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Washington DC, April 16, 2007

Ref: Call for public input under the paragraph 29 of the Decision 8/CMP.2 - proposals for methodologies for small-scale clean development mechanism project activities that propose the switch from non-renewable biomass to renewable biomass.

Honorable Members of the CDM Executive Board,

In response to the call referred to above, the proposals to address the issues of non-renewable biomass are outlined and incorporated in the proposed new methodology, which builds on the Small Scale Working Group's methodologies AMS.I.E and AMS. II.G and proposes suitable revisions to these proposals by incorporating the inputs supporting the CoP/MoP2 decision. This submission provides inputs in the following contexts.

Issues noted in the Paragraph 29 of the CoP/MoP2 decision 1/CMP.2, specifically;

i. Proposals for methodologies for small-scale CDM project activities that propose the switch from non-renewable biomass to renewable biomass
ii. Ways of how to address leakage
iii. Differentiation between renewable and non-renewable biomass
iv. Consistency with paragraph 7 (a) of decision 17/CP.7

And the issues highlighted in the CDM Executive Board discussions:

v. Leakage and monitoring of project activities associated with non-renewable biomass.

The elements of new methodology presented in Annex I proposing the revisions to AMS.I.E could be applied *mutatis mutandis* to AMS.II.G – *Energy Efficiency Measures in*

Thermal Applications of Non-renewable Biomass by incorporating the energy efficient biomass interventions and calculating the associated fossil fuel equivalent energy savings under AMS.II.G in line with the proposals made under the AMS.I.E. Therefore, separate Annex to address the revisions to AMS.I.G is not included with this submission.

The World Bank appreciates the consideration of the proposals made in this submission.

Yours sincerely,

Johannes Heister
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Switch from Non-Renewable Biomass to Renewable Energy Alternatives

1. Introduction

This World Bank submission is in response to the CoP/MoP2 call *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.*

In November 2005, the Executive Board of the Clean Development Mechanism (CDM) decided to cancel a small-scale CDM methodology that allowed for projects to receive credits from reducing the use of "non-renewable biomass". This meant that projects that replace or improve inefficient use of biomass for household energy purposes (typically fuel wood) would no longer be eligible under the CDM. The Conference of Parties in December 2005 acknowledged the significance of such projects in promoting sustainable development and recognized such projects as the only opportunities available to most developing countries and the poor households in these countries to participate in the CDM. The CoP/MoP1 requested the CDM Executive Board to explore the development of suitable methodologies. However, the CDM Executive Board could not approve the proposals of the Small-scale Working Group considering the unresolved issues such as leakage in the Small Scale Working Group's methodology proposals. The issue was then discussed at the CoP/MoP2, which recommended the Parties to make progress by initiating call for public inputs on the issue and to undertake follow up to comply with the paragraphs 29 and 30 of the decision 1/CMP2 outlined below:

> *29. 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;*

30. Requests the Executive Board to make a recommendation to the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, 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 Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol;"

Considering the large potential of biomass based household energy projects in mitigating GHG emissions and their positive impact on sustainable development in terms of alleviating indoor air pollution and productive use of time spent in biomass collection on other income generating activities, it is urgent to resolve the technical and methodological issues and make approved methodologies available to the project participants so as to reduce the institutional uncertainty and to enable member countries that have marginal role so far in the CDM to actively participate in the Mechanism (e.g., less than 1% of all Certified Emission Reductions so far originate from Africa).

In the above context, this World Bank submission presents proposals that seek to operationalize the decisions of the CoP/MoP2 and address the outstanding issues of the CDM Executive Board discussions on the topic. This submission specifically focuses on the following aspects.

Issues noted in the Paragraph 29 of the CoP/MoP2 decision 1/CMP.2:

i. Proposals for methodologies for small-scale CDM project activities that propose the switch from non-renewable biomass to renewable biomass
ii. Ways of how to address leakage
iii. Differentiation between renewable and non-renewable biomass
iv. Consistency with paragraph 7 (a) of decision 17/CP.7

And the issues highlighted in the CDM Executive Board discussions:

(i) Leakage and monitoring of project activities associated with non-renewable biomass.

This submission is organized as follows. **Section 2** outlines the issues highlighted in the CoP/MoP2 decision and CDM Executive Board discussions, and presents relevant proposals to. **Section 3** presents a small-scale methodology that proposes revisions to the Small Scale Working Group's proposal I.E - Switch from Non-Renewable Biomass for Thermal Applications by the User in Annex I.

2. Issues related to non-renewable biomass and relevant proposals

The issues outlined in the Paragraph 29 of the CoP/MoP2 decision.1/CMP2 and those debated in the CDM Executive Board are briefly discussed and relevant proposals are outlined below. The proposals are incorporated in the new methodology in Annex I proposes to replace non-renewable biomass with renewable energy technologies and renewable biomass. .

(i) Proposals for methodologies for small-scale CDM project activities that propose the switch from non-renewable biomass to renewable biomass

In countries where projects are implemented to enhance the share of renewable biomass to meet the household needs of local communities, the CDM could encourage investments in dedicated high density renewable biomass production projects as part of the projects to replace non-renewable biomass; small scale afforestation and reforestation project activities and as well as projects that support production of woody biomass in croplands for meeting household energy needs. By standardizing the methods to assess and monitor the renewable biomass production projects, such projects could be implemented to avoid or limit the use of non-renewable biomass.

Proposals:

To implement the project activities that switch from non-renewable biomass to renewable biomass, the following proposals are outlined, which are also incorporated in the methodology presented in Annex I.

