CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
Version 01 - in effect as of: 1 July 2004

CONTENTS

As of March 17, 2005 by N. Matsuo

SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

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Generalized monitoring methodology for transportation bio-fuel production with LCA

A.2. List of category(ies) of project activity to which the methodology may apply:

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Type III Other Project Activities,
— III.C. Emission Reductions by Low-Greenhouse Gas Emitting Vehicles

in the categorization of small scale CDM projects.

The project is a sort of fuel-switching project from fossil fuel to biomass-based fuel in the transportation sector.

A.3. Conditions under which the methodology is applicable to CDM project activities:

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The methodology categorize the value-chain of the GHG emission reductions into three principal stages as follows:

We categorize the elements of the methodology into these stages (which are influenced by the project activity) of emission reductions in the methodology.

The methodology is applicable to the project which produces a biomass-based transportation fuel[1] ("Bio-Fuel", for short) with the following applicability conditions (*italic* are explanation of the sub-conditions). This applicability conditions are the same as those of the new baseline methodology.

Conditions at the "biomass supply" stage are:

(a) Plantation of raw material (biomass) for the project does not lead to decrease of forest, or does not constrain the afforestation/reforestation activities;

(b) There are no other plans to utilize the area for other exclusive GHG emission reduction activities;

(b') In case waste oil is used as feedstock of the Bio-Fuel, such waste oil shall be biomass-based[2] and would not be utilized as an alternative to fossil fuel [in order to exclude the possibility of leakage].

Above conditions are for excluding the possibility to displace other GHG emission reduction activities at the plantation site.

The conditions (a) and (b) are confirmed by signed letter of the land owner or the seller of the biomass. Condition (b') is confirmed by documented evidences. The OE may request other evidences as it judges, if necessary.

Conditions at the "Bio-Fuel production" stage are:

(c) The project is the optimal solution in its scale in the project participants' decision making considering several barriers with economical consideration, if a Bio-Fuel production plant by using the same biomass is invested;

(d) The project participants do not have any plan to implement other biomass based fuel production projects with different type of production process nearby or at the same place;

(e) The project plant cannot be the most attractive course of action economically without the CER revenue, even if some subsidies[3] and/or tax credits for the Bio-Fuel production (if present) and sales revenue of Bio-Fuel itself and the by-products are included at the planning stage of the project *or* some prohibitive barriers to implement the project exist [additionality condition];

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[1] Biomass-based transportation fuel (Bio-Fuel) is categorized by the mixing rate of biomass-origin fuel and fossil-fuel (this methodology does not limit its application to 100% biomass-based fuel). In general, Bio-Fuel, which can be used for the same type of engine (without major modification) is regarded as the substitutable fuel to the regular fossil based fuel. Hereafter, Bio-Fuel is recognized not as the blended one with the fossil fuel unless otherwise stated, in order to avoid confusion. However, most of the logics can be applied for the blended fuel for its biomass-component.

In case that the Bio-Fuel is originated by biomass waste oil, the condition (b') is used instead of (a) and (b).

It is noted that transportation fuel includes those for automobiles, agricultural instruments, ships, *etc*.

[2] If the waste oil is not purely biomass-based, appropriate correction is needed to extract the biomass part.

[3] Subsidies introduced after the Marrakech Accords do not have to be considered in the development of the baseline scenario, as it is categorized as the "E–"-type policy.

These conditions (c)–(e) exclude the case where any Bio-Fuel production scenario—in spite of its size and biomass-type—cannot be the baseline scenario of the project activity.

The conditions (c) and (d) are verified by the OE by assessing the related material/information provided by the project participants in order to exclude the possibilities to construct Bio-Fuel production plant with other scale as the baseline scenario. How to confirm whether the condition (e) is met, is shown in the sub-section D.1.

Conditions at the "Bio-Fuel consumption" stage are:[4]

(f) The Bio-Fuel produced by the project shall be consumed as to displace fossil fuel based liquid fuel.

The condition (f) can be restated that the Bio-Fuel does neither displace other biomass-based fuels, discard, nor realize hidden demand.

