alone boilers, home stoves)	ERC

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Data/parameter	Source of Data
Monthly and annual energy content of hot water consumed per building unit (<i>excluding hot water generated from home stoves and stand-alone boilers, e.g., district heating</i>) Monthly mass or volume of consumed water per building unit for building units without meters (Housing and Public Utilities Authority Heat meters (GJ): available for education, retail and offices For other buildings, the energy content is calculated: Meters for hot water and heat are on the substation (on the distribution company side of the substation). Volume: Metering of flow (m ³) for hot water at building level (in and out.) Temperature difference: calculation on the basis of assumptions: <ul style="list-style-type: none"> inlet to building: 60 °C inlet to substation 5 °C
Technical distribution loss of hot water production system	District heating companies- ERC Range: 13- 19 % (company specific)
Electricity consumption (MWh) per month and per year for operation of hot water production system	Energy Regulatory Commission (ERC)
Fuel consumption: mass or volume of fuel per month and year for hot water production system	Energy Regulatory Commission (ERC)
Energy content of the water produced by the hot water production system	Energy Regulatory Commission (ERC)

Previously standardized parameters used in the methodology

Data/parameter	Value	Source of data
Grid emission factor for Mongolia's national electricity grid Combined margin CO ₂ emission factor for Mongolia's national electricity grid	0.859 tCO₂/MWh (first crediting period) 0.846 tCO₂/MWh (second and third crediting period)	ASB0039-2018 Version 01.0

Country specific parameters

Data/parameter	Value	Source of data
Net calorific values (NCV) Baganuur	3500 kcal/kg	Supplier: http://www.baganuurmine.mn/?page_id=681
Net calorific values (NCV) Shivee-Ovoo	2850 kcal/kg	Supplier: Shivee-Ovoo Joint Stock Company http://shivee-ovoo.mn/index.php?module=menu&cmd=content&menu_id=109

Data/parameter	Value	Source of data
Country specific EF for combustion of coal	77900 kg CO ₂ /TJ	BUR 1 p.54

Assumptions, calculations steps, and outcomes

Calculation of specific baseline emissions in buildings

Step 1: Categorization of buildings: residential, commercial (hotels, offices, retail) and institutional (hospitals, education) building units (TOOL31 Appendix)

Step 2: Selection of buildings during sampling into cohort of existing buildings and cohort of new buildings (TOOL31 paragraph 10 (h) and (i)).

For new buildings, all sampled buildings for the baseline emissions estimations should have finalized construction within 5 years (2011 inclusive) before the end of the data coverage period (2015).

For existing buildings, all sampled buildings for the baseline emissions estimations should have finalized construction for at least 5 years (2010 inclusive) before the end of the data coverage period (2015).

Step 3: Conducting baseline measurement survey

- ☐ Energy consumption data for electricity, fuels, hot water during the coverage period starting 2013 and 2016-2017 for data currentness.
- ☐ All independent variables affecting energy use (fuel use for generation of electricity and hot water)
- ☐ Determination of sample size using the Guideline: Sampling and surveys for CDM project activities and programmes of activities Version 04.0 and the sample size calculator (Version 03.1) available in the CDM website.

On the basis of the Guideline: Sampling and surveys for CDM project activities and programmes of activities Version 04.0, simple random sampling has been selected as the most convenient and applicable sampling method. The equation applied for the determination of sample size based on simple random sampling approach is:

$$n_{BL,min,i,y} = \frac{cv_{SE,BL,i,y}^2 \times t_{0.05}^2 \times N_{BL,i}}{P_{10\%}^2 \times N_{BL,i} + cv_{SE,BL,i,y}^2 \times t_{0.05}^2}$$

Where:

- $n_{BL,min,i,y}$ = Minimum sample size of baseline building units in building unit category i in year y. Round up to the next integer if it is decimal
- $cv_{SE,BL,i,y}$ = Coefficient of variation of specific emissions of baseline building units in units in building unit category i in year y
- $t_{0.05}$ = t-value for a 90 per cent statistical significance level (1.645)
- $P_{10\%}$ = 10 per cent precision requirement for a sample estimate (0.10)
- $N_{BL,i}$ = Total number of baseline building units in the population for building unit category i at the start of the project activity

The minimum sample size was calculated for each of the six building categories.

Step 4: Calculation of baseline emissions due to energy consumption for each building unit

Step 4.1 Electricity consumption

$$BE_{electricity,j,i,BL} = EC_{grid,j,i,BL} \times EF_{grid,j,i} + EC_{captive,j,i,BL} \times EF_{captive,j,i}$$

(TOOL31 Equation (3))

Since captive sources are not relevant to Mongolia, the equation used is:

$$BE_{electricity,j,i,BL} = EC_{grid,j,i,BL} \times EF_{grid,j,i}$$

- $BE_{electricity,j,i,BL}$ = Baseline emissions from electricity consumption of baseline building unit j in category i included in the sample over the applicable data coverage period (tCO₂/yr)
- $EC_{grid,j,i,BL}$ = Grid electricity consumed by the baseline building unit j in building unit category i included in the sample over the applicable data coverage period (MWh/yr)
- $EF_{grid,j,i}$ = Emission factor of the electric grid supplying electricity to the baseline building unit j in building unit category i (tCO₂e/MWh).