(a) The project participants should establish the proportion of non-renewable biomass used under the baseline scenario using the household surveys and as

well as evaluating biomass production sources with either indicator-based assessment or quantitative assessment as elaborated in the methodology.

(b) The renewable biomass production undertaken to replace the non-renewable biomass forms the part of the project scenario should avoid the double counting of the biomass production that is used in the replacement of non-renewable biomass.

(c) In case one or more renewable biomass production projects are implemented, whose biomass resources used to replace non-renewable biomass in the project, such biomass production and its replacement of the non-renewable biomass should be accounted transparently. This shall be demonstrated through verifiable contractual agreements demonstrating the supply of renewable biomass to replace the non-renewable biomass under the baseline consistent with Annex 8 of the EB 20 decision on the accounting of renewable biomass[1].

(d) The monitoring and accounting methods of renewable biomass are implemented in a way that permits transparent quantification of the renewable biomass production and demonstration of its repacement of the non-renewable biomass.

(e) The project emissions associated with production of renewable biomass are ignored under this methodology under the assumption of energy equivalence between non-renewable biomass that is replaced by the renewable biomass.

(ii) Ways of how to address leakage

Leakage refers to the net change in anthropogenic emissions by sources of greenhouse gases (GHG) that occurs outside the project boundary, and which is measurable and attributable to the CDM project activity.

If project participants demonstrate that the small-scale project activity does not result in the diversion of non-renewable biomass saved under the project by non-project households or does not trigger activities that lead to an increase in the non-renewable biomass use and attributable to the project activity outside the project

[1] http://cdm.unfccc.int/EB/020/eb20repan08.pdf

boundary, leakage assessment is not required. Otherwise, leakage should be assessed and accounted.

Leakage relating to non-renewable biomass should be assessed using general guidelines of the small-scale methodologies. A simplified leakage assessment based on the objective measures could be used to assess the leakage. In situations where leakage is established, the methodology recommends the use of a discounting factor approved for simplified small-scale afforestation and reforestation methodology to account for leakage.

Proposals:

The proposals for leakage assessment and its accounting include:

a) Identification of potential sources of leakage, which could relate to:

   i. Use/diversion of non-renewable biomass saved under the project by the non-project households

   ii. Use of non-renewable biomass, saved due to the project activity to justify other CDM projects.

   iii. Increase in the harvest of non-renewable biomass outside the project boundary.

b) In order to assess the leakage, monitoring data on the status of biomass within the project boundary and biomass in the 3-5 km radius outside the project boundary and patterns of household energy use over a 3-year period after the starting date of the project should be considered to determine the prevalence of leakage.

c) Project developers should undertake leakage assessment as part of the project monitoring by defining the area of project influence and monitoring the biomass use using household surveys within the project area and outside the project boundary. The potential leakage could depend on several location specific factors. However, it is reasonable to assume a radius of 3 to 5 km

radius outside the project boundary to reflect the leakage associated with the project. The radius defined for leakage assessment assumes the reasonable distance those users in biomass-using households travel to areas outside the project boundary to collect the biomass.

d) The project monitoring data and annual household surveys of the project participants could be used in the assessment of leakage. For this purpose, transparent and measurable indicators involving the biomass production and usage in the area should be used so that leakage assessment is transparent. The increase in the biomass harvests in 3 to 5 km radius in relation to the project baseline scenario is considered leakage. If the biomass harvests outside the project boundary

e) If the leakage assessment reflects an increase in the harvest of non-renewable biomass harvested by the non-project households within the project and project households outside the project boundary is less than 10% of the energy equivalence saving achieved from the displacement of non-renewable biomass, then no leakage is assumed to have occur. If the increase in the use of non-renewable biomass is between 10% and 50% of the energy equivalence saving achieved from the displacement of non-renewable biomass, then leakage is assumed to have occurred. In such cases, a 15% discount factor should be applied to the emission reductions to account for the leakage associated with non-renewable biomass. The leakage accounting adopted is on the guidelines of the simplified small scale methodology for afforestation and reforestation projects.

(iii) Differentiation between renewable and non-renewable biomass

As biomass use in a region could include non-renewable and renewable sources, their differentiation is a priority. The proposals in this submission seek to achieve transparent differentiation of biomass sources taking into account the qualitative and quantitative measures of biomass production and use patterns in the project area.

Proposals:

The two methods - qualitative indicator-based assessment and a quantitative assessment proposed in the accompanying methodology seek to differentiate the biomass sources into non-renewable and renewable categories.

1) *Indicator-based assessment*:

The qualitative indicator-based assessment is proposed for situations where data on biomass sources in terms of density, production and renewability are not available. In such cases, indicators could be based on official records, satellite images, local studies and published literature on biomass scarcity in the region such as distance traveled by households, time spent by households in the collection of biomass fuel. Additionally, data and indicators from household surveys on biomass energy use conducted as part of baseline assessment could be used to establish the differentiation between non-renewable biomass and renewable biomass and their respective shares in the baseline scenario

2) *Quantitative assessment*:

In case of availability of data on the biomass production from forest and cropland sources, a quantitative assessment could be used, which entails collection of data on household consumption and inventory data on forest type, area, composition, density, mean annual growth and biomass production. When it can be proven that over the same time period, biomass consumption of households is larger than the biomass increment that could be sustainably harvested, and then biomass is considered non-renewable.

The detailed methods of indicator-based assessment and quantitative assessment are outlined in the proposed methodology.