In order to ensure this, we categorize the related regulation(s) at the consumption stage. The associated regulations may be:

[Case 0] No regulations,

[Case 1] Subsidies or tax incentives to promote the Bio-Fuel or other compatible biomass-based fuels,

[Case 2] Non-mandatory or non-effective regulations to promote the Bio-Fuel or other compatible biomass-based fuels,

[Case 3] Mandatory or virtually mandatory regulation (targeting the fuel seller[5]) to penetrate the Bio-Fuel or other compatible biomass-based fuels by setting some quantified threshold,[6] or

[Case 4] Mandatory or virtually mandatory regulation (targeting the fuel seller or consumer) which exclude to use the fossil fuel and force the pure biomass-based fuel to use.

*The underlying logic of this methodology **is not applicable** to the [Case 4] (as far as it is not categorized as type E– policy[7]), while it **is applicable** to the [Cases 0–2]. In the case of [Case 3], if the compatible biomass-based fuel is not competitive in the market (i.e., the regulation is strictly complied without little excess penetration), supply of the BDF will displace other biomass-based fuel. Therefore, the methodology **is not applicable** to this case. However, if we observe that the compatible biomass-based fuel penetrate more than the threshold specified by the regulation, we can consider that the biomass-based fuel is more competitive than the fossil fuel in the market. In this case, the methodology **can be applied**. The reasons are shown below.*

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4 We categorize "sales of fuel to consumers" in the "Bio-Fuel consumption" stage.

5 Regulations targeting biomass-based fuel producers or consumers can be possible, in theory (but difficult in reality).

6 Examples of such a regulation include setting mandatory minimum percentage on the biomass-component added to the associated fossil fuel, or on the sales amount of the biomass-based fuel among the whole amount of the associated fossil fuel. The "mandatory" nature of the regulation is confirmed that the penetration level of the biomass-component is almost equal to or above the threshold level of the regulation.

7 To date, the difference between type E– and type L– policies (and whether these are exclusive or not) is uncertain. Moreover, the CDM EB has not decided for the case of type L– policy. We expect that the CDM EB will clarify these in the near future.

The condition (f) is confirmed if all of the sub-conditions (i)–(v) below are met (*italic* are explanation of the sub-conditions):

(i) The fossil fuel, which the Bio-Fuel is going to replace, is not banned to use legally or substantially in the host country, or the same Bio-Fuel type is not required to use by some mandatory regulation (which is not the type E– policy) in the host country.

This sub-condition excludes the Case 4 above.

(ii) In case some mandatory or virtually mandatory regulation (targeting the fuel seller) to penetrate the Bio-Fuel or other compatible biomass-based fuels by setting some quantified threshold has been/will be introduced as non-type E– policy, the compatible biomass-based fuel penetrate more than the threshold level and/or competitive in the associated fuel market.

This ensures that the compatible biomass-based fuel is competitive in the market beyond the regulation. See explanation of the sub-condition (iii) below why this condition is good for substitution of fossil fuel by the Bio-Fuel.

(iii) The penetration rate of some biomass based fuels, which can be alternative to, and whose biomass-ratio is above the Bio-Fuel produced by the project, is less than [70]% in the host country if sub-conditions (i) and (ii) are met,

In case we see a biomass fuel (for the same usage) penetrates in the market (less than 100%), there is a concern that the Bio-Fuel produced by the project would displace this penetrated biomass fuel. However, this will not happen, because in this case, such biomass has economically more competitive than the fossil fuel, i.e., the Bio-Fuel of the project would displace less competitive fossil fuel in the market. This logic can be applied for any penetration rate (less than 100%), while the threshold rate is set as [70%] for conservativeness.

(iv) The Bio-Fuel produced by the project is sold through an ordinary sales channel, used in-house, or used to specific purpose as an alternative to fossil based fuel, and not be exported to/used in Annex I countries,

This sub-condition ensures that the Bio-Fuel would not be discarded (and maybe substitute the associated fossil fuel). It is noted that the emission reductions are linked to the "sold and/or used amount", and not the generated amount of the Bio-Fuel.