Step 4.2 Fuel consumption

$$BE_{fuel,j,i,BL} = \sum_k FC_{k,j,i,BL} \times NCV_k \times EF_{CO_2,k}$$

(TOOL31 Equation (4))

- $BE_{fuel,j,i,BL}$ = Baseline emissions from fossil fuel consumption of baseline building unit j in building unit category i (tCO₂/yr)
- $FC_{k,j,i,BL}$ = Amount of fossil fuel type k consumed by the building unit j in building category i (mass or volume unit/yr)
- NCV_k = Net calorific value of the fossil fuel type k (GJ/mass or volume units)
- $EF_{CO_2,k}$ = CO₂ emission factor of fuel type k (tCO₂/GJ)

Step 4.3 Hot water consumption

$$BE_{water,j,i,BL} = \frac{WC_{j,i,BL} \times EF_{WP,j,i,BL}}{1 - \eta_{dist,s,BL}}$$

(TOOL31 Equation (5))

- $BE_{water,j,i,BL}$ = Baseline emissions from hot water consumption of baseline building unit j in building unit category i (tCO₂/yr)
- $WC_{j,i,BL}$ = Energy content of the hot water consumption in baseline building unit j in building unit category i (GJ/yr)
- $EF_{WP,j,i,BL}$ = Emission factor for production of hot water that is supplied to baseline building unit j in building unit category i (tCO₂/GJ)
- $\eta_{dist,s,BL}$ = Average technical distribution losses of the chilled/hot water system s network serving baseline building unit j in building unit category i

$$WC_{j,i,BL} = m_{j,i,BL} \times \Delta t_{j,i,BL} \times C_m$$

(TOOL31 Equation (6))

- $m_{j,i,BL}$ = Mass of chilled/hot water consumption of baseline building unit j in building unit category i (kg/yr)
- $\Delta t_{j,i,BL}$ = Average temperature difference between the outlet water and inlet water of the cooling/heating system used for the cooling/heating of building unit j in building unit category i (K)
- C_m = Specific heat capacity of the chilled/hot water (GJ/(kg·K))

$$m_{j,i,BL} = v_{j,i,BL} \times \rho_{H2O} \quad (\text{TOOL31 Equation (7)})$$

- $v_{j,i,BL}$ = Average hot water consumption (in volume m³) of baseline building unit j in building unit category i
- ρ_{H2O} = Density of the hot water (kg/m³)

and

$$EF_{WP,j,i,BL} = \frac{EC_{WP,s,BL} \times EF_{CO2,electricity} + \sum_k FC_{WP,k,s,BL} \times NCV_k \times EF_{CO2,k}}{m_{s,BL} \times \Delta t_{s,BL} \times C_m} \quad (\text{TOOL31 Equation (8)})$$

- $EF_{CO2,electricity}$ = CO₂ emission factor of power source to which the hot water system s is connected to (tCO₂e/MWh). If the source is grid electricity, the monitoring provisions of the parameter $EF_{grid,j,i}$ shall apply
- $FC_{WP,k,s,BL}$ = Amount of fossil fuel type k consumed to produce the hot water system s (mass or volume unit/year)
- NCV_k = Net calorific value of the fossil fuel k (GJ/mass or volume unit)

The energy content of water produced by the chilled/hot water system, $WP_{j,i,BL}$, is measured. Therefore, the denominator in Equation (8) is plugged in as one value (rather than a calculation of the three parameters of mass, average temperature, and specific heat capacity of chilled/hot water)

$$WP_{s,BL} = m_{s,BL} \times \Delta t_{s,BL} \times C_m \quad (\text{not given as such in tool 31})$$

$WP_{s,BL}$ = Energy content of hot water produced by chilled/hot water system s (GJ/yr)

Step 5: Dividing total baseline emission per building by gross floor area → specific baseline emission per building unit j per unit area

$$SE_{j,i,BL} = \frac{BE_{electricity,j,i,BL} + BE_{fuel,j,i,BL} + BE_{water,j,i,BL}}{GFA_{j,i,BL}} \quad (\text{TOOL31: Equation (2)})$$

Step 6: Calculate average specific emissions per building category per unit area from the top-20% best performing buildings under the building category i

$$SE_{CO2,Top20\%,i} = \frac{\sum_j SE_{CO2,j,i,BL}}{J_{i,BL}} \quad (\text{TOOL31: Equation (1)})$$

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Details on quality control procedures and quality assurance processes of data and calculations are provided in the QC report.

Outcomes

Standardized baseline emission factors in new buildings (top 20% performers) during 2015-2017

Building unit category	Residential	Institutional		Commercial		
		Education	Hospitals	Retail	Hotel	Offices
AVG specific baseline emission per category in new buildings (tCO ₂ /m ²)	0.0703	0.0024	0.0053	0.0213	0.1261	0.0090

Standardized baseline emission factors in existing buildings (top 20% performers) during 2015-2017

Building unit category	Residential	Institutional		Commercial		
		Education	Hospitals	Retail	Hotel	Offices
AVG specific baseline emission per category in existing buildings (tCO ₂ /m ²)	0.0459	0.0058	0.0148	0.0130	0.0214	0.0133

Validity of the proposed standardized baseline

State the period of time for which the proposed standardized baseline is valid in accordance with the "Standard for determining coverage of data and validity of standardized baselines".

Assumption for submission date of the standardized specific baseline emissions: 2018

Data coverage period: 2013-2018

Data currentness period: 2016-2017

The calculations of standardized baseline emission factor in buildings were performed using energy consumption data for electricity and hot water supplied by CHPs during the years 2015, 2016, and 2017. There is no direct fuel use in buildings and therefore no emissions from direct fuel use is calculated.

The period of validity of the standardized baseline emission factors is proposed to be 3 years from the date of its adoption.

Deviations from the approved methodology (if applicable)

Provide descriptions of and justifications for the necessity and the appropriateness of any deviations from the valid version of the approved methodological tool to develop the proposed standardized baseline. Also, justify why a revision of the valid version of the approved methodological tool is not necessary.