(iv) Paragraph 7a of the Marrakech Accords on the eligibility of land use activities

Paragraph 7a of the Marrakech Accords states that eligibility of land use, land-use change and forestry project activities under the clean development mechanism is limited to afforestation and reforestation activities. It is clarified that the proposals outlined below in this submission are in agreement with the modalities and procedures of the Marrakech Accords, including the Paragraph 7a.

Proposals:

Taking into account the Paragraph 7 (a) of decision 17/CP.7, which limits the eligibility of land use activities under the Marrakech Accords to afforestation and reforestation project activities, the proposed methodology the assumes that over time, fossil fuel use will increase in the absence of the project. Such an assumption although is a less probable evolution of the baseline, it is made to address the concerns that land use activities other than afforestation and reforestation activities such as avoided deforestation are out of the purview of the negotiated agreement of Parties under Marrakech Accords and articulated in the Paragraph 7a**.**

The emissions and emission reductions are calculated assuming that the anticipated future use of fossil fuel substitutes in the baseline. The energy equivalence between non-renewable biomass and fossil fuel is used to reflect the fossil fuel energy equivalence of non-renewable biomass. The equivalence between fossil fuel energy and non-renewable biomass usage in the baseline is established recognizing the inefficient combustion of non-renewable biomass. Therefore, combustions efficiencies of stove appliances of non-renewable biomass and fossil fuels are ignored in computing the energy equivalence between non-renewable biomass and fossil fuels. Therefore, fossil fuel energy equivalent of non-renewable biomass and net calorific value of fossil fuels are used to calculate the fossil fuel energy equivalence of non-renewable biomass. The approach of energy equivalence between non-renewable biomass and fossil fuel substitutes permits the representation of the baseline in line with the interpretations of the Paragraph 7a.

In the project scenario, where renewable energy technologies or renewable biomass interventions are expected to replace the non-renewable biomass, the fossil fuel energy equivalence of renewable energy technologies or renewable biomass is used in calculating the emissions and emission reductions.

(v) Monitoring

The monitoring of project renewable technology interventions and renewable biomass sources were raised as the potential concerns in the discussions of the CDM Executive Board on Small Scale Working Group's methodology proposals AMS.I.E and AMS.II.G.

The World Bank appreciates the concerns of the CDM Executive Board and therefore, incorporates more robust approaches to monitoring of project activities.

Proposals:

The project *ex post* monitoring should cover the following aspects

(a) Household monitoring to evaluate the adoption and operation of renewable technologies

The ex post annual monitoring of the representative sample project households should be done to assess the adoption of renewable technologies, usage patterns, discontinuation of the use of renewable technologies, including the malfunction and disrepair of the equipment will be monitored. The monitoring data should be used to assess and to account for the project emissions associated with the non-use of renewable energy technologies and malfunctioning equipment.

(b) Monitoring of the projects involving renewable biomass production

With regard to project involving renewable biomass production, the monitoring regime implemented for the project is expected to collect the relevant data and information on plantation activities used to estimate the quantity of renewable biomass produced from the project to displace the non-renewable biomass.

(c) Biomass monitoring in the areas outside the project boundary

Monitoring of biomass production and harvest patterns in the 3-5 km radius outside the project boundary is intended to demonstrate the occurrence/non-occurrence of leakage. If the leakage estimated from the project monitoring is greater than 5% of the energy equivalence savings achieved under the project, then leakage is assumed to occur. In order to account for the leakage at discount of 15% is applied to the emission reductions, which is in line with the provisions of the simplified small-scale aaforestation and reforestation methodology.

3. Proposed methodology

The proposals discussed above are incorporated into a new methodology presented in **Annex I**. It seeks to revise the proposals of the Small Scale Working Group – AMS.I.E. The methodology is conservative in that it uses a fossil fuel baseline, it suggests cost-effective methods of leakage assessment and simplified and yet practicable steps with the choice in the use of indicator-based assessment or quantitative assessments to demonstrate the share of non-renewable biomass and well as rigorous methods of *ex post* project monitoring to account for project emissions and leakage

Annex I

The methodology proposed below seeks to revise the Small Scale Working Group's proposal I.E - Switch from Non-Renewable Biomass for Thermal Applications by the User.

I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User

Technology/ Measure

This category involves the switch from non-renewable biomass to renewable sources of energy. The renewable technologies could include biogas stoves, solar cookers and electricity from wind solar photovoltaics and measures switch to renewable biomass.

Boundary

The project boundary is the physical, geographical area of the use of non-renewable biomass or the renewable energy.

The project activity covers a group of households that reside in an area that could be delineated with the project boundary and the users/households depend on non-renewable biomass to meet the energy or similar energy needs. The project entity is responsible for implementing the project and it is expected to have complete information on the energy use patterns of all users/households participating in the project.

The project boundary is delineated by the area of influence of users/households that use non-renewable biomass in the baseline. The boundary is delineated taking into account the feasible distance over which non-renewable biomass gets transported in rural settings, e.g., for use in meeting household energy needs or other rural energy needs. In such situations, it is possible to establish the clear demonstration of the relationships between biomass production and its use by the households in the project area

In the case of urban areas, households could have access to multiple fuel types such as fossil fuels and biomass fuels (in the form of fuelwood or charcoal). Furthermore, the biomass fuels are transported over long distance covering large peri-urban area, possibly using motorized transport. Such projects that do not have clear and transparent relationship between the sources of biomass production and consumption are not covered under this methodology[2].

Baseline

It is assumed that in the absence of the project, the baseline scenario reflects a trend towards increased in the proportion of households using fossil fuels for meeting similar thermal energy needs. However, such shifts are likely to vary depending on the socio-economic settings. The biomass use in households is assumed to comprise non-renewable and renewable components under the baseline scenario.

