GOVERNMENT OF MONGOLIA

MINISTRY OF CONSTRUCTION AND URBAN DEVELOPMENT

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CO_2 EMISSION REDUCTION CALCULATION, STANDARDIZED BASELINE EMISSION FACTOR SETTING, AND MRV IN THE BUILDING SECTOR UNDER THE PARIS AGREEMENT

A joint study as part of the Nationally Appropriate Mitigation Actions in the construction sector of Mongolia project. **Authors:** Morten Pedersen, Amr Osama Abdel-Aziz, Nermin Eltouny, Emelie Öhlander, Thomas Thorsch Krader, Bayarlkham Byambaa and Bayarmaa Lkhagvadorj. **Cover photo:** Tushig Khishigtogtokh. **Layout and design:** Khongorzul Bat-Ireedui.

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The Nationally Appropriate Mitigation Actions in the construction sector of Mongolia project is executed by the Ministry of Construction and Urban Development of Mongolia and is designed to facilitate market transformation for energy efficiency by removing barriers to increased adoption of energy efficient technologies in the construction sector.

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List of Abbreviations

CDC	Construction Development Center (Mongolia)
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CHP	Combined Heat and Power
COP	Conference of Parties
GFA	Gross Floor Area
GHG	Greenhouse Gases
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
IPMVP	International Performance Measurement Verification Protocol
JI	Joint Implementation
MCUD	Ministry of Construction and Urban Development (Mongolia)
MET	Ministry of Environment and Tourism (Mongolia)
MRV	Measurement, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Action
NDC	Nationally Determined Contribution
QA	Quality Assurance
QC	Quality Control
SB	Standardized Baseline
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

1.1 International context

The Paris Agreement entered into force on 4th November 2016 and it is the most ambitious effort to reduce Greenhouse gases (GHG) emissions after it was adopted by the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in 2015. The Parties have through the Nationally Determined Contributions (NDCs) committed themselves to a significant reduction in the GHG emissions. This can be done through an effort in its own country or by using the market mechanism in Article 6 of the Agreement. After the 24th session of the Conference of the Parties (COP) in Katowice, Poland in December 2018, the finalization of Article 6 Rulebook was postponed to being finalized at the COP 25 in Chile.

Following the adoption of the Paris Agreement, the focus has been on discussing and analyzing the overall architecture of the institutional set-up under the Paris Agreement. The potential GHG emission reductions shall be sustainable and cover environmental integrity. In the negotiations it has also been discussed that the experience from the flexible mechanisms (CDM, JI, Emission Trading) (https://cdm.unfccc.int/about/index.html) under the Kyoto Protocol shall be taken into consideration, but the discussions are mainly kept on an overall level of the architecture for the implementation of the Paris Agreement. Through the Kyoto Mechanisms (JI, CDM and Emission Trading) of the UNFCCC, the Parties and all stakeholders have already gained significant experience on how to set-up baselines, develop inventories, prepare and perform the Measurement, Reporting and Verification (MRV) of specific projects and also using mechanisms to transfer GHG emission between Parties. This experience shall be carefully analyzed as it can be the significant and crucial input to build up a system under the Paris Agreement.

The potential to use previous experience gained from the existing measuring and reporting structure can save countries time and help them keep up the pace of building a national MRV system without the final decisions from the Paris Agreement Rulebook. However, this is a cost-effective solution, but it shall be done carefully and with critical thinking. Still, country and project specific circumstances need to be included.

1.2 Building sector in cold countries

Globally, the building sector is single handily responsible for 30% of final energy consumption and more than 55% of global electricity demand (IEA) and nearly 40% of total direct and indirect CO_2 emissions. Therefore, targeting the building sector, creates a huge potential for contributing to a low carbon development. Globally, energy efficiency measures have enormous potential for supporting a low carbon development.

> Therefore, this knowledge product will focus on **energy efficiency in building sector**, both for existing and new buildings. For cold countries, energy efficiency measures are extra important due to high demand for heating in the building sector.

To set the need in a context, this knowledge product is based on a UNDP contract covering Mongolia. It is, therefore, based on Mongolian realities and therefore the experience can best be transferred to countries with similar cold climate and stage of development. Having this in mind we focus on addressing cases when data is scarce (e.g. the non-availability of heat meters, non-availability of area corresponding to electricity consumption, etc.) and ways to overcome such issues.

1.3 National circumstances and implementation

The reality under the Kyoto Protocol and now the Paris Agreement, is that developing and emerging countries usually lack capabilities to keep up with the reporting and measurement of the progress. For them to be able to implement the reporting requirements under the UNFCCC, the implementation must be efficient and cost-effective. They cannot do it all at once.

Therefore, it is suggested to start by focusing on

i) **calculate emission reductions,**
ii) **create a standardized baseline emission factor setting** and
iii) **set the MRV system for the specific sector**.

These three areas would be some of the most cost-effective ways of reporting under the Paris Agreement, and would at the same time give input to the national inventory and mitigation actions.

1.3.1 Calculate the CO_2 emission reductions

During the preparation of a national inventory, one of the challenges in dealing with energy efficiency projects is that the inventory is prepared on the basis of data on consumptions. Therefore, it is recommended to prepare a system to calculate the CO_2 emission reductions that can be used to document the emission reductions which can feed in the national inventory estimations. The calculation of CO_2 emission can be used to illustrate how a country is fulfilling their NDC targets.

The knowledge product will present a significant number of important non-GHG indicators and will discuss which indicators that can be realistically measured and reported. The selection shall be done carefully as it shall be managed without requirements for international support.

1.3.2 Standardized baseline

Baseline setting has always been a challenge as the meaning is directly linked to the quantity of CO_2 emission reduced and the potential value as it is part of the emission trading. That's why the development of a global standardized baseline shall be welcomed, and recently under the CDM a methodological tool "Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings" has been developed and valid since 31st August 2018. *This tool will be tested and its usefulness for NAMA development will also be analyzed and a way forward will be proposed.* The estimation of the baseline emissions for the building sector in Mongolia prior to implementation of energy efficiency measures will represent baseline emissions the GHG inventory of the sector prior to implementation of any efficiency measures in the sector.

1.3.3 MRV

The MRV of GHG shall cover what has been proposed under the calculation of CO_2 emission reductions and in the case of specific parameters needed under a proposed standardized baseline. Since MRV has been a core theme within the CDM, it will be beneficial to transfer the CDM practice as much as possible to a Paris Agreement regime. The focus in this knowledge product will be measurement and reporting and the potential validation and verification will only be touched briefly as it is too a high degree a political issue.

The potential MRV of non-GHG will also be addressed. Especially with the trend of addressing SDG for all projects, it is becoming more and more important. It will be a sensitive issue and it will vary from country to country and maybe even from project to project. There is also a tendency that donor supported project are building up more detailed and costly non-GHG measurement and reporting programs. For non-GHG the different options will be analysed, *but the focus is to set-up a sustainable and realistic measurement and reporting system that is not dependent on foreign aid.*

2 General overview

2.1 Calculation of Emission Reductions

2.1.1 Review of methodologies for calculations of emission reductions

The purpose of the methodology was to be applicable to the estimation of reductions of emissions resulting from the implementation of energy efficiency measures in the building sector. The calculations of reductions of emissions, therefore, necessitate calculations of emissions pre and post energy efficiency measures. Following is a description of the principal methods to calculate emissions.

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

- IPCC Guidelines
- Clean Development Mechanism (CDM methodologies)
- International Performance Measurement Verification Protocol (IPMVP): Volumes 1 and 3

Differences between the aforementioned methodologies pertain to their objective (goal of the project for which emissions are calculated: compiling GHG 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 Mongolia in its entirety, i.e., (1) calculation of emission reduction for NAMA energy efficiency projects at the building sector scale and (2) development of a standardized baseline.

A brief description of each methodology reviewed is presented below. Details have been presented in "Methodology Review and Assessment for the Estimation of GHGs Emissions in the Building Sector in Mongolia" performed under the UNDP project covering Mongolia. (https://cdm.unfccc.int/about/index.html)

2.1.1.1 IPCC Guidelines

IPCC guidelines were developed with the objective of compiling GHG inventory of emissions from various sectors (IPCC, 2006). The sectors relevant to the present project are the following:

- Energy Industries sector (1A1): Main Activity Electricity and Heat Production (Subsector 1A1a)
- Other sectors (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. Furthermore, the IPCC guideline cannot be used to develop a standardized baseline.