For the determination of the minimum sample size, published values for average emissions per unit floor area and standard deviation were not available. However, actual energy consumption data for buildings within each category were available and were used to determine emissions per unit floor areas of each category. The average emissions per unit floor area of all buildings for each category and standard deviation were calculated and used in the random sampling equation to determine the minimum sample size. Large variability in emissions per unit areas were observed resulting in large sample size requirements; therefore, on the basis of expert judgement outlying values, (i.e., building having large emissions per unit floor area) were omitted from the calculation of the required sample size. The removal of outliers does not impact the determination of standardized baseline averages since the averages are determined on the basis top 20% best performers from the whole sample (i.e., buildings having the lowest emissions per unit floor area). The scarcity of data is specific to Mongolia's building sector, therefore, a revision of the approved methodology is not necessary.

For the determination of the emission factor for hot water production by CHPs, the energy content of water produced by the chilled/hot water system, $WP_{j,LBL}$, is measured. Therefore, the denominator in Equation (8) is plugged in as one value (rather than a calculation of the three parameters of mass, average temperature, and specific heat capacity of chilled/hot water.) The present modification presents an alternative method to include energy content, which may be measured or calculated. However, the parameter remains the same, therefore, revisions of the approved methodological tool are not necessary.

References and any other relevant information

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Mongolia Baseline Emission Factor for existing and new buildings calculation sheets (2 excel files)

Mongolia Emission Factor for hot water production (1 excel sheet)

Mongolia Baseline Emission Factor for existing and new buildings QC report

SECTION D: PROPOSED STANDARDIZED BASELINE DEVELOPED USING THE APPROACH CONTAINED IN THE "GUIDELINE: ESTABLISHMENT OF STANDARDIZED BASELINES FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES UNDER THE CDM"

Complete this section only when the proposed standardized baseline is developed using the approach contained in the "Guideline: Establishment of standardized baselines for afforestation and reforestation project activities under the CDM".

Applicability of the proposed standardized baseline

Provide the information on the host country(ies) or region(s) within a host country to which the proposed standardized baseline is applicable. In case of region(s) within a host country, document transparently the geographical boundaries of the region(s) (e.g. administrative units, geo-referenced coordinates).

Additionality standardization

Explain how the "Guideline: Establishment of standardized baselines for afforestation and reforestation project activities under the CDM" was applied to standardize the additionality criterion for afforestation and reforestation CDM project activities undertaken in the areas of land included under the scope of the proposed standardized baseline. Document all relevant data sources, assumptions, steps and outcomes in a clear and transparent manner.

Baseline land-use scenario identification

Explain how the "Guideline: Establishment of standardized baselines for afforestation and reforestation project activities under the CDM" was applied to identify the baseline land-use scenario of afforestation and reforestation CDM project activities undertaken in the areas of land included under the scope of the proposed standardized baseline. Document all relevant data sources, assumptions, steps and outcomes in a clear and transparent manner.

Standardization of baseline carbon stocks and GHG removals estimation (if applicable)

Explain how the "Guideline: Establishment of standardized baselines for afforestation and reforestation project activities under the CDM" was applied to standardize the estimation of baseline carbon stocks and GHG removals of applicable afforestation and reforestation CDM project activities undertaken in the areas of land included under the scope of the proposed standardized baseline. Document all relevant data sources, assumptions, calculation steps and outcomes in a clear and transparent manner.

Land eligibility demonstration (if applicable)

Explain whether eligibility of the lands included under the scope of the proposed standardized baseline for the CDM is confirmed by the proposed standardized baseline. If not, explain whether well-defined approaches for demonstrating eligibility of lands for the CDM have been provided which will help the project participants in demonstrating eligibility of the lands under their projects. In either case, document all relevant data sources, assumptions, calculation steps and outcomes in a clear and transparent manner.

Validity of the proposed standardized baseline

State the period of time for which the proposed standardized baseline is valid.

Deviations from the guideline (if applicable)

Provide descriptions of and justifications for the necessity and the appropriateness of any deviations from the "Guideline: Establishment of standardized baselines for afforestation and reforestation project activities under the CDM" to develop the proposed standardized baseline.

References and any other relevant information

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
04.0	21 September 2018	Revision to: <ul style="list-style-type: none"> • Reflect updated list of attachments contained in the version 05.2 of "Procedure: Development, revision, clarification and update of standardized baselines" (CDM-EB63-A28-PROC); • Include editorial and structural improvement.
03.0	1 September 2015	Revision to: <ul style="list-style-type: none"> • Reflect updated requirements in the version 04.0 of "Procedure: Development, revision, clarification and update of standardized baselines" (CDM-EB63-A28-PROC); • Include editorial improvement. •
02.0	1 December 2013	The document title has changed from "Proposed standardized baseline form" (F-CDM-PSB) to "Proposed standardized baseline submission form" (CDM-PSB-FORM). Revision to: <ul style="list-style-type: none"> • Reflect updated requirements in the "Procedure: Development, revision, clarification and update of standardized baselines" • Include editorial improvement
01.0	23 March 2012	Initial publication.
Decision Class: Regulatory		
Document Type: Form		
Business Function: Methodology		
Keywords: DNA, standardized baselines		