[2] Urban projects dealing with the energy and commercial use of biomass should be considered under a separate methodology that incorporates the elements of program of activities that address relevant policies and programs related to the regional energy use context.

Quantity of household biomass use in the baseline scenario

Average biomass energy use in a **sample** household:

$$\overline{Q}_{y\_B,h,BL} = \frac{\sum_{h=1}^{n_{BL}} \sum_{i=1}^{I} Q_{y\_B,i,h,BL}}{n_{BL}} \quad (1)$$

where:

$\overline{Q}_{y\_B,h,BL}$ = average quantity of biomass use in a sample household for meeting household energy purposes in the baseline

$Q_{y\_B,i,h,BL}$ = amount of biomass from source *i* (forest, cropland etc) in a sample household *h* in the baseline scenario; tonnes

n_{BL} = sample size in terms of number of households selected for household survey in the baseline

I = total number of biomass sources contributing to the energy needs of a sample household (I-1,2,3,…I)

Standard deviation of the biomass use of the sample representing the baseline:

$$S_{Qy\_B,h,BL} = \sqrt{\frac{(Q_{y\_B,h,BL} - \overline{Q}_{y\_B,h,BL})^2}{n_{BL} - 1}} \quad (2)$$

where:

$S_{Qy\_B,h,BL}$, = standard deviation of biomass use for sample group in the baseline scenario; tonnes

$Q_{y\_B,h,BL}$ = amount of biomass use from source *i* in a sample household *h* in the baseline; tonnes

$\overline{Q}_{y\_B,h,BL}$ = average biomass use of sample households from source *i* in the baseline; tonnes

n_{BL} = sample size in terms of number of households selected for household survey in the baseline; dimensionless

Quantity of biomass used by households from all sources in the baseline

$$Q_{y\_B,BL} = N_h\left(\overline{Q}_{y\_B,BL} - z \cdot SE\right) \quad (3)$$

where:

$Q_{y\_B,BL}$ = quantity of biomass use in the baseline; tonnes

$SQ_{y\_B,BL}$ = standard deviation of quantity of biomass use in the sample group representing the baseline; tonnes

$\overline{Q}_{y\_B,h,BL}$ = average quantity of biomass use in a sample household in the baseline; tonnes

$N_{h,}$ = total number of households included in the project; dimensionless

n_h = number of sample households selected for survey in the baseline; dimensionless

z = standard normal distribution for a confidence level of 95% (z at 5% significance, 1.96)

SE = standard error of quantity of biomass use; $S_{Qy\_B,BL} / \sqrt{n_{BL}}$

Demonstration of the use of non-renewable biomass

The project participants shall demonstrate the usage of non-renewable biomass and estimate its share in the total biomass using either of the two methods outlined below.

(1) Indicator-based assessment

(2) Quantitative assessment

(1) Indicator based assessment

Indicators related to production and consumption of biomass in the project boundary should be used to demonstrate the use of non-renewable biomass for meeting household energy needs in the baseline

Data sources:

The project participants shall use the most recent data and information that are available in defining the indicators. The data and information relevant to the project area collected from official sources should be considered on priority. In the absence of official data, published data, secondary studies and regional studies could be used. In the absence of local and regional data and information, =relevant data and guidance from Good Practice Guidance for Land Use, Land Use Change and Forestry (GPG/LULUCF) (IPCC 2003) should be used in selecting and evaluating the indicators.

Step 1: Indicators based on woody biomass production

The project participants shall use following information on the biomass supplies to demonstrate the biomass production

a. data and information from official records, satellite data, local studies and published literature that provide evidence on the negative changes in the forest area or low vegetation density associated with biomass use patterns of households observed in the baseline.

b. data and information from official records, local studies and published literature demonstrating a decline in the number of trees per ha and woody biomass in cropland.
c. information from official records, satellite data, local studies demonstrating the small share of renewable biomass relative to the total biomass demand for meeting household energy needs.

Step 2: Indicators based on household biomass use

The data from official records, household surveys and/or participative appraisal methods could be to demonstrate the relationship between woody biomass production and use patterns of households. The household survey data and official records should demonstrate conformity with the following indicators.

1) Biomass fuels constitute at least 50% or more of household energy used for cooking and heating in the project area.
2) The average distance of travel to woody/ non-woody sources of biomass demonstrates the access of households to biomass use and area of influence of the project outside its boundary .
3) Average time spent by households in the collection of fuelwood and supported by the published data and official records on the scarcity of biomass fuels to demonstrate the non-renewable status of biomass.
4) The access of households to biomass production sources that yield less biomass increment than is required to meet the household requirements for energy with information preferably covering 5 to 10 years prior to the start of the project.

Step 3: Demonstrate the use of non-renewable biomass by households in the baseline using indicators from step 1 and step 2.

