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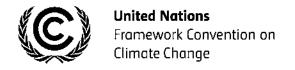
Standardized baseline

Baseline woody biomass consumption for household cookstoves in Malawi

Version 01.0

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1. Introduction

1.1. Background

1. This standardized baseline provides the values for baseline woody biomass consumption per person for household cookstoves to estimate emission reduction from project activities for efficient cookstoves in Malawi.

2. Scope, applicability, and entry into force

2.1. Scope and applicability

2. The scope of the standardized baseline covers the values of baseline woody biomass consumption per person for household cookstoves in Malawi.

3. Clean development mechanism (CDM) project activities can apply this standardized baseline under the following conditions:

   (a)   The project activity is implemented in Malawi; and

   (b)   The approved CDM methodology that is applied to the project activity is small-scale methodology AMS-II.G "Energy efficiency measures in thermal applications of non-renewable biomass" and/or small-scale methodology AMS-I.E "Switch from non-renewable biomass for thermal applications by the user"; and

   (c)   The standardized values are applicable to households using only firewood and/or charcoal in the pre-project scenario as a cooking fuel; households using LPG and/or kerosene in the pre-project scenario as a cooking fuel are not eligible to apply the standardized values in this document;[1] and

   (d)   The standardized values are not applicable to standalone renewable energy based water treatment technologies under AMS-I.E.

4. Project participants who do not wish to use this standardized baseline may alternatively estimate their own values, by applying the latest applicable version of the methodology.

2.2. Entry into force and validity

5. This standardized baseline enters into force upon adoption by the CDM Executive Board on 20 September 2017. This standardized baseline is valid from 20 September 2017 to 19 September 2020.

3. Normative references

6. This standardized baseline is based on the proposed top-down standardized baseline TSB0004 "Baseline woody biomass consumption for cookstoves in Malawi".

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[1] One way to demonstrate this condition is to check and record fuel use at the time of distribution of the project stove.

7. This standardized baseline is derived from small-scale methodology AMS-II.G "Energy efficiency measures in thermal applications of non-renewable biomass" and small-scale methodology AMS-I.E "Switch from non-renewable biomass for thermal applications by the user".

8. For more information regarding proposed new standardized baselines as well as their consideration by the CDM Executive Board please refer to <http://cdm.unfccc.int/methodologies/standard_base/index.html>.

4. Definitions

9. The definitions contained in the Glossary of CDM terms shall apply.

10. The definitions contained in the latest version of AMS-II.G and AMS-I.E shall apply.

11. The standardized baseline values are expressed as:

    (a) **Per person** values based on **woodfuel users**, i.e. residents of households that use firewood and/or charcoal as a cooking fuel in the pre-project scenario;

    (b) **Tonnes of air-dry woody biomass equivalent** (i.e. firewood as such and wood used for the production of the charcoal).

12. The following definitions shall be applied in accordance with FAO Unified Bioenergy Terminology[2].

    (a) **Woodfuel:** "All types of biofuels originating directly or indirectly from woody biomass". In this document, firewood and wood-for-charcoal are grouped as woodfuel;

    (b) **Charcoal:** "Solid residue derived from carbonization distillation, pyrolysis and torrefaction of firewood";

    (c) **Firewood (fuelwood):** "Woodfuel where the original composition of the wood is preserved";

5. Parameters and values

13. This standardized baseline shall be used together with the methodologies AMS-II.G (version 08.0) and/or AMS-I.E (version 07.0)[3]. For the estimation of baseline emissions of project activities, the provisions in the methodology AMS-II.G version 8.0 or AMS-I.E version 7.0 for determining the values of the parameters listed in Table 1 below, do not apply. Instead, standardized values provided in the Table 1 below shall be used.

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[2] FAO (2004): Unified Bioenergy Terminology (UBET)
Accessed on 16 January 2017 from <http://www.fao.org/docrep/007/j4504e/j4504e00.htm>.

[3] The standardized baseline can be used together with future versions of methodologies AMS-II.G or AMS-I.E as long as the requirements related to the parameter mentioned in Table 1 do not change.