Appendix 1. Quality control (QC) report

Sector	Building
Name of DNA	Ms. Anand Tsog Officer of the International Cooperation Division, Ministry of Environment and Tourism of Mongolia
Primary Person Responsible for QC Procedures	Ms. Tegshjargal Bumtsend GHGI Specialist of Environment and Climate Fund, Ministry of Environment and Tourism of Mongolia
Contact of the Primary Person Responsible	Environment and Climate fund (ECF), Margad Center, 8 th khoroo, Student Street, Sukhbaatar District, Ulaanbaatar-14191, Mongolia Tel.: +976-70000753 Fax: +976-11-310-743 Email: tegshjargal77@gmail.com
Implementation Dates of QC Procedures	
Please describe how your QC procedures were implemented	
<p><i>Pre-submission QC:</i></p> <p>Parameters used in the calculations of the standardized baseline consisted of (a) monitored/measured data and (b) previously standardized or reference data.</p> <p>(a) Monitored and/or measured data are listed along with respective units, aggregation levels, acquisition procedures, and sources of data in the data delivery protocol (Appendix 2) and consist of:</p> <ul style="list-style-type: none"> • Building unit level data obtained from the Housing and Public Utilities Authority and private company "Ganbij" LLC: <ul style="list-style-type: none"> • Building unit characteristics (category and construction date) • Energy consumption: electricity and hot water. No direct fossil fuel use occurs in the buildings and therefore, not data for such parameter were used. • Gross floor area • Electricity and heat production facility level data obtained from the Energy Regulatory Council: <ul style="list-style-type: none"> • Fuel consumption for the production of heat (hot water) and electricity for each CHP, characteristics of the hot water distribution network (e.g., losses) • Energy content of hot water produced at the facility level, i.e., hot water production systems (CHP2, CHP3, and CHP4) • Internal electricity consumption for operation of facility <p>(b) Previously standardized or reference parameters consist of:</p> <ul style="list-style-type: none"> • Country specific emission factor for coal for Mongolia reported in Mongolia's first BUR • Grid emission factor for Mongolia's national electricity grid, ASB0039-2018 Version 01.0 <p><i>Post-submission QC:</i></p> <ul style="list-style-type: none"> • All collected data pertaining to building units will be compiled in an online database • Monitoring of changes in standardized or reference values (Grid emission factor and country specific emission factor for coal) will be performed 	

Corrective actions:
Please specify how the credibility of the data sources was checked.
Data sources were governmental authorities. Following two missions attended by local and international consultants and members affiliated to the Energy Regulatory Council, Housing and Public Utilities Authority, data was collected in subsequent correspondences using templates in Appendix 3. Data template format.
Please specify how the accuracy of the data was checked.
General QC procedures implemented to verify accuracy of collected data <ul style="list-style-type: none"> • Units were verified for all data reported and used in the calculations • Conversion factors were verified • All parameters transcribed for the final calculation of emission were verified • All formulae used in calculation were verified Specific QC procedures implemented to verify accuracy of collected data GFA <p>GFA is determined during building design phase and inspected by different bodies such as State Inspection Agency, Commissioning Committee</p> Electricity consumption (grid and hot water production) <ul style="list-style-type: none"> • Reported electricity consumption across three years were compared to identify any variabilities • EF_{grid}: The combined margin EF reported in the CDM Approved Grid emission factor for Mongolia's national electricity grid (ASB0039-2018 Version 01.0) was used in calculations. Future QC would involve verifying updates. Fuel consumed for hot water production <ul style="list-style-type: none"> • NCV: reported values for Baganuur (14.7 TJ/Gg) and Shivee-Ovoo (12.0 TJ/Gg) were verified to be within the uncertainty range reported for IPCC default values, i.e., 5.50 TJ/Gg and 21.6 TJ/Gg (see Table 1.2 Vol 2. Of 2006 IPCC guidelines) (in accordance with TOOL3 referred to in TOOL31) • EF: The country specific EF for coal reported in Mongolia's first BUR submitted in 2017 (p.54) was used in calculations. • To verify accuracy of reported fuel consumption for the generation of electricity and heat, reported amounts of fuel consumed for generation of electricity and heat were compared with reported total amounts of electricity and heat generated. The comparison resulted in acceptable deviations of 13% (CHP2), 10% (CHP3) and 12% (CHP4).
Please specify how the consistency was achieved in particular where multiple secondary data sources were used.
Not applicable
Please specify how the "Standard for data coverage and validity of standardized baselines" was complied with.
Assumption for submission date of the standardized specific baseline emissions: 2018 Data coverage period: 2013-2018 Data currentness period: 2016-2017 <p>To comply with data coverage standard, the calculations of standardized baseline emission factor in buildings were performed using energy consumption data in buildings for electricity, fuels, and hot water, and fuel and electricity consumption data for hot water production during the years 2015, 2016, and 2017, which are within the data coverage period.</p>