The data and indicators of biomass use in households and biomass production in the project boundary and data from secondary sources should =be used to demonstrate the household use of biomass, $Q_{y\_B,BL}$ exceeds the quantity of renewable biomass increment that I s available for harvest in the project area.

$$Q_{y\_B,BL} > H_{F\_Biomass_F} \quad .(4)$$

where:

$Q_{y\_B,BL}$ = quantity of biomass use for household energy purposes in the baseline as assessed from the household survey data; tonnes

$$H_{F\_Biomass} = G_{Biomass} \bullet H_F \quad .(5)$$

where:

The information on reachable forest/cropland area, average density of forest and mean annual increment of biomass from different sources as reported from official data, satellite imagery, published data and local studies (tonnes/year) shall be used to assess the annual increment that could be harvested. It is calculated as follows:

$G_{Biomass,}$ = annual increment of woody biomass from forest/woodland/croplands sources that could be used as fuelwood or for making charcoal for household energy purposes; tonnes.

$$G_{Biomass} = [(A_F + MAI_{WB,F} \bullet P_{Fwood} \bullet D_F) + (A_C \bullet MAI_{WB,C} \bullet P_{Fwood})] \quad .(6)$$

A_F ` = area of accessible forest; hectares

$MAI_{WB,F}$ = woody mean annual increment of forests/woodlands (m^3/ha/year)

P_{Fwood} = Proportion of aboveground woody biomass used as fuelwood / for making charcoal

D_F = average density of forest/woodland (tons/m^3)

A_C = accessible cropland; hectares

$MAI_{WB,C}$ = mean annual increment of woody biomass in cropland (m^3/ha/year)

$H_{F\_Biomass}$ = annual increment of woody biomass from forest/woodland/croplands sources that could be harvested for household energy purpose as assessed from the guidelines in step 1.

H_F = proportion of annual biomass increment that could be used as fuelwood; percent

Default value of 50% of annual increment of fuel wood share of woody biomass that could be harvested for meeting household energy purposes.

Step 4: Estimation of the quantity of non-renewable biomass

$$Q_{y\_NRB} = Q_{y\_B,BL} - H_{F\_Biomass} \quad (7)$$

where:

$Q_{y\_B,BL}$ = quantity of biomass in the baseline as assessed from the household survey data; tonnes

$H_{F\_Biomass}$ = annual increment of woody biomass from forest/woodland/croplands sources that could be sustainably harvested for household energy purpose.

(2) Quantitative assessment

For situations in which data are available to quantify the biomass production in the project area, project participants could use quantitative biomass assessment methods to demonstrate the use of non-renewable biomass as per the steps outlined below.

Data sources:

The suggestions outlined with regard to the data sources under the indicator-based assessment are applicable to the quantitative assessment as well. The sources of data that most appropriately quantifies the biomass production and consumption should be considered.

Step 1: **Identification of biomass sources**

The project participants should identify the significant sources of biomass in household cooking/ heating in the project boundary taking into account the definitions of renewable biomass as per Annex 18, EB23, which categorizes the biomass sources from forests, woody biomass from croplands and/or grasslands, non-woody biomass from croplands and/or grass-lands, biomass residue, or non-fossil fraction of industrial or municipal waste[3]. In this methodology, sources of biomass that represents at least 5% share of biomass in the household energy use considered as significant and the biomass sources falling below this threshold are ignored.

Step 2: Estimation of renewable biomass in the project boundary

Project participants shall quantify the amount of biomass produced from sources that significantly contribute to household energy as per the guidelines below.

I. Woody biomass from forest and woodland (B_{WBF})

All forests and woodlands from which households in the project boundary could realistically obtain biomass, given the means of transport, accessibility, and time spent in collecting and transporting biomass should be identified and delineated on a map outlining the biomass resources in the project boundary.

1. Collect data and information on area and status of forests to which widespread access prevails for biomass collection for household energy purposes.

(a) Data from satellite imagery, aerial photographs, and/or regional maps, shall be used to calculate the forest area within the project boundary.

(b) Data on forest resources from official records, published sources and local studies that reasonably represent the forest area should be collected.

(c) Calculate the mean annual increment of above ground biomass taking into account natural regeneration, forest management, grazing pressure, and fire risk.

$$B_{WBF} = \sum_{ij} (A_{F,jk} \bullet G_{Biomass,F,ij}) \quad . \qquad (8)$$

where:

B_{WBF} = woody biomass from forest and woodland; tonnes

$A_{F,jk}$ = area of reachable forest by forest type/category j (j=1…n) and species type k (j=1...m); hectares

$G_{Biomass,F,jk}$ = average annual increment of biomass by forest type/category j (j=1…n) and species type k (k =1...m) In the event local data on biomass increment for major species is not available, published data and default data from GPG/LULUCF could be used to estimate the mean annual biomass increment for the forest type.

[3] http://cdm.unfccc.int/EB/023/eb23_repan18.pdfhttp://cdm.unfccc.int/EB/023/eb23_repan18.pdf

(d) Estimate the annual renewable woody biomass increment that could be sustainably harvested from forest and woodland to meet the energy needs of households within the project boundary.

$$B_{R\_WBF} = B_{WBF} \bullet P_{Fwood} \bullet H_{SFF} \quad (9)$$

B_{R_WBF} = annual renewable biomass that could be sustainably harvested from forest and woodland to meet the energy needs of households in the baseline scenario.

P_{Fwood} = share of biomass of woody biomass from forests/woodlands representing fuelwood portion; percent

H_{SFF} = annual sustainable harvest of biomass as fuelwood from reachable forest; percent (the value of sustainable harvest reported in the official data or published local studies shall be used. In the absence of relevant data for the project area, a default value of 50% shall be used).

II. Woody biomass from cropland/other land (B_{WBF})

The cropland represents the area from which project households obtain biomass taking into account the accessibility and time spent in collection and transport.

(a) Collect data on woody vegetation in terms of average number of trees per ha in cropland taking into account the annual rate of tree planting over previous 10-year period.