2.1.1.2 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 on an individual project basis. Another objective of CDM methodologies 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 (UNFCCC, Large Scale Methodology AM0091: Energy Efficiency Technologies and Fuel Switching in New and Existing Buildings (https://cdm.unfccc.int/filestorage/B/1/R/B1RCDP4IXY7LHWE2GT3MOQKF695USZ/EB85_repan08_AM0091_ver03.0.pdf?t=VHd8cHFoNGxqfDC2TaMvTEC-udThaOFo0IQ5)
- ACM0022: Alternative waste treatment processes (UNFCCC, Large Scale Consolidated Methodology ACM0022: Alternative waste treatment processes (https://cdm.unfccc.int/methodologies/DB/YINQ0W7SUYOO2S6GU8E5DYVP2ZC2N3))
- AM0107: New natural gas-based cogeneration plant (UNFCCC, Approved baseline and monitoring methodology AM0107: New natural gas based cogeneration plant (https://cdm.unfccc.int/methodologies/DB/XEVLUYAD0J3F3WDV6AQ3SPOK260T08))

Small scale methodologies:

- AMS-II.E: Energy efficiency and fuel switching measures for buildings (UNFCCC, Small Scale Methodology AMS-II.E: Energy Efficiency and Fuel Switching Measures for Buildings (https://cdm.unfccc.int/methodologies/DB/P4PO65N66CEQGPE2RJU15FIVB7AX4A))
- AMS-II.R: Energy efficiency space heating measures for residential buildings (UNFCCC, Small-scale Methodology AMS-II.R: Energy efficiency space heating measures for residential buildings (https://cdm.unfccc.int/methodologies/DB/9SD9B6O4446YU1PEV624CYUO5RF3QU))
- AMS-II.Q: Energy efficiency and/or energy supply projects in commercial buildings (UNFCCC, Small-scale Methodology AMS-II.Q: Energy Efficiency and/or energy supply projects in commercial buildings (https://cdm.unfccc.int/methodologies/DB/YCL1T3NURPHKSHBSR8TIHC2T543HTQ))
- AMS-III.AE: Energy efficiency and renewable energy measures in new residential buildings (UNFCCC, Small-scale Methodology AMS-III.AE: Energy efficiency and renewable energy measures in new residential buildings (https://cdm.unfccc.int/methodologies/DB/FUO73IQ9LLOKEQF2EL3BX8BFP38LJB))

2.1.1.3 IPMVP

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 ((IPMVP), International Performance Measurement and Verification Protocol (https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp)).

2.2 Standardized baseline development

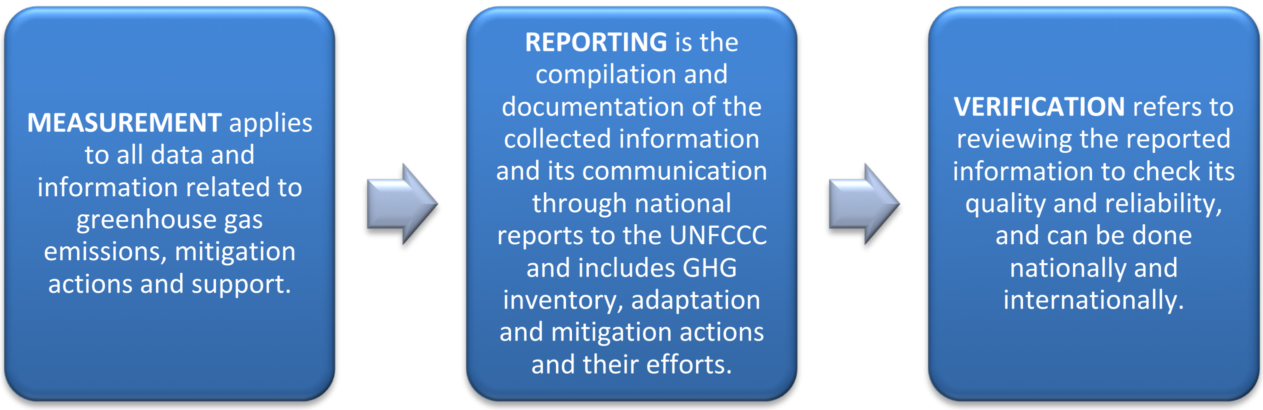
Developing a standardized baseline was the second objective of the project.

A Standardized Baseline (or 'SB') is 'a baseline established for a Party or a group of Parties to facilitate the calculation of emission reduction and removals and/or determination of additionality for clean development mechanism project activities, while providing assistance for assuring environmental integrity' according to COP decision (Decision 3/CMP6/Para44) (UNFCCC, Report of the Conference of the parties serving as the meeting of the parties to the kyoto protocol on its first session, held at Montreal (Decision 3/CMP6/Paragraph 44) https://cdm.unfccc.int/Reference/COPMOP/08a01.pdf, from November 28 to 10 December 2005). The Baseline emissions are GHG emissions that would occur in a Baseline Scenario and through standardization of a baseline, it can help reduce transaction costs, enhance transparency, objectivity and predictability of CDM projects.

Under CDM a methodological tool 31 version 01.0 "Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings" (UNFCCC, Methodological tool 31 for the Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-31-v1.pdf)) has been developed and it has been valid since 31st August 2018. This tool was used to develop a standardized baseline for the building sector in Mongolia.

2.3 MRV

The concept of MRV systems incorporates three independent but interconnected processes of **measurement, reporting and verification.**



National climate MRV framework comprises of three levels: official, institutional and procedural set-up, which are crucial in meeting the UNFCCC reporting requirements (see Figure 2-1). The key information requested to be reported in National Communications (NCs) and Biennial Update Reports (BURs). The existing MRV system in place for countries are built on the mechanism from the Kyoto Protocol (e.g. CDM) and not for the Paris Agreement. Under the CDM the MRV system were heavily developed due to the potential for Emission Trading but under the new Paris regime, this is uncertain and could come to play a less substantial role. However, as countries still need to report on their progress for the NDC, a *MRV system will still be required.