Table 1.   Standardized values for AMS-II.G and AMS-I.E

Parameter	Unit	Description	Applicable values		Source
$B_{old,p}$ **under AMS-II.G**	tonnes/ person/ year	Annual quantity of woody biomass that would have been used per person in the household in the absence of the project activity to generate useful thermal energy equivalent to that provided by the project devices	The following conditions apply: (a) Use values in the table below, according to the location of households (i.e. urban areas or rural areas); Annual per capita consumption values [tonnes/person/year] 	Urban areas	Rural areas
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0.88	0.63			See appendix
$BC_{BL,PP,y}$ **under AMS-I.E**	tonnes/ person/ year	Average annual consumption of woody biomass per person before the start of the project activity	(b) Use the classification included in official documents or government publications to identify urban and rural areas.		

Appendix. Rationale and justifications for the standardized value for baseline woody biomass consumption

1. Introduction

1. This appendix provides the rationale and justification for the standardized values of baseline woody biomass consumption per person in Malawi ($B_{old,p}$ under AMS-II.G and $BC_{BL,PP,y}$ under AMS-I.E). The relevant data quality objectives of the "Guidelines for quality assurance and quality control of data used in the establishment of standardized baselines" have been followed while developing the proposed standardized baselines.

2. The standardized values can be used to determine the parameter $BC_{BL,PP,y}$ under AMS-I.E (Average annual consumption of woody biomass per person before the start of the project activity) and the parameter $B_{old,p}$ under AMS-II.G (annual quantity of woody biomass that would have been used per person in the household in the absence of the project activity to generate useful thermal energy equivalent to that provided by the project device).

2. Standardization of baseline woody biomass consumption - Analysis

3. Taking into account national circumstances in Malawi, the DSB has defined a country-specific default value for baseline woodfuel consumption per person, according to the usage of fuels and the location of households (i.e. charcoal or firewood use in urban areas or rural areas), based on a review of literature and project design documents (PDDs) and programme design documents (PoA-DDs) available for the country.

4. The registered PDDs and PoA-DDs from the country as well as literature such as national studies and reports were reviewed. The values reported in the registered PDDs and PoA-DDs and in the literature are shown in Table 1. Details of the studies of the PDDs and PoA-DDs listed in the table are summarized in the Attachment. A detailed explanation of values reported in the literature is included in paragraphs below.

5. The sources provide the data in a variety of formats (total consumption in all sectors, tons/household-year, kg/person-day as average for whole population or for all users or for main users only, etc.). For easy comparison, all the data for firewood and for charcoal are presented as woody biomass equivalent in tonnes (air-dry)/person-year[1], after appropriate conversion.

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[1] The standardized values are based on data derived in the literature for main users, therefore, the standardized values are applicable to households that use exclusively biomass (woodfuel and/or charcoal) for cooking in the pre-project scenario. Therefore, CDM project activities/PoAs may apply the standardized values for the households that use exclusively biomass in the pre-project scenario.

Table 1. **Average annual consumption of woody biomass per person reported in PDDs, PoA-DDs and literature reviewed for Malawi**

Source	remarks	Ref. year	Standardized values in tonnes air-dry per capita					
			Urban areas			Rural areas		
			Annual **firewood** consumption	Annual **charcoal** consumption (wood eq.)	Annual total **woodfuel** (wood eq.)	Annual **firewood** consumption	Annual **charcoal** consumption (wood eq.)	Annual total **woodfuel** (wood eq.)
Improved Cook Stove Project 1 and 2, Nkhata Bay District, Malawi	PDD 9933 and 9935 (own baseline surveys)	2012			1.008			1.008
Efficient Cook Stove Programme: Malawi	PoA DD 9706 (own baseline surveys)	2011 (Stratum 1)				1.071		
		2011 (Stratum 2)				0.942		
Improved Cookstoves Program for Malawi and cross-border regions of Mozambique	PoA DD 9558 (own baseline surveys)	2012				0.651		
CDM Africa Sustainable Energy Programme	PoA DD 9934 (own baseline surveys)	2012		1.095				
		2013				0.631		
Promotion of Energy Efficient Cook Stoves within Southern African Development Community (SADC)	PoA DD 9780 (own baseline surveys)	2012				0.467		
Malawi Biomass Energy Strategy	GoM, 2009 [1]	2008	0.699	0.938		0.625	1.395	

References and notes:
Government of Malawi. 2009. Malawi Biomass Energy Strategy. Prepared by MARGE International. Accessed on 16 January 2017 from
<http://www.euei-pdf.org/sites/default/files/field_publication_file/EUEI_PDF_BEST_Malawi_Final_report_Jan_2009_EN.pdf>.