(b) Based on the data of woody vegetation, calculate the mean biomass increment of woody vegetation per ha ($G_{Biomass,C,jk}$)

(c) Calculate the annual biomass increment in cropland taking into account tree and shrub species that represent at least 80% of woody vegetation of the cropland/other land uses.

$$B_{WBC} = \sum_{jk} (A_{C,jk} \bullet G_{Biomass,C,jk}) \quad (10)$$

where:

B_{WBC} = woody biomass production from cropland in the project boundary

$A_{C,jk}$ = area of cropland that is accessible for fuelwood collection in the crop land type *j* (j=1…n) and species type k (k= 1...m); hectares

($G_{Biomass,C,jk}$) = average annual increment in total biomass by cropland type j (j=1…n) and species type k (k = 1...m) In the event local data on biomass increment for major woody species in cropland is not available, default data from local studies and GPG/LULUCF could be used to estimate the mean annual woody biomass increment from cropland.

(d) Estimate the annual renewable woody biomass increment that could be sustainably harvested to meet the household energy needs in the project area

$$B_{R\_WBC} = B_{WBC} \bullet P_{Fwood} \bullet H_{SFC} \quad (11)$$

B_{R_WBC} = annual renewable biomass that could be sustainably harvested from cropland to meet the household energy needs in the baseline scenario

P_{Fwood} = share of woody biomass representing fuelwood portion; percent

H_{SFC} = annual sustainable harvest of biomass for fuelwood in cropland; percent (the value of sustainable harvest reported in the official data or published local studies shall be used. In the absence of relevant data for the project area, a default value of 50% shall be used).

III. Non-woody biomass from cropland and biomass residue (B_{NWBF})

The accounting of non-renewable biomass from cropland and biomass residue is only considered provided non-woody biomass and biomass residues form significant proportion of the household energy.

The data from household surveys are used to estimate the proportion of non-woody biomass use in the project as it is assumed that at least 50% of the non-woody biomass is seasonal agricultural biomass and is renewable.

Total quantity of renewable biomass that could be harvested for household energy in the baseline scenario:

$$Q_{y\_RB} = B_{R\_WBF} + B_{R\_WBC} + B_{R\_NWBC} \quad (12)$$

where:

Q_{y_RB} = Quantity of renewable biomass; tonnes

B_{WBF} = Woody biomass from forest and woodlands; tonnes

B_{WBC} = Woody biomass from croplands; tonnes

B_{NWBF} = Non-woody biomass from croplands; tonnes

Step 3: Estimation of biomass use for household energy

Household energy should be estimated using data from surveys, questionnaires and/or participatory appraisal methods covering land use, sources of biomass, collection methods and biomass use.

Data on fuel wood consumption, sources of fuelwood supply, and patterns of fuelwood/ charcoal consumption shall be collected from household survey data. The data and information on household energy use available from official records/market studies/fuelwood studies could be used to compare the estimates from household survey data. Based on household survey data, mean biomass used per household, $\overline{Q}_{y\_B,h}$ should be estimated.

Calculate the total biomass $Q_{y\_B,BL}$. use of households by multiplying the number of households (N_h) in the project boundary and the average amount of household energy $\overline{Q}_{y\_B,h,BL}$

Step 4: Estimation of non-renewable biomass in the baseline

$$Q_{y\_NRB} = Q_{Y\_B,BL} - \quad Q_{y\_RB} \qquad (13)$$

where:

Q_{y_NRB} = total amount of non-renewable biomass; tonnes

$Q_{y\_B,BL}$ = total amount of biomass used in the household energy; tonnes

Q_{y_RB} = total amount of biomass that could be sustainably harvested; tonnes

Step 5: Calculation of energy equivalent fossil fuel needed to replace the non-renewable biomass used in the baseline

$$Qy_{\_ffeq\_NRB} = Q_{y\_NRB} * F_{ffeq.fossil}(0.456) \qquad (14)$$

where:

$Q_{y\_ffeq\_NRB}$ = Quantity of fossil fuel that supplies equivalent energy derived from non-renewable biomass; tonnes

F_{ff_fossil} = Factor to convert energy from non-renewable biomass into fossil fuel equivalent energy (Kg oil equivalent of kilogram of wood /Kg oil equivalent per liter of kerosene) (0.376/0.824)[4]

Step 6: Calculation of baseline emissions

$$BE = Qy_{\_ffeq\_NRB} \bullet NCV_{fossil} \bullet EF_{CO2.fossil} \qquad (15)$$

where:

ER_y = emission reductions during the year y in t CO_2

$Q_{y\_ff\_eq\_NRB}$ = quantity of fossil fuel equivalent replacement of non-renewable biomass; tonnes (average annual consumption of non-renewable biomass of the households in the project area (tonnes/year), which is replaced by equivalent fossil fuel energy ignoring the appliance efficiency as fossil fuel equivalence of non-renewable biomass in the baseline assumes the biomass use at its lowest efficiency.

[4] Data from World Bank (2000)

Therefore combustion efficiencies of energy sources in the baseline are ignored under this methodology.

OR

Quantity of fossil fuel equivalent of renewable biomass that is substituted in place of non-renewable biomass; tonnes

NCV_{fossil} = Net calorific value of fossil fuel (IPCC default for kerosene, 44 MJ/Kg; LPG 45 MJ/Kg)

EF_{CO2_fossil} = CO2 emission factor for the fossil fuel; 71.5 tCO2/TJ for Kerosene, 63.0 tCO2/TJ for LPG or the IPCC default value of the fossil fuel commonly observed with local consumers

Project

The renewable technologies considered under the project scenario are solar cookers, biogas units and electricity from hydropower, wind and solar photovoltaics and other technologies that enable switch to renewable biomass and similar technologies. The characteristics of each technology and the associated emissions, if any shall be taken into account in demonstrating the project and calculating emissions under the project.