(v) Supply of the fossil fuel, which the Bio-Fuel displaces, has excess supply capacity in the host country, therefore the project does not create new/hidden demand of the fossil fuel, *i.e.*, the Bio-Fuel displace fossil fuel fully under the competitive environment of the Bio-Fuel,

This sub-condition ensures that the Bio-Fuel would not generate hidden demand. In other words, this sub-condition shows that the Bio-Fuel would displace the fuel demand to be met by the fossil fuel, otherwise.

The project participants shall demonstrate them with suitable evidences/documents, such as signed agreement by the wholesaler and/or retailer of the Bio-Fuel. The OE may request other evidences as it judges, if necessary.

Condition to assure that the build margin component of the grid electricity used is negligible:

(g) In calculation of the CO_2 emission factor of the grid to which the Bio-Fuel plant is connected to, the electricity demand by the plant is small enough not to affect the power development plan, thus only operating margin component is applied.

In order to justify the usage of operating margin, the project participants shall obtain the signed letter of the person who is in charge of the power development plan of the power company that the power development plan is never affected by the existence/non-existence of the facility.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

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This monitoring methodology grasps the whole emission reductions at the supply side of the Bio-Fuel, rather than demand (consumption) side. Therefore, it is rather easy and accurate to monitor.

On the other hand, the whole uncertainty to evaluate emission reductions relies on the LCA part of the methodology. One is related to the N_2O emissions at the fertilizer production stage and application stage. IPCC GHG Inventory Guidelines/Good Practice Guidance may provide the best estimation method available, even the default factors are used, because direct measurement of such emissions is unrealistic to be done. Another one is LCA analysis of the fossil fuel to be displaced by the Bio-Fuel. The necessary consideration is specified in the baseline methodology.[8]

SECTION B. Proposed new monitoring methodology

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B.1. Brief description of the new methodology:

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The monitoring methodology consists of the emissions of each source in the value chain:

for both baseline and project scenarios.

[8] In parallel with the LCA estimation of the Bio-Fuel, the LCA is also assessed for displaced fossil fuel. This is dependent on the host country and the fossil fuel type, and not needed when conservative.

Therefore, project participants shall provide related objective information, such as scientific documents/paper with relative comparison between several studies. The appropriateness of the information is judged by the OE, as a validator, considering the cases applied beforehand. Life-cycle assessment is not needed if the project participants cannot provide such information as a conservative estimation (only CO_2 emissions from direct combustion is considered).

This LCA effect is included in the emission factor $COEF^{FF}$ as it is easier to understand. However, strictly speaking, it is outside of the boundary.

However, emissions at the bio-fuel consumption stage are monitored at the supply point, *i.e.*, output point of the Bio-Fuel production stage.

Characteristic feature of the methodology is to include LCA analysis. Therefore, despite the main part of the project is the second stage (Bio-Fuel production), the first stage (Biomass plantation) has some significant activity to be monitored. LCA-related emission factors are assessed by scientific literature including IPCC Guidelines/Good Practice Guidance.

The outline of the monitoring points are shown below:

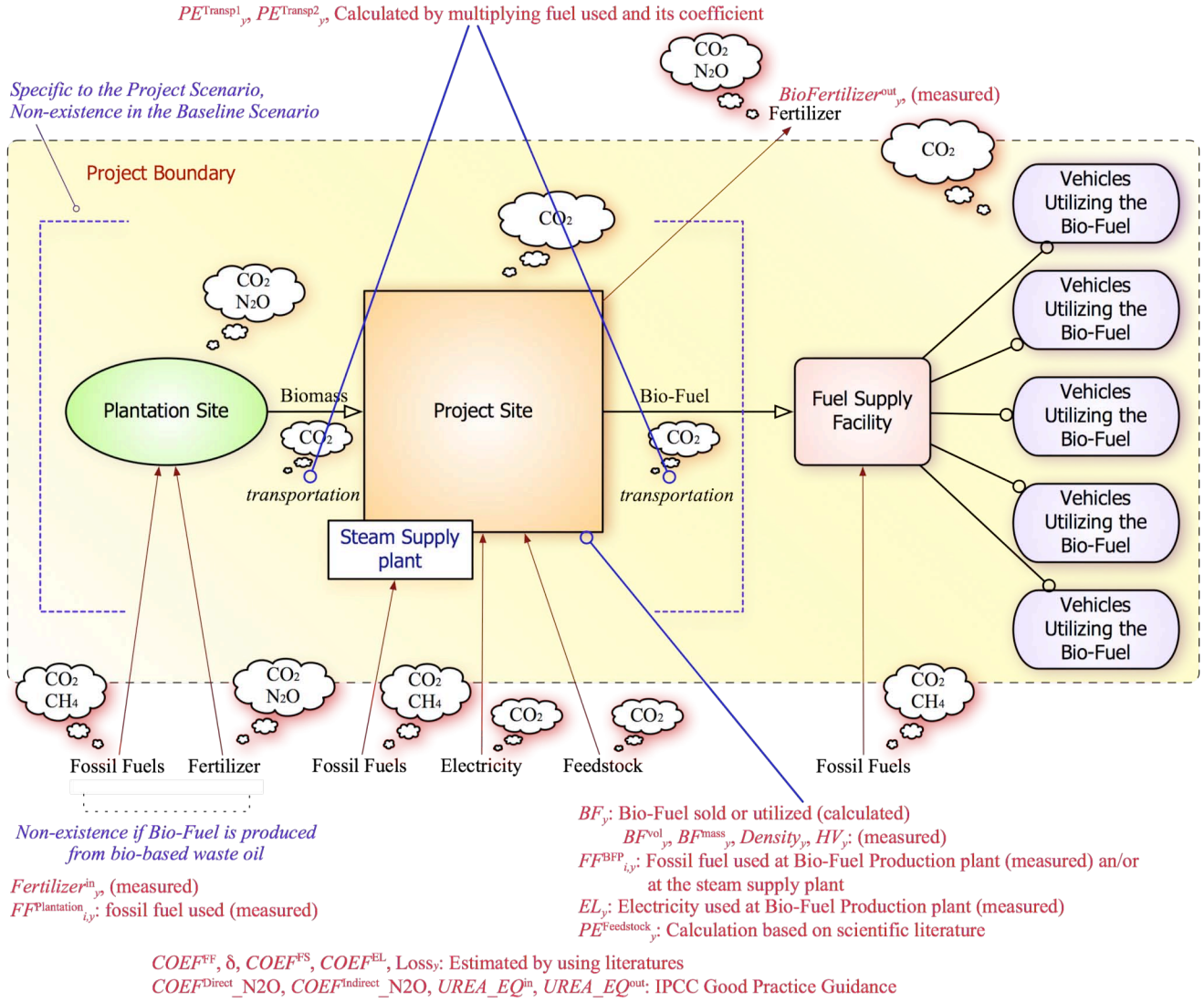

Figure NMM-1: Outline of the parameters to be monitored

B.2. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

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B.2.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P1. $FF^{BFP}_{i,y}$	*Fossil fuel i combusted at the Bio-Fuel production plant and/or at the steam supply plant*	*Weight meter or other meter or provided by the steam supplier*	*[physical unit]*	*m*	*daily*	*100%*	*electronic*	*Checked against the fuel purchase receipt (Bio-Fuel production plant). Relevant data to be provided by the steam supplier if steam is supplied from outside.*
P2. $COEF^{FF}_{i}$	*LCA CO_2 emission factor of the fossil fuel i (incl. oxidization factor)*	*Fuel supplier, statistics, and/or scientific literature*	*[tCO_2/ physical unit]*	*c*	*Once in the beginning of the crediting period*	*100%*	*electronic*	*Direct part of emission factor: Fuel supplier or other statistics, if unavailable. Appropriateness of the data source is checked by OE. Indirect part: Project participants shall provide related objective information, such as scientific documents/paper with relative comparison between several studies. The appropriateness of the information is judged by the OE, as a validator, considering the cases applied beforehand. Life-cycle assessment is not needed if the project participants cannot provide such information as a conservative estimation*