To comply with data currentness standard, data used was no more than 2 years old relative to submission date (tool 31 provisions)
The proposed period of validity for the standardized baseline emission factors is 3 years from the date of its adoption.
Please specify how the completeness was achieved.
<p>All fields requiring input of data were verified</p> <p>All dates for reported data were verified to be within the coverage period</p> <p>Construction dates reported were verified according to the definition of existing and new building</p>
Please specify how the transparency was achieved.
All data pertaining to building units used for the calculation of the standardized specific baseline emission factor are archived in an online database
Please specify major issues and uncertainties identified during the QC procedures.
<ul style="list-style-type: none"> ✓ Insufficient energy consumption data for existing buildings to fulfill minimum sample size requirements in all categories with the exception of retail ✓ Insufficient energy consumption data for new buildings to fulfill minimum sample size requirements for hotels (2015-2017) and residential buildings 2017 ✓ Inconsistency between reported energy consumption data and construction dates for new buildings (e.g., buildings built in 2016 have data reported in 2015) ✓ Absence of details on hot water consumption data acquisition for building units without heat meters (i.e., no details on calculations and parameters) ✓ Outdated NCV value for Shivee-Ovoo is obtained from the supplier Shivee-Ovoo Joint Stock Company website (http://shiveeovoo.mn/index.php?module=menu&cmd=content&menu_id=109), which was last updated in 2016 ✓ Insufficient details on calculations of NCV value for both Shivee-Ovoo and Baganuur coal, which should represent weighted average values per year (TOOL3 referenced in TOOL31) ✓ Inconsistent NCV value reported for Baganuur and presented on supplier's website; ✓ Incomplete information on dates pertaining to NCV of Baganuur (http://www.baganuurmine.mn/?page_id=681) ✓ Incomplete reporting of internal electricity consumption for CHP2 and CHP3 ✓ Inconsistent reporting of data available for internal electricity consumption for CHP2
Please specify major corrective actions taken during the QC procedures.
Please justify the conservativeness of the approaches taken during the QC procedures.
The aggregation level of internal electricity consumption reported varied for the three CHPs, where total electricity consumption was available for all internal operation activities and not specific to hot water generation (except for CHP4). Therefore, for consistency, the total internal electricity consumption was used in the calculations of the emission factor for hot water production. In the case of CHP4, where electricity consumption for hot water production and for all activities are available, the final value of the EF resulted in a 9% difference. The resulting difference in the average EF value of for the three CHPs for each year was 4% and did not result in changes up to the second decimal point.
Please summarize key findings and present a plan to improve the data quality in the future.
<p>Building energy consumption data</p> <ul style="list-style-type: none"> • Data to fulfill the minimum sampling size for buildings defined as new should be obtained <p>Electricity consumption</p> <ul style="list-style-type: none"> • For building unit level consumption: electricity purchase invoices should be cross-checked with electricity generation records (TOOL31 refers to TOOL5)

- Records for calibration of meters measuring electricity consumption should be verified (in accordance with TOOL5 referred to in TOOL3). The accuracy class of the meters should be provided and verified against grid operator or national requirements.
- Electricity produced by CHPs should be cross-checked with sold electricity

Fuel consumed for hot water production

- Fuel quantity: The amount of fuel consumed for electricity and heat production should be cross-checked by annual energy balance based on fuel purchase receipts (in accordance with TOOL3 referred to in TOOL31).
- Energy content of hot water produced: calculations and assumption verification needed (measured mass or volume flows, temperatures etc.). Hot water generated should be cross-checked with records for hot water sold.
- NCV: verification of calculation of NCV; NCV should be weighted average annual values in accordance with TOOL3 referred to in TOOL31)

Date to finalize this report

2nd June 2020



Signature of DNA

Anand Tsog

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Appendix 2. Data delivery protocol

General information

The purpose of data collection is to establish a standardized baseline for specific emissions due to energy consumption in the building sector in Mongolia.

Confidentiality:

Data obtained was kept confidential. Selected data will be shared publicly on the website (under construction.)

Requests for further clarification

Contact person to address inquiries and further clarifications needed.

Requirements for data collection and delivery

Data types: Data required for the establishment of the standardized baseline are presented in Table 1: Data delivery protocol.

Data acquisition/aggregation:

Data was collected for each year in the data coverage period (2015-2017)

Building unit level

- Energy consumption: electricity, fuel, and hot water
- Gross floor area

Electricity and heat production at facility level

- Fuel consumption for the production of heat (hot water) and electricity for each CHP, characteristics of the hot water distribution network (e.g., losses)
- Energy content of hot water produced at the facility level, i.e., hot water production systems (CHP2, CHP3, and CHP4.)
- Internal electricity consumption for operation of facility

Table 1: Data delivery protocol

Data/parameter	Units	Acquisition procedures	Source of Data	Contact persons
Building category	NA	Building Code	Housing and Public Utilities Authority	Heating engineer of Dept. Policy and Planning
Gross floor areas (GFA) per building unit per category	m ²	Building design	Housing and Public Utilities Authority State Inspection Agency, Commissioning Committee	Heating engineer of Dept. Policy and Planning
Electricity consumption per building unit	kwh/month	Building unit level monthly metered bills Compilation in data collection form template per year	Housing and Public Utilities Authority Private company "Ganbij" LLC.	Heating engineer
Energy content of hot water consumed per building unit (supplied by district heating network)	GJ/month-year	Measurement of energy content: Building unit on-site measurements using heat meters (GJ): for education, retail and office building units	Housing and Public Utilities Authority	Heating engineer of Dept. Policy and Planning
	m ³ /month	Calculation of energy content Substation on-site measurements using flow meters (on distribution company side): for residential, hospital, hotel building units Calculation of energy content using temperature difference: <ul style="list-style-type: none"> • inlet to building: 60 °C • inlet to substation 5 °C 	Housing and Public Utilities Authority	Heating engineer of Dept. Policy and Planning
Technical distribution loss of hot water production system	%	Distribution network level	District heating companies-ERC	Building Efficiency Specialist of Dept. Energy Conservation

Data/parameter	Units	Acquisition procedures	Source of Data	Contact persons
Internal electricity consumption for hot water production system	kWh	Facility level (CHP2, CHP3, CHP4)	ERC	Building Efficiency Specialist of Dept. Energy Conservation
Fuel consumption for hot water production system	kg actual coal/yr	Facility level calculation of actual coal consumed for hot water production per year: <ul style="list-style-type: none"> On-site measurement (measurement or calculation) of energy content of hot water produced (Gcal/yr) Coal consumption (kg of coal equivalent/yr) (measurement or calculation) Conversion of kg coal equivalent to actual coal	ERC	Building Efficiency Specialist of Dept. Energy Conservation
Energy content of the water produced by the hot water production system	Gcal/yr	Facility level on-site measurement of energy produced (measurement or calculation)	ERC	Building Efficiency Specialist of Dept. Energy Conservation

Summary report

Data was collected in accordance with the data delivery protocol in

Table 1 and using data collection forms provided in Appendix 3. Data template format. The quality of the data was ensured by:

- ✓ Checking consistency of units of reported data
- ✓ Performing validation calculations
- ✓ Verifying all fields in data collection forms were completed
- ✓ Verifying consistent aggregation details in reported data

Identified data quality issues include:

- ✓ Insufficient energy consumption data for existing buildings to fulfill minimum sample size requirements in all categories with the exception of retail
- ✓ Insufficient energy consumption data for new buildings to fulfill minimum sample size requirements for hotels (2015-2017) and residential buildings 2017
- ✓ Inconsistency between reported energy consumption data and construction dates for new buildings (e.g., buildings built in 2016 have data reported in 2015)
- ✓ Absence of details on hot water consumption data acquisition for building units without heat meters (i.e., no details on calculations and parameters)
- ✓ Outdated NCV value for Shivee-Ovoo is obtained from the supplier Shivee-Ovoo Joint Stock Company website (http://shiveeovoo.mn/index.php?module=menu&cmd=content&menu_id=109), which was last updated in 2016
- ✓ Insufficient details on calculations of NCV value for both Shivee-Ovoo and Baganuur coal, which should represent weighted average values per year (TOOL3 referenced in TOOL31)
- ✓ Inconsistent NCV value reported for Baganuur and presented on supplier's website;
- ✓ Incomplete information on dates pertaining to NCV of Baganuur (http://www.baganuurmine.mn/?page_id=681)
- ✓ Incomplete information on operation mode of cooking stoves (i.e., electricity or fuel combustion)
- ✓ Incomplete reporting of internal electricity consumption for CHP2 and CHP3
- ✓ Inconsistent reporting of data for internal electricity consumption for CHP2

Date to provide this Protocol

2nd June 2020

Signature of DNA



Appendix 3. Data template format

Definition of sector: This data template is to be used for the establishment of a standardized baseline by building category for the building sector in Mongolia.

Scope of standardized baselines: The data collected pertains to energy consumption of buildings covering 6 categories of buildings identified in the urban areas of Ulaanbaatar, Mongolia. Energy for consumption in the form of electricity and hot water is supplied to the buildings via national electricity grid and hot water distribution networks. The electrical grid and hot water distribution networks are supplied by CHPs (CHP2, CHP3, and CHP4.)

Structure of data templates: Key information reported in the data templates consists of:

- a) Measured/monitored parameters (collected in the data collection template):
 - Electricity, fuel, and hot water consumption data for each building unit
 - Gross floor area for each building unit
 - Fuel and electricity consumption for hot water production for CHPs (CHP-2, CHP-3, and CHP-4)
 - Energy content of hot water produced for CHPs (CHP-2, CHP-3, and CHP-4)
 - Technical distribution losses for the hot water distribution system
 - NCV for coal types used in each CHP facility provided by ERC and supplier (Shivee-Ovoo Joint Stock Company) and Baganuur supplier

The data templates consist of:

- Characteristics and energy consumption of building units- an example for the residential category and year 2015 for NEW and Existing buildings (Figure 1 and Figure 2, respectively.) The same templates are used for other categories and years
- Fuel and internal electricity consumption for hot water production for CHPs (CHP-2, CHP-3, and CHP-4) (Figure 3)
- Energy content of hot water produced for CHPs (CHP-2, CHP-3, and CHP-4) (Figure 4)

Building age: all sampled buildings should have finalized construction within the past 5 years

YEAR 2015

ENERGY CONSUMPTION DATA OF RESIDENTIAL BUILDINGS (Minimum: 20 Maximum: Unlimited)

#	Sub station code	Building ID	Date of construction	Building address	Urban Area or Rural Area or Ger	Area of building (m ²)	Fuel consumption (ton/yr)	Electricity consumption (kWh/yr)	Hot water consumption (if available from hot water grid) (Gcal/yr)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

Figure 1: Data collection form for new residential buildings in the year 2015

Building age: all sampled buildings should have finalized construction more than 5 years ago

YEAR 2015

ENERGY CONSUMPTION DATA OF RESIDENTIAL BUILDINGS (Minimum: 20 Maximum: Unlimited)

#	Sub station code	Building ID	Date of construction	Building address	Urban Area or Rural Area or Ger	Area of building (m ²)	Fuel consumption (ton/yr)	Electricity consumption (kWh/yr)	Hot water consumption (if available from hot water grid) (Gcal/yr)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

Figure 2: Data collection form for existing residential building in the year 2015

Fuel consumption for electricity and heat production

Parameter		Unit	2015	2016	2017
Fuel consumption rate (in coal equivalent)	Electricity	g/kWh			
	Heating	kg/Gcal			

Internal electricity consumption

Electricity used for internal consumption (kWh)	2015	2016	2017

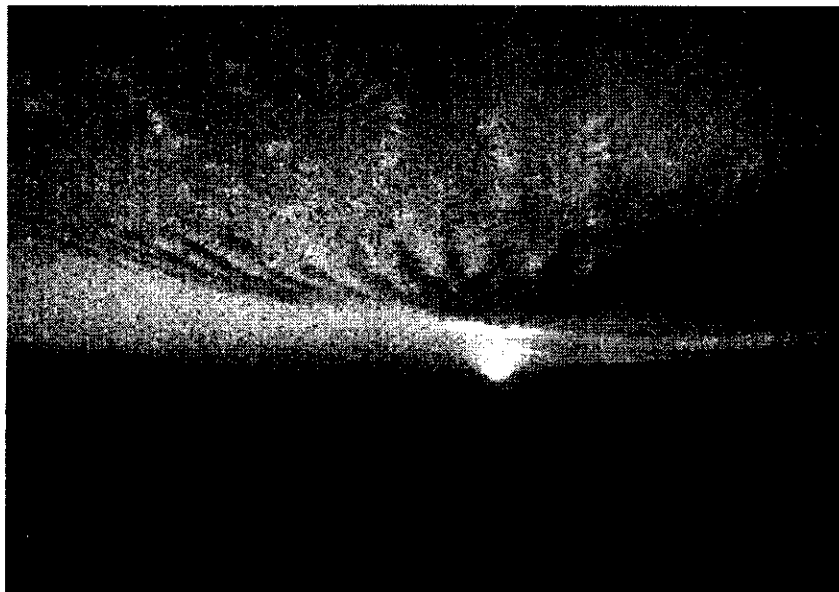
Figure 3: Data collection form for (a) fuel consumption for electricity and heat production at the CHP facility level and (b) internal electricity consumption for operation of CHP