The energy equivalence of non-renewable biomass and renewable technologies is assessed from the *ex post* monitoring of renewable technologies at annual intervals should be conducted for the sample households that participated in the baseline assessment of non-renewable biomass so that panel data on technology adoption, including behavioral aspects in the use of non-renewable biomass and adoption of renewable energy technologies could be realistically assessed and measured.

In the projects supporting the renewable biomass production to replace the non-renewable biomass, the following aspects should be considered.

(a) The renewable biomass production undertaken to replace the non-renewable biomass forms the part of the project scenario should avoid the double counting of the biomass production that is used in the replacement of non-renewable biomass.

(b) In case one or more renewable biomass production projects are implemented, whose biomass resources used to replace non-renewable biomass in the project, such biomass production and its replacement of the non-renewable biomass should be accounted transparently. This shall be demonstrated through verifiable contractual agreements demonstrating the supply of renewable biomass to replace the non-renewable biomass under the baseline consistent with Annex 8 of the EB 20 decision on the accounting of renewable biomass[5].

(c) The monitoring and accounting methods of renewable biomass are implemented in a way that permits transparent quantification of the renewable biomass production and demonstration of its replacement of the non-renewable biomass.

[5] http://cdm.unfccc.int/EB/020/eb20repan08.pdf

(d) The project emissions associated with production of renewable biomass are ignored under this methodology under the assumption of energy equivalence between non-renewable biomass that is replaced by the renewable biomass.

The ex post monitoring data is used to account for project emissions resulting from the non-.use of project technologies and malfunction and disrepair of project technologies and equipment

Project emissions

The project emissions covered under this methodology fall into two categories

(1) Emissions from non-use of the renewable energy equipment and technologies under the project scenario

Step 1: Estimation of number of households not using renewable energy technologies under the project scenario.

$$N_{,non-use_{,PJ}} = \left[\frac{\sum_{n=1}^{n_{PJ}} n_{non-use,PJ}}{n_{PJ}} \right] \bullet N_{PJ} \qquad (16)$$

where:

$N_{non-use,PJ}$ = number of households not using the renewable energy technologies in the project

$n_{non-use,PJ}$ = number of households not using the renewable energy technologies in the sample households considered in the *ex post* monitoring

n_{PJ} = number of sample households considered for *ex post* project monitoring in the project

N_{PJ} = total number of households in the project

Standard deviation of number of households' that are not- using the renewable technologies under the project as observed from the ex-post monitoring data.

Step 2: Project emissions associated with non-use of renewable technologies/disrepair of equipment, thereby, contributing to project emissions

$$E_{non-use,PJ} = N_{non-use,PJ} \bullet Q_{y\_ffeq\_NRB,h,BL} \bullet NCV_{fossil} \bullet EF_{CO2\,fossil} \qquad (17)$$

where:

$E_{non-use,PJ}$ = Emissions from non-use of renewable energy technologies in the project

$N_{non-use,PJ}$ = total number of households not using the renewable energy technologies in the project

$Q_{y\_ffeq\_NRB,h,BL}$ = quantity of fossil fuel equivalence of non-renewable biomass used in a sample household under the project; tonnes

NCV_{fossil} = Net calorific value of fossil fuel (IPCC default for kerosene, 44 MJ/Kg; LPG 45 MJ/Kg)

EF_{CO2_fossil} = CO2 emission factor for the fossil fuel; 71.5 tCO2/TJ for Kerosene, 63.0 tCO2/TJ for LPG or the IPCC default value of the fossil fuel commonly observed with local consumers

(2) Emissions from malfunctioning of renewable energy technologies

The emissions from malfunctioning of renewable technologies / disrepair of equipment that could result in project emissions such as emissions from incomplete combustion in biogas units

Step 1: Estimation of malfunction rates of renewable energy technologies under the project scenario

$$N_{,mal\_fun,PJ} = \left[\frac{\sum_{h=1}^{n_{BL}} n_{mal\_fun,PJ}}{n_{PJ}} \right] \bullet N_{PJ} \quad (18)$$

where:

$N_{mal\_fun,PJ}$ = number of households with malfunctioning renewable energy technologies /disrepair of equipment in the project; dimensionless

$n_{mal\_fun,PJ}$ = number of households with malfunctioning renewable energy technologies disrepair of equipment in the sample households considered for *ex post* monitoring

n_{PJ} = number of sample households in the project

N_{PJ} = total number of households in the project

Standard deviation of number of households' malfunctioning renewable technologies under the project should be estimated from the ex-post monitoring data.

Step 2: Project emissions associated with malfunctioning technologies, thereby continuing the dependence on non-renewable biomass under the project

$$E_{mal\_fun,PJ} = N_{mal\_fun,PJ} \bullet MF_{type} \bullet E_{mal-type} \bullet EF_{CO2-e} \quad (19)$$

where:

$E_{mal\_fun,PJ}$ = emissions from mal function of renewable energy technologies in the project

$N_{mal\_fun,PJ}$ = number of households with malfunctioning renewable energy technologies in the project

$MF_{mal-type\,PJ}$ = malfunction type of the equipment that causes specific rate of project emissions

$MF_{mal-type\,PJ}$ = Emission associated with specific type of equipment malfunction.