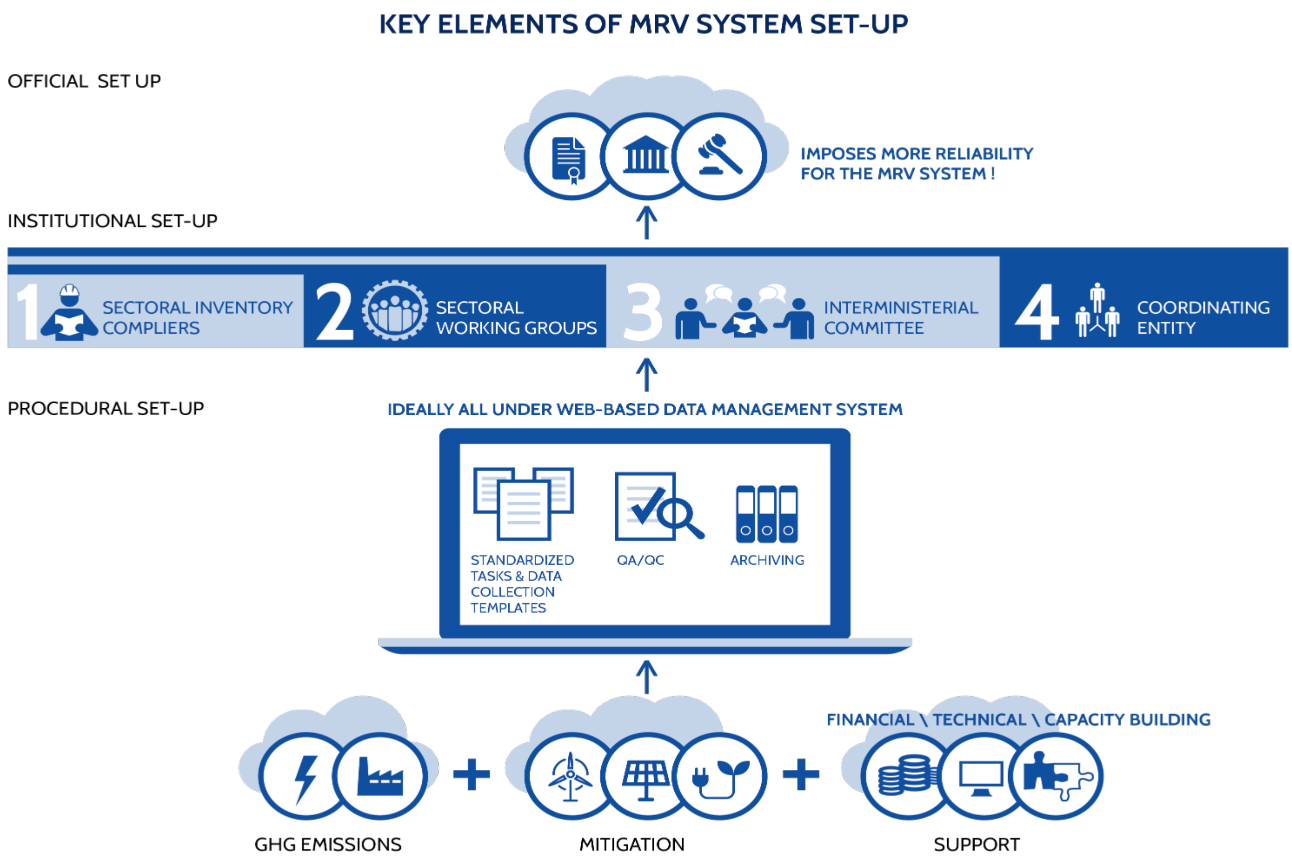


Figure 2-1 Developed by NIRAS and Integral. Also published at www.mrvafrica.com

3 Mongolia Case Study

3.1 Methodology assessment and selection

3.1.1 Selection criteria determination

3.1.1.1 General criteria

General criteria for the selection of the appropriate methodology should fulfill the project objectives, which require (1) isolation of emission reduction and 2) possibility of use as a basis for developing standardized baselines.

In addition to the general criteria, the appropriate methodology should also be applicable to circumstances specific to Mongolia.

3.1.1.2 Mongolia specific criteria

a) Sources of Emissions in Mongolia's building sector

Energy consumption in the commercial and residential subsector represents the fourth largest GHG emitting subsector (GEF). Energy consumption sources consist of electricity and hot water supplied by cogeneration power plants (CHPs) and fuel used in stand-alone boilers and cooking/heating stoves. According to the TNA document (GEF), CHPs produce 70 percent of the total country's heat supply, while small and medium capacity boilers and home stoves produce 20 percent and 10 percent, respectively.

In the urban areas of the city of Ulaanbaatar, buildings receive electricity and hot water produced by three CHPs, namely, CHP2, CHP3 and CHP4 through the national electrical grid and district heating networks. Building units may also be connected to stand-alone boilers and contain cooking and heating stoves. Therefore, energy sources responsible for emissions consist of CHPs, boilers, and cooking stoves.

b) Building stock characteristics

The energy consumption varies according to characteristics of the building. The status of the buildings were classified according to construction date, which spanned from 1940's up to 2017. Therefore, the stock is heterogeneous consisting of old (<2011), from here on referred to as 'existing' and 'new' buildings (>2011). With respect to type, buildings in Ulaanbaatar have been classified into six categories, namely, residential, institutional including education buildings and hospitals, and commercial including retail, hotels, and offices.

c) Skill level and data availability

The skill level of personnel anticipated to collect data and use the methodology should be basic and not requiring highly technical and expert knowledge such as that required for computer simulations.

The required data should be basic and easily obtainable (e.g., not requiring elaborate instrumentation), therefore, methodology should not be data exhaustive.

Table 3.1: Summary of Mongolia's specific circumstances and impact on selection of methodology

Mongolia specific circumstances	Adaptation for selection of methodology
Heterogeneous building stock –construction dates from 1940's to 2017	Methodology that requires consideration of construction dates
Basic skill level for data collection and application of methodology	Methodology should be straightforward and not requiring expert knowledge or highly technical personnel
Data scarcity and simplicity	Methodology should not be data exhaustive or requiring advanced instrumentation, which are not available in old buildings (e.g., heat meters in each building)
Emission sources include stand-alone boilers and cooking stoves used for heating	Methodology should be general and versatile

3.1.1.3 Assessment and selection of methodologies for applicability in Mongolia

The applicability of methodologies was assessed according to 6 principal criteria (general and specific to Mongolia.) The selection criteria are as follows:

- Emissions reduction isolation
- Building status: new and existing (Mongolia specific)
- Building types: categories to be covered: residential, offices, retail, hospitals, hotels, education building (Mongolia specific)
- Energy source (CHPs, boilers, stoves)
- Ease of implementation-not data exhaustive, no computer simulations required etc. (Mongolia specific)
- Data availability (data available should be consistent and accurate)

Table 3.2: Assessment of applicability of methodologies for emissions reduction calculations in building sector in Mongolia

Methodology	Applicability conditions					
	Emissions reductions isolation (to specific measures)	**Building** New-N Existing-E	**Category** Residential-R Commercial-C Institutional-I	**Energy source** CHP/ boilers/stoves	**Ease of implementation** Computer simulation-CS, stipulation-S	**Data** availability, consistent, accurate
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	√	√ 1		x CS	x

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

ES: Energy savings. X: not covered by methodology. CS: computer simulations required. S: Expert assessment

Following the assessment both IPCC and IPMVP options did not satisfy all criteria as shown in Table 3.2; CDM methodologies, however, were found to be suitable and were thus selected as a starting point. By further comparing all relevant CDM methodologies, the assessment resulted in the selection of CDM methodology AMS.II-E, which references detailed calculations outlined in CDM AM0091.

3.2 Calculations of emission reductions in building sector in Mongolia

3.2.1 Specific circumstances in Mongolia

Modifications were made to AM0091 to adapt the methodology to Mongolia's circumstances. Specific circumstances in Mongolia's building sector requiring modifications/deviations from approved CDM methodology (AM0091) for calculations of emission reductions are summarized in Table 3.3.

Table 3.3: Mongolia specific circumstances and associated modifications to methodology performed

Specific circumstance	Modification performed
Building types in the urban areas of Ulaanbaatar fall into six categories only in contrast with the detailed classification provided in AM0091.	Simplification of building categorization into residential, institutional (education and hospital), and commercial (retail, hotels, and offices)
Electricity in all buildings in the urban areas of Ulaanbaatar is supplied from the national electrical grid, which is supplied by CHPs. AM0091 is not applicable to CHP.	Applicability of AMS-II.E referencing AM0091 to determine emissions due to electricity and heat consumption supplied by CHPs. To allow applicability of AM0091, emission factors (tCO_2/unit of energy) due electricity and heat generation were determined on the basis of separate quantities of fuel consumed. Apportioned quantities of fuel consumed were provided by the CHPs. Using quantities of fuels consumed, emission factors for heat generation for each CHP were determined. In the case of electricity generation, the recently approved standardized emission factor for the national electrical grid was used (add reference.)
AM0091 estimate reduction using a benchmark on the basis of top 20% performers.	To prevent underestimation of real reductions in emissions and free riders, the benchmark for specific baseline emission per m^2 is determined on the basis of the average of all buildings and not the top 20% performers as in CDM
Emissions calculation are performed based on data obtained on a per building unit basis, which requires a measuring system per building unit.	Heat measuring systems on a per building unit basis are not consistently available. Instead, a collection of building units can be supplied to a main substation. In those cases, the total emissions due to all buildings served by the substation were calculated on the basis of the quantity of hot water delivered by the substation. The specific emissions were determined using the total Gross Floor Area of all the buildings (served by the substation)
The calculation of emission reductions includes a term for refrigerant use.	The use of refrigerants is not applicable in Mongolia. Omission of term for refrigerant use
Heat energy consumption includes hot water for domestic use as well as heating purposes.	Domestic use of hot water was not included in the emissions calculations for building units due to a different supply source, i.e., hot water for domestic is not supplied by the hot water distribution network. Data on supply for domestic use was unavailable. Modification of methodology in type of sources of energy consumption to be included in the calculations of reductions of emissions. The sources of energy consumption covered do not include consumption of hot water for domestic use (e.g., showers) for which data was unavailable.

