CLEAN DEVELOPMENT MECHANISM

CDM-MP79-A06

Concept note

Methodological approaches for calculating emission reductions from project activities, resulting in the reduced use of non-renewable biomass in households

Version 01.0

United Nations
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Climate Change

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1. Procedural background

1. The Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP), at its fourteenth session, encouraged the CDM Executive Board (hereinafter referred to as the Board) to review methodological approaches for calculating emission reductions from project activities, resulting in the reduced use of non-renewable biomass (NRB) in households (decision 4/CMP.14, para. 4).

2. The Board, at its 102nd meeting, considered the methodological approaches for calculating emission reductions from project activities, resulting in the reduced use of non-renewable biomass in households, and requested the Methodologies Panel (MP) to conduct an analysis on the following issues:

   (a) The use of fossil fuel emission factor as surrogates for biomass combustion (Issue 5 in table 1 of Annex 6 to the annotated agenda): The MP should explore options for revising the globally applicable default factor taking into account data on actual usage of various fossil fuels for cooking in different regions/countries of the world. The MP should also explore a method for providing an option for the Project Participants to determine the factor for their project or PoA based on geographic coverage of the project or PoA and fossil fuel usage in the region for cooking;

   (b) Non-CO_2 greenhouse gas (GHG) emissions such as methane and nitrous oxide emissions (Issue 6 in table 1 of Annex 6 to the annotated agenda); The MP should explore including these gases in the project boundary considering the same mix of fossil fuels that are identified under issue 5;

   (a) Harmonized standards for stove tests (Issue 8 in table 1 of the Annex 6 to the annotated agenda): The MP should explore options for applying international (e.g. International Organization for Standardization (ISO)) standards and national standards where they are available to determine the performance of the stoves.

3. In this context, the Board requested the MP to provide the analysis, including the draft revised methodologies for its consideration at a future meeting.

2. Purpose

4. The purpose of this concept note is to present the analysis as requested by the Board including references to the possible draft revised methodologies for consideration of the Board.

3. Key issues and proposed solutions

3.1. Default global fossil fuel emission factor

3.1.1. Mandate

5. The Board requested to the MP to explore options for revising the globally applicable default factor taking into account data on actual usage of various fossil fuels for cooking in different regions/countries of the world.

3.1.2. Analysis and proposed solutions

6. A hypothetical emission factor ($EF_{projected\_fossilfuel}$) was introduced in methodology AMS-II.G. which was cross referenced in AMS-I.E., following the guidance from the Board at its twentieth meeting (see appendix, hereafter this is referenced as fossil fuel emission factor).

7. Version 3 to 8 of AMS-II.G. had included a default value of 81.6 t CO_2/TJ for the fossil fuel emission factor based on the following assumptions: a 50 per cent weight is assigned to coal as the alternative solid fossil fuel (96 t CO2/TJ) and a 25 per cent weight is assigned to both liquid and gaseous fuels (71.5 t CO2/TJ for kerosene and 63.0 t CO2/TJ for LPG).

8. Version 9 and 10 (current) of AMS-II.G. included a default value of 63.7 t CO_2/TJ for the fossil fuel emission factor based on the following assumptions; 9 per cent weight assigned for kerosene (71.5 t CO2/TJ) and 91 per cent for LPG (63.0 t CO2/TJ).

9. The data[1] of actual usage of various fossil fuels for cooking in different regions/countries are summarized in the table 1 below:

Table 1. Actual usage of various fossil fuels for cooking (average percentage value in developing countries)

Share of households using fossil fuels for cooking (simple average)	Households cooking with LPG[(a)]	Households cooking with kerosene	Households cooking with coal	Households cooking with other fuels (non-fossil fuel based)	Total
Percentage share[(b)] of all cooking fuels	30%	3%	1%	66%	100%
Percentage share of fossil fuels	87%	9%	4%	--	100%

(a) The original data also covers other gases such as natural gas and biogas. No separation of data on LPG was possible in the database of STATcompiler referred above.

(b) Percentage share is the simple average of the values for the individual countries. Use of weighted average share taking into account countries population along with fuel use is also a plausible alternative. The MP does not recommend the use of weighted average as it may underrepresent the data of countries with smaller population.