$MF_{mal-type\,PJ}$ = Emission factor associated with the GHG emission from the mal function,

$EF_{CO2-e,PJ}$ = emission factor for CH4 emitted from incomplete combustion in a biogas unit

(3) Calculation of project emissions

$$PE_t = E_{non-use,PJ} + E_{mal\_fun,PJ} \quad (20)$$

where:

PE_t = project emissions in year t

$E_{non-use,PJ}$ = emissions from non-operation or non-use of renewable energy technologies in the project

$E_{mal\_fun,PJ}$ = emissions from mal function of renewable energy technologies in the project

Leakage

Leakage relating to the non-renewable biomass shall be assessed using the using general guidelines of the small-scale methodologies and as well as the data from ex post household surveys and other relevant measures of project monitoring.

The potential sources of leakage that would need to considered are:

a) Identification of potential sources of leakage, which could relate to:

   i. Use/diversion of non-renewable biomass saved under the project by the non-project households

   ii. Use of non-renewable biomass, saved due to the project activity to justify other CDM projects.

   iii. Increase in the harvest of non-renewable biomass outside the project boundary.

b) In order to assess the leakage, monitoring data on the status of biomass within the project boundary and biomass in the 3-5 km radius outside the project boundary and patterns of

household energy use over a 3-year period after the starting date of the project should be considered to determine the prevalence of leakage.

c) Project developers should undertake leakage assessment as part of the project monitoring by defining the area of project influence and monitoring the biomass use using household surveys within the project area and outside the project boundary. The potential leakage could depend on several location specific factors. However, it is reasonable to assume a radius of 3 to 5 km radius outside the project boundary to reflect the leakage associated with the project. The radius defined for leakage assessment assumes the reasonable distance that users in biomass-using households travel to areas outside the project boundary to collect the biomass.

d) The project monitoring data and annual household surveys of the project participants could be used in the assessment of leakage. For this purpose, transparent and measurable indicators involving the biomass production and usage in the area should be used so that leakage assessment is transparent. The increase in the biomass harvests in 3 to 5 km radius in relation to the project baseline scenario is considered leakage. If the biomass harvests outside the project boundary

e) If the leakage assessment reflects an increase in the harvest of non-renewable biomass harvested by the non-project households within the project and project households outside the project boundary is less than 10% of the energy equivalence saving achieved from the displacement of non-renewable biomass, then no leakage is assumed to have occur. If the increase in the use of non-renewable biomass is between 10% and 50% of the energy equivalence saving achieved from the displacement of non-renewable biomass, then leakage is assumed to have occurred. In such cases, a 15% discount factor should be applied to the emission reductions to account for the leakage associated with non-renewable biomass. The leakage accounting adopted is on the guidelines of the simplified small scale methodology for afforestation and reforestation projects.

Emission reductions

The emissions reductions achieved under the project are based on the energy equivalence of the quantity of non-renewable biomass replaced under the project.

Emission reductions are calculated as:

$$ER_t = BE_t - PE_t - LK_t \quad (21)$$

BE_t = Baseline emissions during year t in t CO_2

PE_t = Project emissions during year t in t CO_2

LK_t = Leakage during year t in t CO_2

Monitoring

Monitoring should confirm the displacement of the non-renewable biomass in the participating households of the project. The monitoring involves implementing annual surveys of project

households by independent agencies. The project *ex post* monitoring should cover the following aspects.

(a) Household monitoring to evaluate the adoption and operation of renewable technologies

The ex post annual monitoring of the representative sample project households should be done to assess the adoption of renewable technologies, usage patterns, dis-continuation of the use of renewable technologies, including the malfunction and disrepair of the equipment will be monitored. The monitoring data should be used to assess and to account for the project emissions associated with the non-use of renewable energy technologies and malfunctioning equipment. Monitoring shall consist of an annual check of all renewable energy technologies and appliances or a representative sample thereof to ensure that they are still operating or replaced by an equivalent in service appliance.

Monitoring will check that all household energy devices based on renewable energy are working and the number of devices that are under maintenance and repair could be accounted and thereby suitable discount to the energy equivalent savings due to displacement of NRB under the project could be implemented

(b) Monitoring of the projects involving renewable biomass production to replace non-renewable biomass

With regard to project involving renewable biomass production, the monitoring regime implemented for the project is expected to collect the relevant data and information on plantation activities used to estimate the quantity of renewable biomass produced from the project to displace the non-renewable biomass.

In projects that seek to shift from non-renewable biomass to renewable biomass, monitoring data on the renewable sources of biomass created as part of the project should be collected. The monitoring indicators such as afforestation and reforestation rate of the previous 10-year period and activities implemented to promote renewable biomass in cropland and quantities of renewable biomass that will be available as a result of project activities should be demonstrated. In the switch to renewable biomass, the quantity of renewable biomass use should be monitored[6].

(c) Biomass monitoring in the areas outside the project boundary

Monitoring of biomass production and harvest patterns is intended to demonstrate the occurrence/non-occurrence of leakage. If the leakage assessment reflects an increase in the harvest of non-renewable biomass harvested by the non-project households within the project and project households outside the project boundary is less than 10% of the energy equivalence saving achieved from the displacement of non-renewable biomass, then no leakage is assumed to have occur. If the increase in the use of non-renewable biomass is between 10% and 50% of the energy equivalence saving achieved from the displacement of non-renewable biomass, then leakage is assumed to have occurred. In such cases, a 15% discount factor should be applied to the emission reductions to account for the leakage associated with non-renewable biomass. The leakage accounting adopted is on the guidelines of the simplified small scale methodology for afforestation and reforestation projects.

[6] http://cdm.unfccc.int/EB/020/eb20repan08.pdf