Comparison between average of all buildings and top 20% performers in the calculation of emission reduction for the building sector

The benchmark used in the calculation of reduction in emissions depends on the scope of the project for which it is calculated. The scope of CDM projects is individually based rather than sector-wide based. Due to this limited scope, the use of the top 20% performers' approach for the calculation of the average emissions results in more conservative and representative values. In contrast, NAMA energy efficiency projects have a larger scope in that they are sector-wide. The use of the average of all buildings for the sector results in values representative of reality and does not penalize a country with a too conservative baseline.

Because the scope of the project was to estimate emission reduction for the building sector, which is much larger than the scope for which CDM projects are conceived, the average of all buildings instead of the top 20% performers was used for calculations of reductions in emissions. Figure 3-1 below illustrates the difference between using a top 20% performers approach and the all buildings approach <u>when the scope is sector wide</u> (i.e., not on an individual applicant basis as is customary for CDM projects).

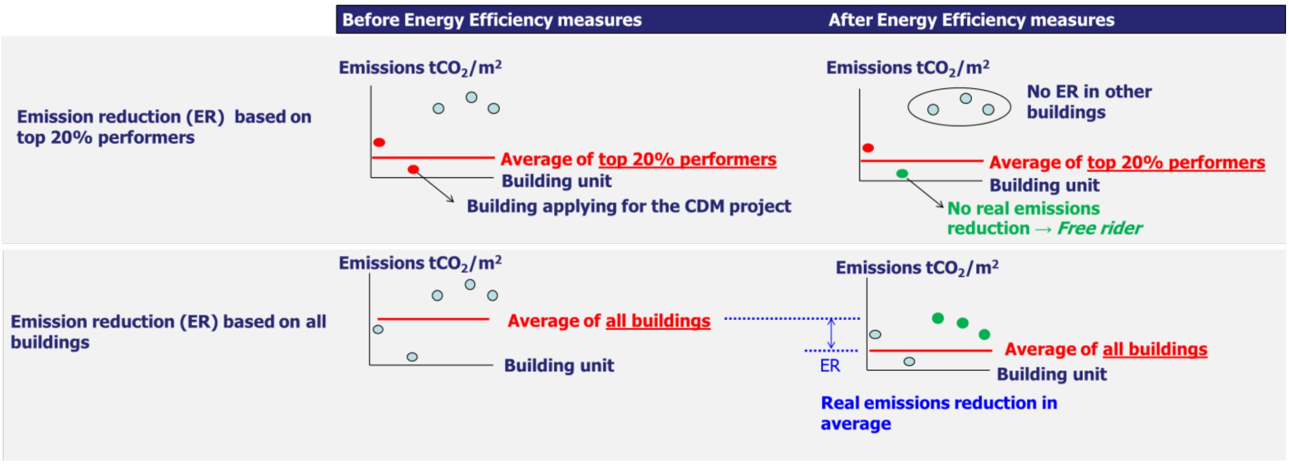


Figure 3-1: Difference between a top 20% performers approach and the all buildings approach in sector-wide emission reductions calculations

3.2.2 Modified methodology for the calculation of emission reductions in buildings

Following is a step-by-step procedure of the modified methodology adopted for the estimation of reduction of emissions resulting from implementation of energy efficiency measures.

Steps:

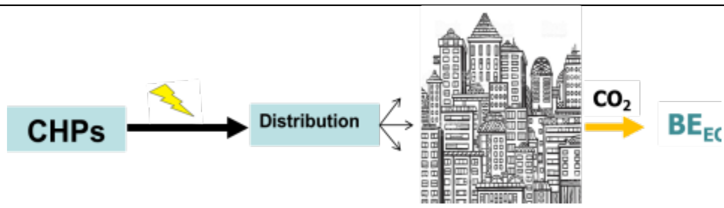
1. **Categorization** of buildings: residential, education, hospitals, retail, hotels, and offices
2. Conduct a **baseline measurement survey** (in accordance with sampling and survey guideline)
   - ❑ Energy consumption data for electricity and fuels
   - ❑ All independent variables affecting energy 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.

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 (0.1×0.5 = 0.05 = 5% points either side of p)

3. **Estimation of baseline emissions due to energy consumption**:

Electricity consumption

Buildings connected to grid

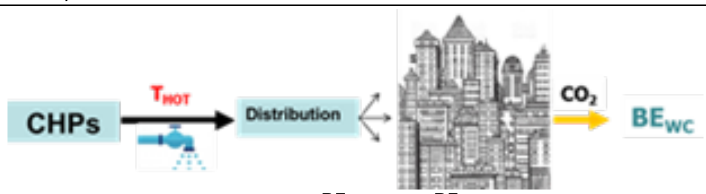


$BE_{EC,i,j,y} = BE_{EC,non-REcaptive,i,j,y} = EC_{BL,i,j,k,y} \times EF_{grid}$ *(Equation 22)*

- **$BE_{EC,non-REcaptive,I,j,y}$** = 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

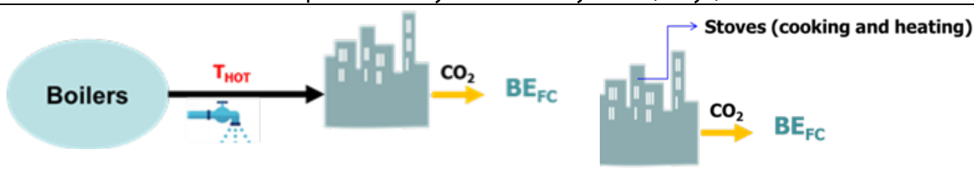
Buildings connected to District Heating Network



$BE_{WC,i,j,y} = \frac{WC_{BL,i,j,y} \times EF_{BL,WP,i,j,y}}{1-\eta_{BL,dist,l,y}}$ *(Equation 24)* and $EF_{BL,WP,i,j,y} = \frac{BE_{WP,EC,l,y}+BE_{WP,FC,l,y}}{WP_{BL,l,y}}$ *(Equation 25)*

- **$BE_{wc,i,j,y}$** = 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



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

- $BE_{FC,i,j,y}$ = Baseline emissions from fossil fuel consumption in baseline building unit (tCO_2/yr)
  a. $FC_{BL,i,j,k,y}$ = Quantity of fossil fuel type *k* fired in baseline building unit (mass or volume unit/yr)
  b. $COEF_{k,y}$ = 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**

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

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

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

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

   - $BE_{BL,i,y} = SE_{i,y} \times GFA_{PJ,i,y}$

8. Summation of all baseline emissions of each NAMA category → **baseline emissions of NAMA buildings**

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

9. **Calculation of NAMA project emissions (PE), by repeating steps 1-8 for each category** → NAMA project emissions

   - $PE_y = \sum_i SE_{i,y} \times GFA_{PJ,i,y}$

10. **Estimation of the emissions reduction for each category**:

    - $ER_y = BE_y - PE_y$

3.3 Standardized baseline for building sector in Mongolia

The standardized baseline for each category was developed in accordance with TOOL31 Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings Version 01.0. A standardized baseline was determined for each category during the coverage period between 2015 and 2017.

3.3.1 Calculation of standardized specific baseline emissions in buildings

Step 1: Categorization of buildings: residential, commercial (hotels, offices, retail) and institutional (hospitals, education) building units (TOOL31 Appendix (UNFCCC, Methodological tool 31 for the Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-31-v1.pdf)))

Step 2: Selection of buildings during sampling into cohort of existing buildings and cohort of new buildings (TOOL31 paragraph 10 (h) and (i)). (UNFCCC, Methodological tool 31 for the Determination of standardized baselines for energy efficiency measures in residential, commercial and institutional buildings (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-31-v1.pdf))

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

- ❑ Current energy consumption data for electricity, fuels, hot water during the coverage period starting 2013 and up to 2016-2017.
- ❑ 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 (UNFCCC, Sampling and surveys for CDM project activities and programmes of activities (https://cdm.unfccc.int/Reference/catalogue/document?doc_id=000003360)).

According to the sampling guideline, there are several types of sampling approaches that can be used in different situations. For this case, simple random sampling has been selected as the most convenient and applicable sampling method, since it is easy to implement.

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

- *Step 4.1 Electricity consumption*
- *Step 4.2 Fuel consumption*
- *Step 4.3 Hot water consumption*

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

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

An overview of the methodology for the determination of the standardized baseline emission factor per category of building is illustrated in Figure 3-2.