10. Proposed revised value of the fossil fuel emission factor is represented in Table 2 below.

[1] Source: The DHS Program- Demographic and Health surveys - STATcompiler (www.statcompiler.com) except for China where the data was sourced from *Cashman S, Rodgers M, Huff M, Feraldi R, Morelli B. Life Cycle Assessment of cookstove fuels in India and China. Washington, DC U.S. Environmental Protection Agency; 2016.*

Table 2. Proposed revised value of the fossil fuel emission factor (CO2 and Non-CO2 GHG emissions)

		Households cooking with LPG	**Households cooking with kerosene**	**Households cooking with coal**	**Total**	**Fossil fuel emission factor (t CO2/TJ)**	**Fossil fuel emission factor (t CO2e/TJ) including CH_4 and N_2O emissions**
AMS-II.G. (version 3 to 8) and AMS-I.E. (version 4 to 7)		25%	25%	50%		81.6	
AMS-II.G. (version 9 and 10) and AMS-I.E. (version 8 and 9)		91%	9%			63.7	
Proposed revision: based on the percentage of the total number of households using fossil fuels for cooking (simple average)	% share of total fuel use	30%	3%	1%	34%		
	% share of fossil fuel use	87%	9%	4%	100%	65.1	**a) 65.6 (based on fossil fuel mix) b) 73.8 (based on wood)**
Information for comparison:	Emission factor of wood is 112.0 (t CO2/TJ) and 120.7 t CO2e/TJ including CH_4 and N_2O emissions						

3.2. Non-CO_2 GHG emissions

3.2.1. Mandate

11. The Board requested to the MP to explore including these gases (CH_4, N_2O) in the project boundary considering the same mix of fossil fuels that are identified under issue above.

3.2.2. Analysis and proposed solutions

12. Default emission factors for stationary combustion in the residential and agriculture/forestry/fishing/fishing farms categories provided in 2016 IPCC Guidelines are extracted and provided below in Table 3 and 4:

Table 3. Default emission factors for stationary combustion in the residential and agriculture/forestry/fishing/fishing farms categories (kg of GHG per TJ on a Net Calorific Basis)

Fuel	CO_2			CH_4			N_2O		
	Default Emission Factor	Lower	Upper	Default Emission Factor	Lower	Upper	Default Emission Factor	Lower	Upper
Other Kerosene	71,900	70,800	73,700	10	3	30	0.6	0.2	2
Liquefied Petroleum Gases	63,100	61,600	65,600	5	1.5	15	0.1	0.03	0.3
Anthracite	98,300	94,600	101,000	300	100	900	1.5	0.5	5
Other Bituminous Coal	94,600	89,500	99,700	300	100	900	1.5	0.5	5
Sub-Bituminous Coal	96,100	92,800	100,000	300	100	900	1.5	0.5	5
Lignite	101,000	90,900	115,000	300	100	900	1.5	0.5	5
Wood / Wood Waste	112,000	95,000	132,000	300	100	900	4	1.5	15
Charcoal	112,000	95,000	132,000	200	70	600	1	0.3	3

Table 4. Default emissions factors after multiplying Global Warming Potential (GWP) values

	Unit	LPG	Kerosene	Coal	Wood
CO2 Emission factor	t CO2/TJ	63.1	71.9	94.6	112.0
CH4 Emission factor (GWP: 25)	t CO2e/TJ	0.13	0.25	7.50	7.50
N2O Emission factor (GWP: 298)	t CO2e/TJ	0.03	0.18	0.45	1.19
GHG Emission Factor	t CO2e/TJ	63.25	72.33	102.55	120.69

***Source*:** Table 2.5, Chapter 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories

13. With the inclusion of methane and nitrous oxide emissions, fossil fuel emission factor will be as follows:

    (a) When CH_4 and N_2O emission factors of the same mix of fossil fuels are used: 65.6 t CO2e/TJ;

    (b) When CH_4 and N_2O emission factors of wood are used: 73.8 t CO2e/TJ.

14. The MP recommends the fossil fuel emission factor of **65.6 t CO2e/TJ**, which includes non-CO2 GHG emissions using the same mix of fossil fuels (Please see Table 2).

15. As decision 17/CP.7 (see appendix) placed restrictions only on considering changes to carbon pools, use of CH_4 and N_2O emission factors of wood was considered as a plausible alternative. However, the MP did not recommend it, taking into account guidance from the Board to consider the fossil fuel non-CO_2 emissions as reflected above.

16. Furthermore, it is acknowledged that the above recommended values do not take into consideration the effects of fuel shifts on the energy efficiency of the thermal appliances, consideration of which would lead to lowering of the value of the fossil fuel emission factor.