6. "Malawi Biomass Energy Strategy" prepared by the Government of Malawi in 2009 ("BEST report") provides average per capita firewood (fuelwood) and charcoal consumption values in rural and urban areas as values relative to the total population i.e. total consumption is divided by the population. The development process of the BEST report included the survey of energy consumption habits of 851 rural households in 22 districts. The household survey included a questionnaire and an assessment of fuel consumption based on direct weighing.

7. Per capita consumption values relative to the total population were transformed to the values relative to main users i.e. total consumption divided by share of population that use firewood or charcoal, based on the information on the penetration (i.e. the source of fuels used for cooking in urban and rural areas) from the Integrated Household Survey 2010-2011 (IHS 2011) made by the National Statistical Office of Malawi. See Table 2 for the values used for conversion.

8. The transformed **firewood** consumption value by main rural users is **0.63** tonnes/person-year, and by main urban users is **0.70** tonnes/person-year. The transformed per capita

charcoal consumption value by main rural users is **1.40** tonnes[2] of wood-equivalent/person-year, and by main urban users is **0.94** tonnes of wood-equivalent/person-year.

Table 2.   Population data, firewood and charcoal penetration in percentages

	Rural population[3] ('000)	Urban population ('000)	Total population ('000)	Rural firewood penetration[4]	Urban firewood penetration	Rural charcoal penetration	Urban charcoal penetration
2008	11,304	2,326	13,630	96.2	41.9	2.3	44.6

3.   Recommendation

9.   In analysing all available data sources in the Table 1, it was considered that the most reliable data source should be selected, taking into account several factors such as i) whether it is primary or secondary data, ii) what is the geographical coverage of the survey, iii) what is the vintage of the survey, iv) whether it is conservative.

10.   The values reported in PDDs and PoA-DDs are primary data, based on own baseline sampling surveys. The values from Biomass Energy Strategy prepared by the Government of Malawi in 2009 (BEST report) are comprehensive, covering both urban and rural areas. Considering that the values from the BEST report are comparable and conservative as compared to the values reported in PDDs and PoA-DDs, the following values are recommended as standardized values for the baseline woody biomass consumption per person in Malawi:

(a)   Use values in Table 3 below, according to the location of households (i.e. urban areas or rural areas). Recommended values for urban and rural areas were calculated as a weighted-average values combining the use of firewood and charcoal, based on the penetration rates reported in recent studies (i.e. database published by USAID);[5]

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[2]   In the case of Malawi, the use of charcoal as main fuel in rural households is rare (only 2.3%, according to the Integrated Household Survey 2010-2011 made by the National Statistical Office of Malawi). In such cases, even small inconsistencies between total rural charcoal consumption estimates and penetration estimates (which are used to calculate per capita consumption estimates) could produce wide margins of error in the calculation of per capita consumption. Hence charcoal consumption in rural areas is not included.

[3]   Population data is from the BEST report mentioned in paragraph 7 of this appendix.

[4]   Penetration data is from the Integrated Household Survey 2010-2011 (IHS 2011) made by the National Statistical Office of Malawi. See the table 8.5 "Percentage distribution of households by main source of fuels used for cooking according to background characteristics, Malawi 2011". Accessed on 16 January 2017 from <http://www.nsomalawi.mw/publications/integrated-household-survey/third-integrated-household-survey-ihs3.html>.

[5]   USAID (United States Agency for International Development) (2017), USAID Database, STATcompiler, <www.statcompiler.com>, accessed on 16 January 2017. The penetration data is comparable to that of IHS2011.