3.4 Emission reductions in NAMA buildings and standardized baseline emission factor

The determination of a standardized baseline for each category allows the application of the methodology outlined in 3.2.2 starting STEP 8. The standardized baseline would replace the average specific baseline emission determined in Steps 1-7. The availability of a standardized baseline, therefore, reduces data requirements and steps to for the calculation of emissions in the sector. The only data required is the NAMA buildings GFA (which was unavailable at the time of submission of this document.)

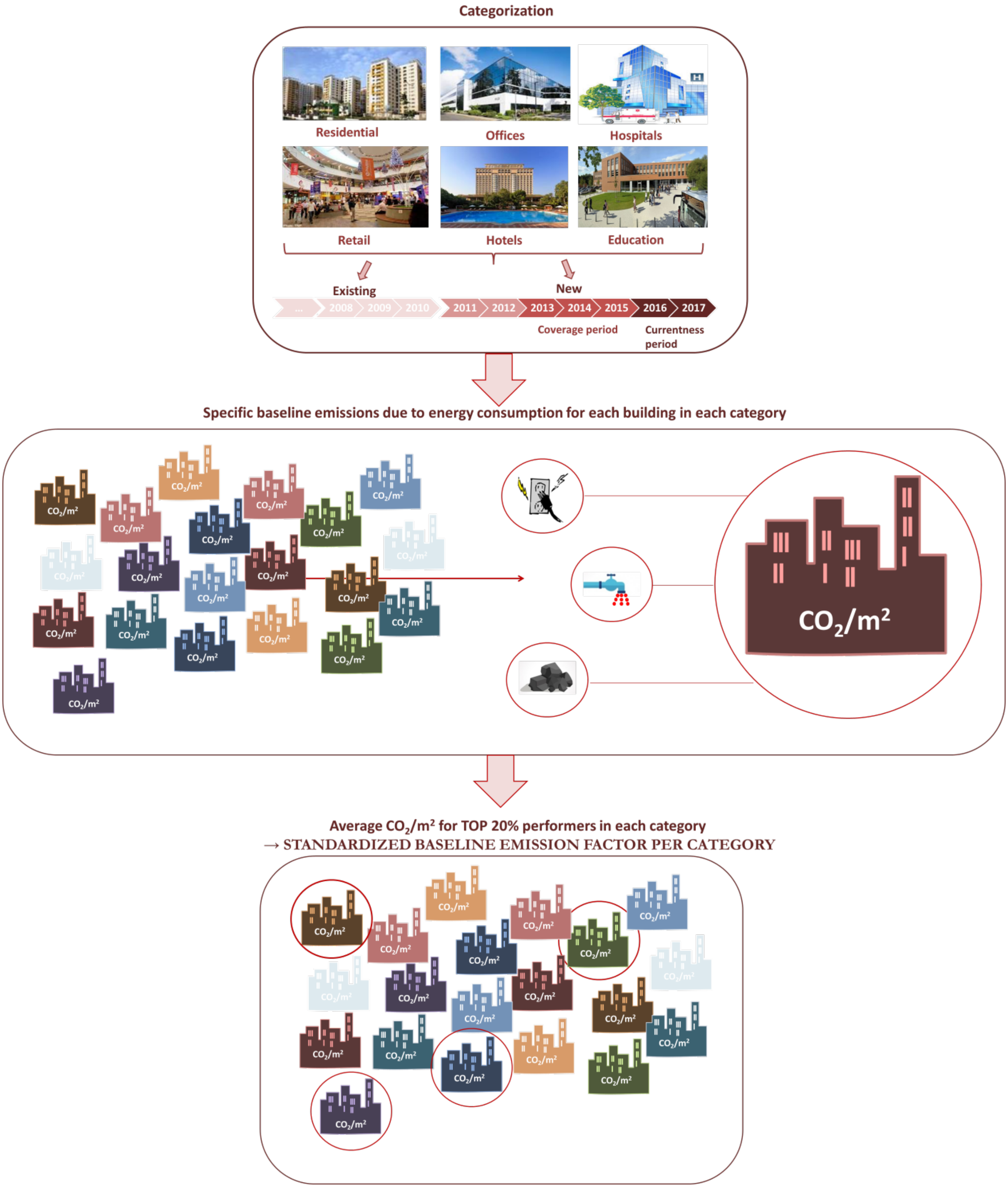


Figure 3-2: Overview of methodology for standardized baseline emission factor determination

4 Challenges to implementation of standardized baseline methodology in Mongolia

Challenges were encountered during the implementation of the standardized baseline methodology. The following sub sections outline specific challenges and solutions, where applicable. Challenges were also encountered when carrying out quality control procedures on data.

4.1 CHALLENGE 1: Data scarcity

The main challenge encountered in the determination of standardized baselines of buildings in Mongolia was scarcity of energy consumption data for new buildings (built post 2011).

To determine a representative standardized baseline value, a minimum number of buildings, i.e., a minimum sampling size is required. The minimum sampling size was determined according to the random sampling approach; however, the actual number of buildings for which data was available were lower (in some instances available data was as low as 2 buildings). As the solution to data scarcity is collection of additional data, the consultants were not able to overcome this challenge at the time of the submission of this report. However, a modifiable calculation excel sheet was created such that when data becomes available, it can be easily entered, and the standardized baseline emission factor values updated to reflect the change.

Data was also unavailable for GERs, which consist of portable round tents with felt skins. Therefore, GERs were not included in the present determination of the standardized baseline. However, should energy consumption data from GERs become available, the methodology for calculation of the standardized baseline emissions would be applicable.

4.2 CHALLENGE 2: Data completeness

4.2.1 No common ID for buildings

Thermal energy and electricity consumption data were provided by two separate entities without associating to a common building ID. Therefore, thermal energy consumption and electricity for the same building could not be matched on the basis of the data provided.

To match thermal energy and electricity consumption of buildings, a web-based system based on the coordinates of the building was used.

4.2.2 Incomplete reporting of internal electricity consumption for CHPs

Internal electricity consumption for the generation of hot water and electricity was required for each of the three CHPs. Data for the three CHP was provided at different detailed levels. Only one CHP had data specific to generation of electricity and hot water. For the second CHP, a total value was provided, i.e., including other activities in addition to electricity and hot water generation. For the third, data values showed large discrepancies with the previous two CHPs, which suggested an error in units.

To overcome the various levels of details, a conservative approach was adopted in calculations, whereby, total values were used for the two CHPs with reliable data. With respect to the large discrepancies observed for the third CHP, a modifiable calculation excel sheet was created such that when data becomes available, it can be easily entered and the average emission factor of all three CHPs per year calculated.

4.2.3 Incomplete reporting of energy consumption data for buildings

Energy consumption data was missing for several buildings, where cells in the data collection forms were either empty or given zero values. In such cases, the data providers were contacted again to obtain the missing data.

4.3 CHALLENGE 3: Data accuracy

4.3.1 Large variability in raw data sets

Raw energy consumption data appeared scattered for buildings within the same category and built age range. To verify the consistency of data provided, the calculated specific baseline emissions (tCO_2/m^2) for buildings within the same category and age were plotted. Large variabilities (several orders of magnitude) were noted. Requests for clarifications were communicated to the local data providers to verify accuracy of data provided.

4.3.2 Data reported in wrong units

Hot water and electricity consumption data reported in the agreed upon data collection form were observed to be too large or too small. To verify accuracy of reported data, previous data provided in older data collection forms were reviewed and requests for clarifications were communicated to data providers. It was revealed that energy consumption data was not reported using correct units. To minimize potential errors, reporting and calculation sheets were modified to fit customary reporting habits of the local team.

4.3.3 Replicated data across time series

Replications of energy consumption data was observed for several buildings across the three-year time period. To verify accuracy of reported data, requests for clarifications were communicated to data providers.

4.4 CHALLENGE 4: Data transparency and clarity- insufficient details on calculations

4.4.1 Fuel consumed for heat and electricity generation

Fuel consumption data for the generation of electricity and heat (hot water and steam) by CHPs separately, were reported using two sets of units: coal equivalents were used for fuel consumption per unit energy generated and actual tons of coal used for total energy produced. Details on the calculation of quantities were not provided by data providers; specifically, conversion tables were absent making the data quality and accuracy verification across sets of data incomparable. Furthermore, some data were reported in wrong units for one of the CHPs.

To overcome the calculations challenge, a conversion table was added, and ton equivalents converted to actual tons. With respect to inaccurate units, questionable data was compared with data reported for the remaining CHPs and assumptions made accordingly.