3.3. Option for the Project Participants to determine the fossil fuel emission factor for their project or PoA

3.3.1. Mandate

17. The Board requested the MP to explore a method for providing an option for the Project Participants to determine the fossil fuel emission factor for their project or PoA based on geographic coverage of the project or PoA and fossil fuel usage in the region for cooking.

3.3.2. Analysis and proposed solutions

18. Considering that the Board also requested the MP to explore a method for providing an option for the Project Participants to determine the fossil fuel emission factor for their project or PoA, the MP recommended an option as reflected in equation (2) below. However, the MP considered that having only a default value in the methodology may be a better option, considering that projection of the fossil fuel is a hypothetical one.

19. Proposed addition to the equations of the methodology AMS-II.G. are provided below, for illustration purpose:

$$\mathrm{ER_{y,i,j}} = \mathrm{B_{y,savings,i,j}} \times \mathrm{N_{y,i,j}} \times \mu_y \times \mathrm{f_{NRB,y}} \times \mathrm{NCV_{biomass}} \times \mathrm{EF_{projected\_fossil\ fuel}} \quad \text{Equation (1)}$$

As an alternative to the use of the default value for the fossil fuel emission factor, project participants may estimate the fossil fuel emission factor for their project or PoA by determining x_j (a fraction representing fuel type j used in the region/country or project area for cooking).

$$ER_{y,i,j} = B_{y,savings,i,j} \times N_{y,i,j} \times \mu_y \times NCV_{biomass} \times f_{NRB,y} \times \sum_j \{x_j \times (EF_{FF,j,CO2} + EF_{FF,j,CH4} \times GWP_{CH4} + EF_{FF,j,N2O} \times GWP_{N2O})\} \quad \text{Equation (2)}$$

Where:

$ER_{y,i,j}$	=	Emission reductions by project device of type *i* and batch *j* during year *y* in t CO_2e
$B_{y,savings,i,j}$	=	Quantity of woody biomass that is saved in tonnes per cookstove device of type *i* and batch *j* during year *y*
$f_{NRB,y}$	=	Fraction of woody biomass that can be established as non-renewable biomass (fNRB)
$NCV_{biomass}$	=	Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.0156 TJ/tonne, based on the gross weight of the wood that is 'air-dried')
$EF_{projected_{FF}}$	=	Emission factor for the fossil fuels projected to be used for substitution of non-renewable woody biomass by similar consumers. Use a value of ~~63.7~~ 65.6 t CO_2/TJ
x_j	=	Percentage share of fossil fuel use[1] (a fraction representing the share of fossil fuel type *j* in total fossil fuel used in the region/country or project area for cooking)
$EF_{FF,j,CO2}$	=	CO_2 emission factor for the fossil fuel *j* projected to be used for substitution of non-renewable woody biomass by similar consumers. Use a value in the table ## below (t CO_2/TJ)
$EF_{FF,j,CH4}$	=	CH_4 emission factor for the fossil fuel *j* projected to be used for substitution of non-renewable woody biomass by similar consumers. Use a value in the table ## below (t CH_4/TJ)

[1] For example, percentage share of kerosene, LPG and coal in total fossil fuel used in the country X is 10%, 70% and 20%, then the parameter value for x_j should be 0.1, 0.7 and 0.2 respectively.

$EF_{FF,j,N2O}$ = N_2O emission factor for the fossil fuel *j* projected to be used for substitution of non-renewable woody biomass by similar consumers. Use a value in the table ## below (t N_2O/TJ)

GWP_{CH4} = Global Warming Potential of CH_4 valid for the commitment period

GWP_{N2O} = Global Warming Potential of N_2O valid for the commitment period

$N_{y,i,j}$ = Number of project devices of type *i* and batch *j* operating during year *y*

μ_y = Adjustment to account for any continued use of pre-project devices during the year *y* when applying equations 6 and 8 (fraction). Use 1.0 in other cases

Table 5. Default emission factors (kg of GHG per TJ on a Net Calorific Basis)

Fuel	Default CO_2 Emission Factor	Default CH_4 Emission Factor	Default N_2O Emission Factor
Kerosene	71,900	10	0.6
Liquefied Petroleum Gases (LPG)	63,100	5	0.1
Coal	94,600	300	1.5

***Source*:** Table 2.5, Chapter 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories

3.4. Harmonized standards for stove tests

3.4.1. Mandate

20. The Board requested to the MP to explore options for applying international standards (e.g. ISO) and national standards where they are available to determine the performance of the stoves.