Table 3.   Annual per capita consumption values [tonnes/person-year]

Urban areas			Rural areas		
Firewood	Charcoal (wood equivalent)	**Recommended value for urban areas**	Firewood	Charcoal (wood equivalent)	**Recommended value for rural areas**
0.70	0.94	**0.88**	0.63	-	**0.63**

(b)   Use the classification included in official documents or government publications to identify urban and rural areas.

Attachment.   The values reported in PDDs and POA-DDs

1.   The following provides more details of the studies of the PDDs and PoA-DDs listed in Table 1 below:

   (a)   **PA 9933:** A survey involving a questionnaire and a series of Kitchen Performance Tests (KPTs) has been conducted by the project implementer, RIPPLE Africa, within the project area to determine the baseline woody biomass consumption. A sample of households from the project area was selected to participate in the survey. The KPT survey results showed that the conservative estimate for the annual consumption of woody biomass per household is 5.04 [tonnes/HH/year]. The number of operating stoves in the project is limited to one per household, so B_{old} = 5.04 [tonnes/device/year]. Assuming an average household size of 5 persons, annual consumption per person would be **1.01 [tonnes/person-year]**. The PDD also compares this figure with other studies listed below:

      (i)   The FAO report "The role of Wood Energy in Africa"[1] shows that the household wood fuel consumption in Malawi for 1996 was 12,160,000 m^3. This is equivalent to a household wood fuel use of 4.16 [tonnes/HH/year];

      (ii)   The report[2] on the wood fuel choice of rural households in Malawi analyzed the data collected from two studies on household wood fuel use in Chimaliro and Liwonde forest reserves located in the Central/Northern and Southern Regions of Malawi, respectively. This study reported the average annual household wood fuel consumption based on forest type (forest reserves, customary forests and plantation forests), and the value was around 4.5 [tonnes/HH/year] for all sources;

   (b)   **PA 9935:** The same value as that of PA9933 was used in the PDD;

   (c)   **PoA 9706:** The baseline woody biomass consumption was determined using the sampling survey method in accordance with the sampling standard (Source: "Baseline Report: Alchemy Carbon CDM Efficient Cook Stove Programme Malawi", CO2Balance UK LTD, 29/2/2012). Two strata were identified within Malawi, and the Kitchen Performance Test was performed on 90 households in Stratum 1 and 89 in Stratum 2. The results of the Kitchen Performance Test are as follows:

      (i)   **For Stratum 1** (districts where forest cover per person exceeds 0.005 [km^2/capita]), the average household size was 5.28, and the woody biomass consumption per household (firewood) was 15.5 [kg/HH/day]. Hence, the annual consumption per person is **1.07 [tonnes/person-year]**;

      (ii)   **For Stratum 2** (districts with less than 0.005 [km^2/capita] forest cover), the average household size was 4.88, and the woody biomass consumption per

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[1]   Forestry Department, Food and Agriculture Organization of the United Nations, Rome, Italy. 1999. The role of Wood Energy in Africa, Wood Energy Today for Tomorrow Regional Studies. 1999.

[2]   Modeling choice of fuelwood source among rural households in Malawi: A multinomial probit analysis. Jumbe, C. B.L. and Angelsen, A. 2011. 2011, Energy Economics, Vol. 33.

household (firewood) was 12.6 [kg/HH/day]. Hence, the annual per capita consumption is **0.94 [tonnes/person-year]**;

(d)   **PoA 9558:** The baseline firewood consumption in rural households was determined using the sampling survey method in accordance with the sampling standard (Source: "Malawi Firewood Baseline Report 2012 (HED Consulting Ltd.)"). Two clusters were considered i.e. (i) Northern and Central regions of Malawi where per capita fuel consumption is similar and (ii) Southern region of Malawi, where wood is relatively scarce and per capita wood use is lower. The survey was carried out during May 2012. Adjustments were made to account for seasonal variation in firewood consumption and the simultaneous use of multiple stoves. The results of the survey are as follows:

Table 1.   Average annual consumption of woody biomass per person (Based on the draft survey report as of 11 December 2012)