4.4.2 Net calorific values of coal types consumed by CHPs

Net calorific values (NCV) should represent weighted average values per year. However, details on calculations of NCV values reported for both Shivee-Ovoo and Baganuur coal were not specified by data providers. Modifiable excel calculation sheets were created to allow updating of data.

Requests for clarifications were also communicated to data providers.

4.4.3 Hot water consumption data

As not all buildings in the project area are equipped with heat meters, hot water consumption data for some buildings was calculated; details on hot water consumption data acquisition for building units without heat meters i.e., calculations and parameters were not provided. The accuracy of calculated data could not be verified. Requests for clarifications were communicated to data providers

4.5 CHALLENGE 5: Data inconsistency

In the review of reported raw data, inconsistencies between energy consumption data and construction dates for new buildings were observed. For example, buildings built in 2016 had data reported in 2015. Requests for clarifications and review of data accuracy were communicated to local consultants.

4.6 CHALLENGE 6: Communication barriers

As the local language was not English, many documents and references received were not translated to English prompting requests for translations, which resulted in lengthy response times.

5 Measurement, Reporting and Verification

The overall legal, institutional and procedural set up of the MRV needs to be addressed in all countries and this is addressed in most countries and proposals for many countries have been prepared. (NIRAS)

Limited work has been done to develop and present the GHG parameters to be measured and even less work has been done to address non-GHG parameters. It is recommended at this stage to follow the CDM to the largest extent possible for the GHG parameters, but with the adoption of country specific conditions.

Measurement

Measurement shall to a high degree take its starting point in the experience from CDM and build further from this and integrate the national context, which is also the approach in CDM.

Supplementary to normal building structures, Mongolia also has dwellings, which consist of GERS which are portable, round tents with skins and felt. This will be a supplementary issue to be addressed when establishing the measuring system for NAMAs in the building sector in Mongolia.

Reporting

A report should be forwarded annually (in Mongolia for the project) with the aggregated data that have been collected and processed to the resort Ministry. In Mongolia the report should be forwarded to Ministry of Construction and Urban Development (MCUD).

The annual report should be prepared by an institution with in-depth understanding of the technical issues. The institution or company preparing the report depends on the actual content of the NAMA in the building sector.

Verification

The first step of national verification was to select an authority to perform the quality control (QC) of the forwarded annual report. It was proposed in the project that a Department in a Ministry, for instance MCUD, could make the quality assurance (QA) before the results are submitted to a Ministry that is responsible for the overall national coordination. In Mongolia, the Ministry of Environment and Tourism (MET) has the overall national coordination of UNFCCC related projects and reporting. It is important that that the Department in the MET has not been involved in the preparation of the annual report.

Construction Development Center (CDC) is a national expertise center and CDC could be appointed to double check the quality of the different parameters. It is specifically proposed that CDC double check the aggregated annual quantities of coal.

5.1 Parameters to measure greenhouse gases

GHG Parameters

Data should only be collected, and indicators developed if they can be used widely and efficiently. In the context of Mongolia, the cost of managing an indicator and thereby also the related MRV must be crucial due to limited financial resources.

In general, it is recommended to use utility meters for the whole building, but with the electricity and fuel bills can also be used covering the whole building. Metering of whole buildings are preferred compared to for instance metering of the appliances as it will reduce the costs and it will be easier to administer. Furthermore, the measurements will be using the existing meters – for electricity and hot water.

The energy consumption in the buildings can be electricity, hot water and fuel. Therefore, these parameters shall be covered by the MRV system. The parameters to be monitored are presented in detail and are applicable for the entire building sector.

In the GERs and GER areas coal is often used, but the invoices and bills for purchased coal are seldom available, so in these areas a survey will be needed to gather the information.

To respond to requests for energy consumption intensity. knowledge of GFA will be necessary to perform the calculation. GFA is an area occupied by internal walls and partitions of a building unit. If a building unit contains common service areas in its physical boundary (meeting rooms, corridors, lift wells, plant and machinery, etc.), GFA of the common service areas should be included. Otherwise, GFA of the common service areas shall be excluded.

Table 0.1 GHG Parameters and matrices

	Electricity Consumption	Hot water Consumption	Fuel Consumption	Fuel Consumption (option for a GER or GER areas)	Gross Floor Area (GFA)
Data / Parameter	Electricity Consumption (EC)	Hot Water Consumption	Coal Consumption	Coal Consumption	Gross Floor Area (GFA)
Data Unit:	MWh/year	GJ/year	Tons/year	Tons/year	M^2
Description:	Total quantity of electricity consumed by the building per year, including all electricity consumption for instance lighting, ventilation system, equipment, alarms etc.	Total quantity of hot water consumed by the building per year.	Quantity of consumed coal by the boiler or stove	Quantity of consumed coal by a GER or the average consumed by a group of GERs	To calculate the energy consumption intensity.
Source of data:	Measured data of total electricity supplied to the building. On-site measurements.	Measured data of total hot water supplied to the building. On-site measurements.	Invoices and paid bills	Survey	The following data sources may be used if the relevant conditions apply: Data source — Conditions for using the data source Building plan — Preferred source On-site measurement — If the building plan is not available
Measurement procedures (if any):	Measurement should be conducted by using the existing watt-hour meter at the building or to be installed. .	Measurement should be conducted by using of the existing hot water meter at the building or to be installed.	Monitored data (by payment bills)	The sample will be surveyed for self-reported coal consumption during the previous year. It can be for one GER or a group of GERs in case of limited data available.	Gathering the documents or simple on-site measurements
Monitoring frequency:	Measuring and recording continuously, reading monthly. Aggregated at least annually	Measuring and recording continuously, reading monthly. Aggregated at least annually	Recording when coal has been purchased. Aggregated at least annually	Annually	Only measured once.
QA / QC procedures:	- Use of measuring equipment which meets the national standard - The meter should be verified by a national authority Check consistency of the monitored records with the records from previous monitoring intervals from the year before, if available.	Use of hot water meter which meets the national standards. The hot water meter should be verified according to national standards. Check consistency of the monitored records with the records from previous monitoring intervals from the year before, if available.	The building administrator will double check aggregated annual quantities of coal before submission. Check consistency of the monitoring records with the records from previous monitoring intervals from the prior year, if available.	CDC could be appointed to double check aggregated annual quantities of coal. Check consistency of the monitoring records with the records from previous monitoring intervals from the year before, if available.	When determined through the building plan, confirm on-site that building geometry represented in the plan is accurate;

Many countries already have official standardized emission factors which can be used, so the calculations explicitly for the project will often not be needed.

Table 0.2 Emission Factors and NCV

	Grid Emission Factor - EF_{grid}	Hot Water Emission Factor – $EF_{hot\ water}$	Net Calorific Value of Coal	Emission Factor of Coal
Data / Parameter	EF_{grid}	$EF_{hot\ water}$	NCV_{coal}	EF_{coal}
Data Unit:	tCO_2e/MWh	tCO_2/GJ	TJ/ton	tCO_2/TJ
Description:	CO_2 emission factor of the electric grid supplying electricity	CO_2 emission factor of the CHP supplying hot water. Also referred to as the hot water production system	Net calorific value of the coal that is substituted	Emission Factor
Source of data:	Grid emission factor for national or regional electricity grid.	National data	Either conduct measurements or use national data, if available in the future. IPCC can be used.	Either conduct measurements or use national data, if available in the future. IPCC can be used.
Value applied	Standard value to be used or to be calculated	To be calculated	IPCC = 0.0189	IPCC = 96.1
Purpose of data	Calculation of CO_2 emissions	Calculation of CO_2 emissions	Calculation of both baseline and project CO_2 emissions	Calculation of both baseline and project CO_2 emissions

5.2 Parameters to measure non-greenhouse gases

Indicators, including non-GHG, have been part of decision making and project documentation for many years selection of the indicators to be included in an MRV system. Indicators for energy performance in buildings and they are regulated for instance in EU, and therefore an EU methodology has been developed. Furthermore, it is well-described in ISO standards, e.g. EN ISO 52003, EN ISO 52000-1. The NAMA Facility (http://www.nama-facility.org/concept-and-approach/glossary/), defined three types of indicators: core mandatory indicators, sector-specific outcome indicators and project-specific output indicators. All indicators have to be SMART (specific, measurable, achievable, realistic and time-bound).