3.4.2. Analysis and proposed solutions

21. Building on the past work done in the area, ISO has recently published a series of standards for harmonized lab and field tests of cookstoves to determine emission performance and efficiency, such as *ISO 19867-1:2018: Clean cookstoves and clean cooking solutions -- Harmonized laboratory test protocols -- Part 1: Standard test sequence for emissions and performance, safety and durability*.[2] ISO 19867-1:2018 specifies laboratory measurement and evaluation methods for a) particulate and gaseous air pollutant emissions, b) energy efficiency, c) safety, and d) durability of cookstoves, and it provides a standard test sequence to establish comparability in measurement of cookstove emissions and efficiency.

22. The MP is of the view that the use of ISO standards should also be cited in CDM methodologies, besides other international standards or national standards which are

[2] In addition, *ISO/FDIS 19869: Clean cookstoves and clean cooking solutions -- Field testing methods for cookstoves* is under development

currently available and in use. During the practitioner workshop[3] held on 06 May 2019, stakeholders requested the continued use and acceptance of the existing protocols (e.g. WBT protocol, CCT protocol, KPT protocol listed in Clean Cooking Alliance) alongside the recently approved ISO Standards as there is limited experience in its application.

23. The MP also noted that under ISO's laboratory testing protocol, thermal efficiency is calculated as simple or weighted averages of the three test phases (high, medium, low powers), while under the WBT protocol, only high power thermal efficiency is calculated as the average of the two phases (i.e. cold start high-power, hot-start high-power, not including the simmer phase).

24. The MP also considered that it may be necessary that the same protocol for stove testing is consistently used both for the baseline and project parameters, in order to ensure comparability of the test results between baseline test and project tests that will be conducted during the crediting period.

25. Furthermore, considering that infrastructure for stove test (e.g. accredited laboratories) for ISO 19867-1:2018 is currently not widely available, the MP considered that the flexibility with lab testing available for other protocols (e.g. WBT protocol or a national standard are eligible under the methodology) should also apply while using the ISO standard.

26. Therefore, before finalizing the recommendation to the Board (i.e. inclusion of ISO 19867-1:2018 standard as an optional method in AMS-II.G. and AMS-I.E. for testing the efficiency of stoves), the MP identified the need to conduct further analysis on the differences in WBT test protocol and ISO standard, and explore what guidance would be required when applying the ISO standards as an option for testing efficiency of stoves (e.g. which sections to be applied, guidance on eligibility of labs). The findings of the analysis will be considered while proposing a revision of AMS-I.E. and AMS-II.G to the Board at a future meeting.

4. Impacts

27. The improvement of the methodological approaches for the calculation of emission reductions by reducing use of non-renewable biomass will facilitate the implementation of CDM project activities and PoAs in the household cookstove sector, which have strong relevance for the regions that are underrepresented in the CDM.

5. Subsequent work and timelines

28. The MP will propose revisions to AMS-I.E. and AMS-II.G at a future meeting based on the guidance from the Board.

6. Recommendations to the Board

29. The MP recommends that the Board consider the concept note and provide further guidance.

[3] Practitioner workshop on methodological issues related to clean cookstoves, safe drinking water and sampling held on 06 May 2019

Appendix. Background

1. Past decisions related to the reduced use of non-renewable biomass

1. An earlier version of the methodology "AMS-I.C. Thermal energy for the user"[1] stated that "This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels or non-renewable sources of biomass….For renewable energy technologies that displace non-renewable sources of biomass, the simplified baseline is the non-renewable sources of biomass consumption of the technologies times an emission coefficient for the non-renewable sources of biomass displaced. Intergovernmental Panel on Climate Change (IPCC) default values for emission coefficients may be used", until the provision was revised at the twenty first meeting of the Board (September 2005) through a revision to its appendix B of the methodology. A few CDM project activities for clean cookstoves were registered by then, applying the methodology AMS-I.C, notably the two biogas project activities in Nepal[2].