Parameter	Unit	CHP-2			CHP-3			CHP-4		
		2015	2016	2017	2015	2016	2017	2015	2016	2017
Electricity generation	1000 kWh									
Electricity production	1000 kWh									
Total Heat Generation	Gcal									
Steam	Gcal									
Water	Gcal									

Figure 4: Data collection form for energy content of hot water produced at the CHP facility level

Implementation of a Nationally Appropriate Mitigation Action (NAMA) in the building (and construction) sector in Mongolia

Summary of Methodology Review and Assessment for the Estimation of GHGs Emissions in the Building Sector in Mongolia



6/25/2018

In case any questions please contact NIRAS att.: Morten Pedersen e-mail: mop@niras.dk

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1 Objectives of the project

The objective of this project is to measure emission reductions that would result from the implementation of energy efficiency measures in the building sector in Mongolia. To this end, GHGs emissions must be measured in buildings before and after measures, i.e., a methodology for the calculations of GHGs emitted from buildings before and after implementation of measures. A secondary objective is developing a standardized baseline for the building sector in Mongolia. The present document is a summary of the Methodology Review and Assessment Report. This document aims at presenting the methodology for estimating the baseline emissions for the building sector in Mongolia prior to implementation of energy efficiency measures. The baseline emissions represent the GHG inventory of the sector prior to implementation of any efficiency measures in the sector.

2 Review and assessment of methodologies for calculations of reductions of GHG emissions

The principal methodologies that can and have been used to calculate GHG emissions (in general) are:

- 1- IPCC Guidelines
- 2- Clean Development Mechanism (CDM) methodologies
- 3- International Performance Measurement Verification Protocol (IPMVP): Volumes 1 and 3
- 4- Japanese Crediting Mechanism (JCM)- MN_AM003 "Installation of Solar PV System"

Differences between the aforementioned methodologies pertain to their objective (goal of the project for which emissions are calculated: compiling GHGs inventory, measuring emissions reduction, measuring energy savings etc.), and scope and applicability (e.g., coverage and data requirements). Therefore, the 'best' methodology should fulfill objectives of the project in its entirety.

2.1 IPCC Guidelines

IPCC guidelines were developed with the objective of compiling GHG inventory of emissions from various sectors. The relevant sectors to the present project are

- Energy Industries sector (1A1): Main Activity Electricity and Heat Production (Subsector 1A1a)
- Others sector (1A4): Commercial/ institutional buildings (Subsector 1A4a) and residential buildings (1A4b).

With respect to measuring reductions in emissions due to measures implemented in single buildings, the IPCC guidelines are not applicable.

2.2 CDM methodologies

CDM methodologies were developed with the objective of helping developed countries reduce their emissions by earning certified emissions reductions (CERs) that can be sold. CDM methodologies were specifically developed to provide stringent guidelines for the calculations of emissions reductions. Another objective of CDM is to serve as basis for the development of standardized baselines. The methodologies relevant to the present project and reviewed consist of the following:

Large scale methodologies:

- AM0091: Energy efficiency technologies and fuel switching in new and existing buildings

- ACM0022: Alternative waste treatment processes
- AM0107: New natural gas based cogeneration plant

Small scale methodologies:

- AMS-II.E: Energy efficiency and fuel switching measures for buildings
- AMS-II.R: Energy efficiency space heating measures for residential buildings
- AMS-II.Q: Energy efficiency and/or energy supply projects in commercial buildings
- AMS-II.AE: Energy efficiency and renewable energy measures in new residential buildings

2.3 International Performance Measurement Verification Protocol (IPMVP): Volumes 1 and 3

The IPMVP provides an overview of current best practice techniques available for verifying results of energy efficiency, water efficiency, and renewable energy projects with the objective of increasing investments in efficiency projects. The IPMVP is used when payments or contracts need to be issued on the basis of performance. The IPMVP guideline cannot be used as basis for the development of a standardized baseline.

2.4 Japanese Crediting Mechanism (JCM)-MN_AM003 “Installation of Solar PV System”

The JCM methodology has been reviewed specifically to address the determination of grid emission factors from the power grid, which is required for calculating emissions from an electricity system.

2.5 Summary of methodologies and assessment for applicability in Mongolia

This Methodology was assessed according to 6 criteria presented in Table 2-1. The assessment resulted in the selection of CDM methodology AMS.II-E in addition to using calculations outlined in CDM AM0091 as they provide the proper details needed for applying the methodology.