The most critical non-GHG indicators to be part of the MRV system in the building sector are:

i) Energy cost savings (parameter: MWh/yr and cost of energy/ MWh)
ii) Indoor air quality and temperature (parameter: particles and temperature)
iii) Gender and children (parameter: number of women, men and children)

However, for national MRV system, all data gathering is cost heavy and thus countries and projects need to be able to economically finance the data gathering. It is therefore recommended that the most crucial data is gathered, and maybe choose the indicators to measure that is easily obtained during the project or after, through desk research.

5.3 Mongolian parameters of non-GHG

For Mongolia and the current UNDP project it would not be possible to measure and monitor all non-GHG indicators. Mongolia itself cannot continuously measure and monitor indicator as indoor quality and energy cost savings at the moment. For the Mongolian case and building sector, the realistic indicators chosen were i) Temperature, ii) Gender and children and iii) Number of Employees and number of students/pupils. Table 0.3, shows the indicators and respective method to obtain the data and measurement procedures; monitoring frequency is also suggested

Table 0.3 Non-GHG parameter and matrices

Indicator	Temperature	Gender and children	Number of Employees and number of students/pupils
Data / Parameter	Temperature	Number of beneficiaries in a building unit – gender and age	Number of employees and students/pupils
Data Unit:	°C.	Number of women > 18 years old in a building unit Number of men > 18 years old in a building unit Number of girls < 18 years old in a building unit Number of boys < 18 years old in a building unit	Number of women and men employed Number of students/pupils split in two groups girls and boys
Description:	For a building, at least one thermometer shall be installed.	The number of beneficiaries that have activities related to the building unit. The type of activity is not defined, but it could for instance be the number of beneficiaries living in a building unit or the number of beneficiaries working in a building.	The number of employees employed at the school or universities or similar Number of Students/pupils enrolled
Source of data:	Thermometer	It can be the number of people living and formally registered in a public register or the extract from the payroll of employees working in a building unit.	For the employees extract from the payroll. For the students/pupils an extract of the list of students/ pupils
Measurement procedures (if any):	Manual reading	Extract from the payroll or public registration. The registered data can be split in two groups – women and men The registered data can be split in two groups girls and boys	Extract from the payroll and split in two groups – women and men Extract from the list of students/pupils and split in two groups –female and male
Monitoring frequency:	Weekly In case of more than one thermometer is used in the building, the average temperature shall be calculated. Aggregated at least annually.	Recorded annually	Recorded annually
QA / QC procedures:	Check consistency of the monitored records with the records from the week and the year before, if available.	Check consistency of the monitored records with the records from previous year, if available.	Check consistency of the monitored records with the records from previous year, if available.

6 Key Recommendations

6.1 Effective communication channels

Efficient communication channels between local consultants, data providers and international consultants should be established. Exploring various communication channels such as email, conference calls, and in person contact can help address misunderstandings and reduce lengthy time responses. The issue of language barrier should also be taken into account early on in the project by deploying technical translators. The language of communication of the project should also be stressed upon to the local data providers to avoid misunderstandings and inefficient use of time. Therefore, for an effective communication mechanism, it is recommended that the role of the local consultants prioritize the coordination aspect and include a minimal QC role of basic review and verification to avoid inadequate and incomplete responses to clarifications requested from local data providers (who are not in direct contact with international consultants' team).

6.2 Reliable data collection

Having encountered numerous challenges related to quality control, requirements for quality control procedures should be explicitly communicated to data providers early on in the project phase. Communication of QC procedures can be achieved by provision of training workshops. Consultants should also prepare a check list outlining every required detail for the calculations at the time of data collection form preparation. Data providers would then verify against the list that every component is fulfilled.

6.3 Sufficient data for representative results

6.3.1 Minimum sample size

To determine a representative specific baseline emission factor for a given building category, a minimum number of buildings is necessary according to the Sampling tool and guideline. Serious data scarcity was encountered especially for new buildings (i.e., constructed post 2011.) across all six categories. The minimum number is determined on the basis of all available buildings belonging to a category within the project's geographical area. For several categories, the data provided by local data providers were much lower than the minimum sample size.

The minimum sample size not being fulfilled impacted results for the two objectives of the project: determination of emission reductions in NAMA buildings and standardized baseline emission factor for each category. It is recommended that the importance of data sufficiency be explicitly communicated to data providers in the early stages of the project lifecycle. If possible, the minimum sample size be communicated as well. If the minimum sample size cannot be obtained early on, conservative estimates should be provided to avoid the insufficiency encountered at later stages.

6.3.2 Total gross floor area of NAMA buildings

For the determination of emission reduction in NAMA buildings, total gross floor area (GFA) of NAMA buildings is required. Total GFA was unavailable for all categories. It is recommended to communicate specific data requirements during the planning stages of the project to allow sufficient time for data providers to deploy a task force to obtain this data.

To address and possibly avoid issues related to data scarcity and unavailability, it is recommended to outline key requirements during kick-off meetings to allow data providers to gather such data.

6.4 Representative emission reductions in NAMA buildings using average specific emissions of all buildings

The benchmark used in the calculation of reduction in emissions depends on the scope of the project for which it is calculated. The scope of CDM projects is individually based rather than sector-wide based. Due to this limited scope, using the top 20% performers for the calculation of the average emissions results in more conservative and representative values. In contrast, NAMA energy efficiency projects have a larger scope in that they are sector-wide. The use of the average of all buildings for the sector results in values representative of reality and does not penalize a country with a too conservative baseline.

Because the scope of the project was to estimate emission reduction for the building sector, which is much larger than the scope for which CDM projects are conceived, the average of all buildings instead of the top 20% performers was used for calculations of reductions in emissions.

6.5 Management of data from different sources

Energy consumption data, namely, electricity and hot water, originated from different agencies using different nomenclatures and identification systems. The building units receiving both services did not have a unified identification code, which prevented matching consumption data to the same building. To match consumption data to the same building, the GIS system identifying building on the basis of their geographical coordinated implemented by the service providers was used.

6.6 Alternative use of data on the basis of level of detail

The first objective of this project was to develop a methodology for the calculation of reduction of emissions in NAMA buildings. To calculate reduction of emissions in NAMA buildings, energy consumption data on a building unit level is required. In the case of Mongolia, data on a building unit level was not consistently available. Specifically, building units within a district were not individually equipped with heat meters; the district was supplied by a main hot water substation. Emissions were therefore determined at the district level composed of all building units. By dividing emissions at the district level by the total gross floor area of all building units, a specific baseline emission factor is obtained (tCO_2/m^2). The resulting specific baseline emission is an average and does not allow assigning the emissions to a specific building unit. If the CDM methodology is followed, this result cannot be used since the specific baseline emission is based on top 20% performers, which cannot be determined without data at the building unit level. In this project, however, a modification of the methodology to use the average of all specific buildings was proposed. In this case, the data at the district level can be used.

The emissions (tCO_2) result obtained at the district level can also be used for the GHG inventory, which is based on a large scope of buildings and not on building unit level.

Depending on the level of detail of data provided, results can be used towards various objectives. It is recommended to consider the versatility of uses of data, which can be beneficial to other related projects.

6.7 Calculation of reductions of emissions in NAMA projects using CDM

Under the UNFCCC, no explicit methodologies, procedures, or rules are defined for use in NAMA projects. Following a rigorous assessment of the main GHG accounting methodologies defined by international organizations (e.g., IPCC and CDM), it is recommended to use a methodology based on CDM and apply necessary modifications to adapt it to national circumstances. A summary of the assessment, selection, and modifications applied in the Mongolian building sector is provided in section 3.

6.8 Application of standardized baseline emission factor in NAMA projects

A secondary objective of the project was determining standardized baseline emission factors for each of the six categories in the building sector compliant with CDM. The use of a standardized baseline emission factor to calculate reduction of emission in NAMA buildings reduces data collection requirements and provides a consistent calculation process (see section 3.4).

It is recommended for sectors having extensive data requirements such as the building sector, whenever applicable, to determine a standardized baseline emission factors for use in NAMA projects.

It should be noted, however, that the reliability of the standardized baseline emission factors depends on the availability of reliable data. In the case of Mongolia, the determination of reliable standardized baseline emission factors was hampered by data availability and quality. It is therefore recommended to address data requirements and associated quality control procedures early on in the project lifecycle.

