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

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

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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-CS, expert assess-S	Data availability, consistent, accurate
		Building New-N Existing-E	Category Residential-R Commercial-C Institutional-I	Energy source CHP/ boilers		
IPCC	X	√	√	√	√	√ T1,T2 X T3
CDM -AM0091	√	√	√	X no CHP	√*	√ if no CS
CDM -AMS II.R	X Space heating only	X N-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
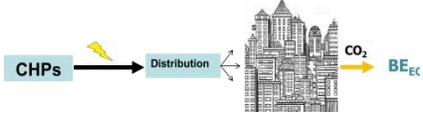ES: Energy savings
✓ covered by the methodology
X Not covered by the methodology

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 = Sample size N = Total number of households
$n \geq \dfrac{1.645^2 N \times p(1-p)}{(N-1) \times 0.1^2 \times p^2 + 1.645^2 p(1-p)}$	P = Our expected proportion (0.50) 1.645 = Represents the 90% confidence required 0.1 = Represents 10% relative precision (0.1×0.5 = 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

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

- **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)
- **$\eta_{BL,dist,l,y}$** = Average technical distribution losses of the hot water system *l* network serving baseline building
- **BE$_{WP,EC,l,y}$** = Baseline emissions from electricity consumption of hot water system *l* (tCO_2/yr).
- **BE$_{WP,FC,l,y}$** = Baseline emissions from fuel consumption of hot water system *l* (tCO_2/yr).
- **WP$_{BL,l,y}$** = Energy content of annual hot water produced by hot water system (GJ/yr)

Fuel consumption

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

- 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/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**

   - ❏ **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**

   - ❏ $SE_{BL,i,j,y} = \dfrac{BE_{i,j,y}}{GFA_{BL,i,j,y}}$

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**

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