2. Subsequently the Conference of the Parties (COP) decided that "… the eligibility of land use, land-use change and forestry project activities under the CDM is limited to afforestation and reforestation" (decision 17/CP.7). In response, the Board at its twentieth meeting agreed that (see EB20 meeting report, annex 8, para. 3(b)):

   (a) Where a project activity, which does not seek to obtain temporary certified emission reductions (tCERs) or long-term certified emission reductions (lCERs) from afforestation or reforestation project activities, may directly or indirectly result in a **net increase of carbon pools** compared to what would occur in the absence of the project activity, this **increase should not be taken into account in the calculation of emission reductions**;

   (b) Where a project activity, which does not seek to obtain tCERs or lCERs from afforestation or reforestation project activities, may directly or indirectly result in a **net decrease of carbon pools** compared to what would occur in the absence of the project activity, such changes **should be taken into account** in the calculation of emission reductions by subtracting the corresponding quantities from emission reductions.

3. This Board decision was translated in version 06 of appendix B of the methodology AMS-I.C. as "…. Combustion of any non-renewable biomass shall be accounted in the same way as combustion of fossil fuels. Emissions reductions due to the displacement of non-renewable biomass shall not be accounted ….".

[1] As contained in appendix B of the "Simplified modalities and procedures for small-scale CDM project activities" (version 05 or older).

[2] <http://cdm.unfccc.int/Projects/DB/DNV-CUK1132666829.52/view> <http://cdm.unfccc.int/Projects/DB/DNV-CUK1132671435.09/view>.

4. Subsequently, the CMP, by its decision 7/CMP.1, paragraphs 29 and 30 (December 2005):

   (a) "Welcomes the public call launched by the Executive Board for "alternative methods for calculating emission reductions for small-scale project activities that propose the switch from non-renewable to renewable biomass";

   (b) "Requests the Board to develop, as a priority, a simplified methodology "for calculating emission reductions for small-scale project activities that propose the switch from non-renewable to renewable biomass".

5. Then the CMP, by its decision 1/CMP.2, paragraphs 29 and 30 (November 2006):

   (a) "Invites Parties, intergovernmental organizations and non-governmental organizations to submit to the Executive Board proposals for methodologies for small-scale clean development mechanism project activities that propose the switch from non-renewable biomass to renewable biomass, **addressing issues related to leakage, differentiation between renewable and non-renewable biomass and consistency with paragraph 7(a) of decision 17/CP.7**";

   (b) "Requests the Executive Board to make a recommendation to the CMP, at its third session, on a simplified methodology for calculating emission reductions for small-scale project activities that propose the switch from non-renewable to renewable biomass; **approval of such methodologies by the Executive Board for use for clean development mechanism project activities can occur only after concurrence of the CMP**".

6. Furthermore, the CMP, by its decision 2/CMP.3, paragraph 24 (December 2007):

   (a) "Requests the Executive Board to approve, at its first meeting in 2008, the simplified methodologies for "Switch from non-renewable biomass for thermal application by the user" and "Energy efficiency measures in thermal applications of non-renewable biomass", as recommended by the Executive Board, for use for clean development mechanism project activities, as contained in annexes 3 and 4 to document FCCC/KP/CMP/2007/3 (Part II), incorporating the necessary changes to ensure that **the application of these methodologies introduces new or improves existing end-user technologies and that, in the case of the methodology "Energy efficiency measures in thermal applications of non-renewable biomass", the baseline energy efficiency is measured or is based on referenced literature values**".

7. The Board at its thirty seventh meeting (January−February 2008) approved the revised simplified methodologies "AMS-I.E. Switch from non-renewable biomass for thermal applications by the user" and "AMS-II.G. Energy efficiency measures in thermal applications of non-renewable biomass".

8. The Board, through its 2017 "Annual Report of the Executive Board of the clean development mechanism to the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (FCCC/KP/CMP/2017/5)", paragraph 60, requested guidance from the CMP as follows: "The Board, while considering the matter of eligibility under the CDM of a shift from non-renewable biomass to liquefied petroleum gas for end users, noted that the CMP decided that the Board may, if necessary, revise the methodologies called "Switch from non-renewable biomass for thermal application by the

user" and "Energy efficiency measures in thermal applications of non-renewable biomass" without the need to make recommendations to the CMP (decision 2/CMP.3, paragraphs 24 and 25). The Board considered whether it may initiate the development of a methodology on shifting from non-renewable biomass to low-carbon intensive fossil fuels, such as liquefied petroleum gas, for end-users without going back to the CMP. The Board could not reach a consensus and seeks guidance from the CMP on whether the Board may develop this methodology". The CMP considered the issue but did not provide guidance on the matter.

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Document information

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