The use of standardized baseline in NAMA should also be done cautiously as CDM and NAMA have different scopes. The standardized baseline according to CDM is determined on the basis of top 20% performing buildings, which may result in a conservative benchmark value. When the conservative value is applied to the larger scope of NAMA buildings, emission reductions from NAMA buildings would be underestimated (see Figure 3-1). It is recommended to assess the applicability of the standardized baseline to NAMA projects.

6.9 MRV system – GHG indicator and matrices.

In general, it is recommended to use utility meters for the whole building but with the electricity and fuel bills can also be used covering the whole building. Metering of whole buildings are preferred compared to for instance metering of the appliances as it will reduce the costs and it will be easier to administer. Furthermore, the measurements will be using the existing meters – for electricity and hot water.

In the GERs and GER areas they most often use coal and often they do not have invoices and bills for purchased coal. Therefore, in these areas a survey will be needed to gather such information. Probably, this will also be the case in rural areas or poorer regions. The survey should cover the rural areas if such areas are part of the NAMA.

6.10 MRV system – selection of non-GHG indicators

Selection of the Non-GHG indicators are of course dependent on the importance of the specific indicator. Furthermore, it is dependent of the actual administrative set-up and whether an indicator can be managed within the existing administrative set-up and the available financial resources. The proposed non-GHG has been selected carefully to keep the cost low and in the same time generated the most important information, for instance the number of persons, gender and children that will benefit from the initiative.

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MINISTRY OF CONSTRUCTION AND URBAN DEVELOPMENT

"Nationally Appropriate Mitigation Actions (NAMA) in the Construction Sector in Mongolia"

Brief Information

Project period: 2017-2020
Executing entity:

Ministry of Construction and Urban Development
Government of Mongolia

Implementing/responsible partners:

Ministry of Environment and Tourism, Ministry of Energy and

Project Funding

Project fund:

- Global Environment Facility (GEF) $1,269,863

Other in-kind contributions:

- Government $3,350,000
- Private sector $3,450,000
- UNDP $100,000

Global Benefits

- Direct cumulative emission reduction by EOP: 10,709 tCO2e
- Direct emission reduction over project lifetime: 64,219 tCO2e

SDGs:

Project Brief Description and Outputs

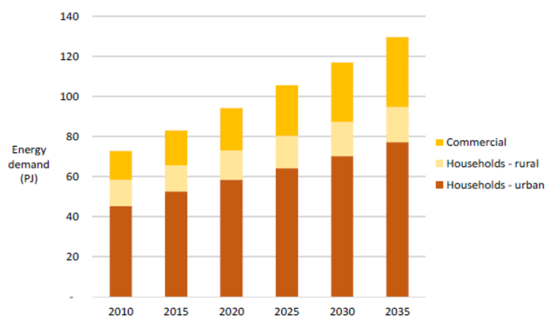
The objective of the project is to facilitate market transformation for energy efficiency in the construction sector through the development and implementation of Nationally Appropriate Mitigation Actions (NAMA) in Mongolia. This objective will be achieved by removing barriers to increased adoption of energy efficiency technology in construction sector through three components:

- **Component 1:** Establishment of baseline energy consumption & GHG emission in the construction sector
- **Component 2:** Development & implementatio n of NAMA in the construction sector
- **Component 3:** Measurement, Reporting and Verification (MRV) system for NAMA in the construction sector

Increasing Energy Demand in the Construction Sector

With an increase in housing demand from economic growth and a surging rural to urban migration, the construction sector had been thriving reciprocally over the past decade. The projection of housing demand based on the population growth rate indicates approx. 140,000 apartment units will be constructed between 2020 and 2030, which translates to around 14,000 new units annually. As the building stock continues to grow, energy demand simultaneously escalates.

Figure 1. Energy demand in the buildings sector, reference scenario, PJ (10^{15} joules)



Source: Strategies for Development of Green Energy Systems in Mongolia (2013-2035), GGGI, 2015

Urban household energy use dominates energy demand in the buildings sector, which is projected to nearly double between 2010 and 2035, despite the combination of energy efficiency improvements and ongoing shift away from less-efficient biomass heating fuels (GGGI, 2015).

National Benefits

- Long term reduction of energy cost to households help lessen household expenditure and improve their financial conditions;
- Reduced energy usage contributes to lower demand from coal fired heat-only boilers and power plants, hence, significantly reducing air pollution. This leads to improvements in health benefits for the entire population;
- Improved living comfort and quality of life of building occupants;
- Reduced GHG emissions thereby reducing the long term risk of climate change;
- Increased demand of EE construction materials/technologies which will support local manufacturers and businesses leading to better employment prospects and eventually improved local economy;
- Improved access to energy efficiency financing in the construction sector leading to EE investments;
- Enhanced capacities and skills of people, specifically women, employed in the con-

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Energy Consumption and GHG Emission by the Construction Sector

The energy sector is by far the largest contributor with almost 52% of total GHG emissions in 2012 (MEGD, MARCC-2014). At current rates, Mongolia's GHG emissions is expected to increase four times the 2006 levels by 2030 and account for approx. 82% of the total to 51.2 Mt CO2-eq.

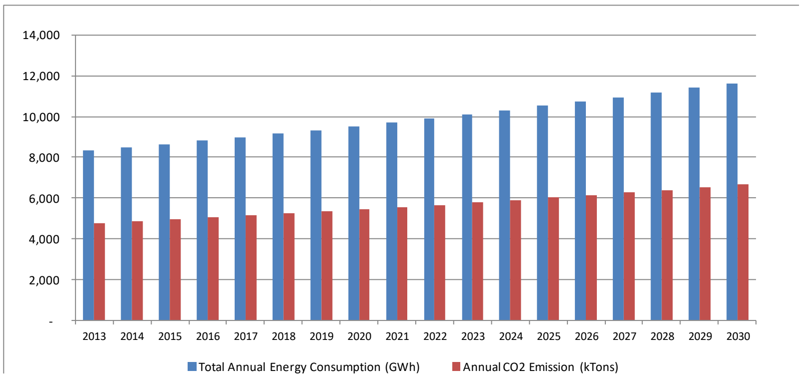
Table 1. Construction sector's energy consumption and GHG emissions

	2015	2020	2030
Energy consumption by the construction sector (GWh/yr)	8,641	9,526	11,636
Baseline GHG emission (million tCO_2eq)	4.94	5.45	6.66

Source: NAMA project document, UNDP, 2016

Construction sector consumed 8,641 GWh of energy that resulted in 4.94 million tCO_2eq greenhouse gases in 2015. If this BAU outcome continues, projection shows that GHG emissions in Mongolia construction sector will increase to approximately 5.45 million tones CO_{2eq} in 2020 and 6.66 million tones CO_{2eq} in 2030. This is based on growth of energy consumption in construction sector to meet the expected demands from 9,526 GWh in 2020 and 11,636 GWh in 2030.

Figure 2. Estimations of annual energy consumption and GHG emission 2013-2030



What is Nationally Appropriate Mitigation Actions (NAMA)?

NAMA, firstly used in the Bali Action Plan, under the UNFCCC, Dec 2007, refers to a set of policies and actions that countries undertake as part of a commitment to reduce GHG emissions. NAMA recognizes that:

- Different countries, different NAMAs on the basis of equity and in accordance with common but differentiated responsibilities and respective capabilities
- Developing countries will effectively implement national action depends on the effective implementation of the commitments by developed countries in provision of financial resources and transfer of technology
- NAMAs shall be based on MRV framework

EXPECTED RESULTS AND INDICATORS

10.709 tCO2e cumulative emissions reduced by EOP

Energy consumption and GHG emission inventory system became operational and adopted for the construction sector NAMA by Year 3

6 individual EE interventions that constitute construction sector NAMA by Year 4

MRV system for construction sector emissions set up and operational by Year 2

18,722 MWh cumulative heat and electrical energy savings by EOP

100% of new buildings fully or beyond in-compliance with BCNS by EOP

50 people gainfully employed on EE in the constructio n sector

4 public and private sector entities supporting the sustainable operation of GHG inventory system by EOP

3 identified fully capable and qualified private/public entities that are interested in funding prioritized NAMA projects by Year 4

2 institutions adopting and operationalizin g MRV systems of the Pilot NAMA, by Year 3

3 construction sector NAMA case studies using the approved MRV framework and incorporated in policy document by EOP