Table 2-1: Summary of methodologies and assessment criteria for applicability in Mongolia

Methodology	Emissions reductions isolation (to specific measures)	Applicability conditions			Ease of implementation Computer simulation-ES, expert assess-S	Data availability, consistent, accurate
		Building New-N Existing-E	Category Residential-R Commercial-C Institutional-I	Energy source CHP, biomass		
IPCC	X	✓	✓	✓	✓	✓ T1,T2 X T3
CDM -AM0091	✓	✓	✓	X no CHP	✓ ^a	✓ if no CS
CDM -AMS II.R	X Space heating only	X R-only	X R-only			X Building/tenancy
CDM -AMS II.E	✓	✓	✓	✓	✓	✓
CDM -AMS-III.AE	✓	X	X R-only	X No fossil fuel	X - Approach 1 CS ✓ - Approach 2	X Building/tenancy
CDM -AMS II.Q	✓	✓	X C-only	✓	X CS	X
IPMVP-A	✓ ES	✓	✓		X S	✓
IPMVP-B	✓ ES	✓	✓		✓	X Full measurement
IPMVP-C	✓ ES	✓	✓		✓	Existing Energy data X New-building data
IPMVP-D	✓ ES	✓	✓		X CS	X

*Mandatory for existing buildings, and mandatory in one of the options for new buildings

ES: Energy savings

✓ covered by the methodology

X Not covered by the methodology

3 Calculation of GHG Inventory Emissions (Methodology)

1. **Categorization** of buildings: residential, hotels, offices, hospitals, retail, education
2. Conduct a **baseline measurement survey** (in accordance with sampling and survey guideline)
 - ☐ Energy consumption data for electricity and fuels
 - ☐ All independent variables affecting energy use
 - ☐ Determination of sample size according to 'Simple Random Sampling'
 - ☐ Selection of buildings during sampling: When sampling for new buildings, all sampled buildings for the baseline emissions estimations should have finalized construction within 5 years prior to start of NAMA activities. When sampling for existing buildings, all sampled buildings for the baseline emissions estimations should have finalized construction for at least 5 years prior to the start of NAMA activities. The minimum number of sample per category is 20 buildings.

Sampling size equation:

$$n \geq \frac{1.645^2 N \times p(1-p)}{(N-1) \times 0.1^2 \times p^2 + 1.645^2 p(1-p)}$$

n = Sample size N = Total number of households

P = Our expected proportion (0.50)

1.645 = Represents the 90% confidence required

0.1 = Represents 10% relative precision ($0.1 \times 0.5 = 0.05 = 5\%$ points either side of p)

3. Estimation of baseline emissions due to energy consumption:

Electricity consumption

Buildings connected to grid



$$BE_{EC,i,j,y} = BE_{EC,non-REcaptive,i,j,y} = EC_{BL,i,j,k,y} \times EF_{grid}$$

- $BE_{EC,non-REcaptive,i,j,y}$ = Baseline emissions from electricity consumption of baseline building unit supplied by grid fossil-fuel-fired captive power plant(s) (tCO_2/yr) for purposes other than hot water production.
- $EC_{BL,i,j,k,y}$ = Electricity consumption (MWh/yr)
- EF_{grid} = Grid emission factor (tCO_2/MWh)

Hot water consumption

Buildings connected to District Heating Network



$$BE_{WC,i,j,y} = \frac{WC_{BL,i,j,y} \times EF_{BL,WP,i,j,y}}{1 - \eta_{BL,dist,i,y}} \quad (\text{Equation 24}) \quad \text{and} \quad EF_{BL,WP,i,j,y} = \frac{BE_{WP,EC,i,y} + BE_{WP,FC,i,y}}{WP_{BL,i,y}}$$

- $BE_{WC,i,j,y}$ = Baseline emissions from hot water consumption of baseline building (tCO_2/yr)
- $WC_{BL,i,j,y}$ = Energy content of annual hot water consumption in baseline building (GJ/yr)
- $EF_{BL,WP,i,j,y}$ = Emission factor for production of hot water supplied to baseline building (tCO_2/GJ)
- $\eta_{BL,dist,i,y}$ = Average technical distribution losses of the hot water system / network serving baseline building
- $BE_{WP,EC,i,y}$ = Baseline emissions from electricity consumption of hot water system / (tCO_2/yr).
- $BE_{WP,FC,i,y}$ = Baseline emissions from fuel consumption of hot water system / (tCO_2/yr).
- $WP_{BL,i,y}$ = Energy content of annual hot water produced by hot water system (GJ/yr)

Fuel consumption



$$BE_{FC,i,j,y} = \sum_k FC_{BL,i,j,k,y} \times COEF_{k,y} \quad (\text{Equation 23})$$

- $BE_{FC,i,j,y}$ = Baseline emissions from fossil fuel consumption in baseline building unit (tCO_2/yr)
- $FC_{BL,i,j,k,y}$ = Quantity of fossil fuel type k fired in baseline building unit (mass or volume unit/yr)
- $COEF_{k,y}$ = CO_2 emission coefficient of fuel type k in year y ($tCO_2/\text{mass or volume unit}$)

j : building unit; i : building unit category; k : fuel type; y : year

4. Summation of all baseline emissions from all sources for each building → total baseline emission per building unit

$$\square BE_{i,j,y} = BE_{EC,i,j,y} + BE_{FC,i,j,y} + BE_{WC,i,j,y}$$

5. Dividing total baseline emission per building by gross floor area → specific baseline emission per building unit per unit area

$$\square SE_{BL,i,j,y} = \frac{BE_{i,j,y}}{GFA_{BL,i,j,y}}$$

6. Calculate **specific emissions per building category per unit area**

$$\square \quad SE_{BL,i,j,y} = \frac{\sum_j SE_{i,j,y}}{J_{i,y}}$$

7. Multiply average specific emissions per building category per unit area by total gross floor area of NAMA building per category.

$$\square \quad BE_y = \sum_i SE_{i,y} \times GFA_{PJ,i,y}$$

8. Summation of all baseline emissions of each NAMA category → **baseline emissions of NAMA buildings which represents the GHG inventory of the building sector**

$$\square \quad BE_y = \sum_i SE_{i,y} \times GFA_{PJ,i,y}$$