	Daily per household [kg/HH/day]	Yearly per person [tonnes/person-year]
National mean household firewood consumption in rural households, adjusted for seasonal trends	9.34	0.68
	Daily per stove [kg/stove/day]	Yearly per stove per person [tonnes/stove/person-year]
National mean firewood consumption in rural households, adjusted for seasonal changes and patterns of multiple stove use	8.92	0.65
(i) Northern/central (n=96)	9.22	0.67
(ii) Southern (n=97)	8.62	0.63

Note: An average household size of 5 persons is assumed in Table 1 above. To calculate the annual amount of woody biomass equivalent from the amount of consumed charcoal, a mass basis conversion factor of 6.0 was used.

(e)   Analysis of the data from all locations concludes that there is no statistically significant difference between them in terms of mean household firewood consumption. Thus, the average baseline household firewood consumption, adjusted for multiple stove use, across the whole of Malawi is 8.92 [kg/stove/day] or 0.65 tonnes/stove/person-year;

(f)   **PoA 9934:** The baseline charcoal consumption in urban areas was determined using the sampling survey method in accordance with the sampling standard (Source: "Malawi Firewood AMS IE Baseline Report 2013 (HED Consulting Ltd.)"). Urban areas are defined as settlements with population > 4,765 at the time of the 2008 Census. The study was carried out in three provincial capitals (population > 100,000) and three smaller settlements (population 4,765 – 100,000) during the dry hot season in August and September 2012. Settlements with a population of < 4,765 were not targeted by the charcoal stove dissemination project, and so were not included in this study sample. 583 samples were taken in total;

(g)   Adjustments were made to account for seasonal variation in charcoal consumption and the simultaneous use of multiple stoves. The results of the survey are as follows:

Table 2.   Average annual consumption of woody biomass (woodfuel) per person (wood equivalent)

	Daily per stove [kg/stove/day]	Yearly per stove per person [tonnes/stove/person-year]
National mean household charcoal consumption in urban areas, adjusted for seasonal trends	2.64	1.16
National mean charcoal consumption in urban areas, adjusted for seasonal changes and patterns of multiple stove use	2.50	1.10
(i) Northern Capital (charcoal) (n=91)	2.70	1.18
(ii) Northern Smaller Settlement (charcoal) (n=96)	2.50	1.10
(iii) Central Capital (charcoal) (n=99)	2.12	0.93
(iv) Central Smaller Settlement (charcoal) (n=101)	2.44	1.07
(v) Southern Capital (charcoal) (n=98)	2.84	1.24
(vi) Southern Smaller Settlement (charcoal) (n=98)	2.43	1.06

Note: An average household size of 5 persons is assumed in Table 2 above.

(h)   Analysis of the data from all locations concluded that there was a statistically significant difference between the study locations in terms of mean household charcoal consumption. Hence, they cannot be treated as a single homogeneous cluster;

(i)   In addition to the study report on charcoal use in urban areas, the PoA-DD of PoA9934 also includes the study report for firewood use in rural households. While PoA9558 uses the report prepared on December 2012, PoA9934 uses the report updated on July 2013. Therefore, there is a slight difference in the values used;

Table 3.   Average annual consumption of woody biomass per person (Based on the final draft survey report as of 29 July 2013)

	Daily per household [kg/HH/day]	Yearly per person [tonnes/person-year]
National mean household firewood consumption in rural households, adjusted for seasonal trends	9.26	0.68
	Daily per stove [kg/stove/day]	Yearly per stove per person [tonnes/stove/person-year]

National mean firewood consumption in rural households, adjusted for seasonal changes and patterns of multiple stove use	8.64	0.63
(i) Northern/central (n=103)	8.97	0.65
(ii) Southern (n=103)	8.31	0.61

Note: An average household size of 5 persons is assumed in the Table 3 above.

(j)   **PoA 9780:** The value of baseline woody biomass consumption was sourced from a baseline assessment study report conducted by an independent third party, in 2012. The study has shown that the per capita consumption of firewood in a rural household at 1.28 [kg/person-day], which is equivalent to **0.47 [tonnes/person-year]**.

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Document information

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