								(only CO_2 emissions from direct combustion is considered). Oxidization factor: Defaults in the IPCC Guidelines/Good Practice Guidance are used.
P3. BF^{mass}_{y}	Bio-Fuel sold or utilized in a certain year (in mass)	*Weight meter*	*[ton-BioFuel]*	*m*	*daily*	*100%*	*electronic*	*Check against* BF^{Vol}_{y} *and fuel sales record. More accurate one is prioritized.*
P4. $COEF^{FS}$	CO_2 emission factor of the non-bio feedstock contained in the Bio-Fuel	-	*[tCO_2/ton-BioFuel]*	*c*	*Once at the time of drafting the PDD*	*100%*	*electronic*	*Theoretical calculation*
P5. $PE^{Tarnsp1}_{y}$	Transportation-related CO_2 emissions from plantation site to the project site	-	*[tCO_2/yr]*	*c*	*monthly*	*100%*	*electronic*	*Calculated by multiplying P6 and P7*
P6. $EN^{TR}_{mode1,y}$	energy used for transportation mode *i*[9]	*Receipt of payment*	*[physical unit]*	*m*	*monthly*	*100%*	*electronic*	*Receipts of payment are used. Check against the records of mileage recorder*
P7. $COEF^{TR}_{mode1}$	CO_2 emission coefficient for transportation mode *i*	*Statistics*	*[tCO_2/ physical unit]*	*c*	*Once in the PDD*	*100%*	*electronic*	*National statistics and/or IPCC Guidelines/GPG is used*
P8. $PE^{Tarnsp2}_{y}$	Transportation-related CO_2 emissions from project site to the fuel supply facilities	-	*[tCO_2/yr]*	*c*	*monthly*	*100%*	*electronic*	*Calculated by multiplying P9 and P10*
P9. $EN^{TR}_{mode2,y}$	energy used for transportation	*Receipt of payment*	*[physical unit]*	*m*	*monthly*	*100%*	*electronic*	*Receipts of payment are used. Check against the records of*

[9] "Transportation mode" implies ship, railway, truck, *etc.*

	mode *i*							*mileage recorder*
P10. $COEF^{TR}_{mode2}$	CO_2 emission coefficient for transportation mode *i*	*Fuel supplier and/or statistics*	*[tCO_2/ physical unit]*	*c*	*Once in the PDD*	*100%*	*electronic*	*National statistics and/or IPCC Guidelines/GPG is used*
P11. $PE^{Plantation}\_N2O_y$	N_2O emissions from fertilizer use at plantation site (direct)	-	*[tCO_2eq/yr]*	*c*	*monthly*	*100%*	*electronic*	$PE^{Plantation}\_N2O_y = Fertilizer^{in}_y * UREA\_EQ^{in} * COEF^{Direct}\_N2O * GWP\_N2O$
P12. $Fertilizer^{in}_y$	fertilizer input to the plantation site	*Weight meter*	*[ton-fertilizer]*	*m*	*monthly*	*100%*	*electronic*	*Checked against the fertilizer purchase receipt.*
P13. $UREA\_EQ^{in}$	urea-equivalence factor of the fertilizer for N-component	-	*[ton-urea/ton-fertilizer]*	*c*	*Every time when fertilizer is changed*	*100%*	*electronic*	*Calculated by using the data of fertilizer supplier*
P14. $PE^{Plantation}\_CO2_y$	CO_2 emissions from fossil fuel use at plantation site	-	*[tCO_2/yr]*	*c*	*monthly*	*100%*	*electronic*	$PE^{Plantation}\_CO2_y = \sum_i FF^{Plantation}_{i,y} * COEF^{FF}_i$
P15. $FF^{Plantation}_{i,y}$	fossil fuel *i* combusted at the plantation site	*Receipt of payment*	*[physical unit]*	*m*	*monthly*	*100%*	*electronic*	*Receipts of payment are used. Check against the activity records at the plantation site*

[note] At the PDD level, some emissions are not needed to be monitored. In this case, the project participants shall demonstrate its rationale (*e.g.*, by showing the rough estimation of such emissions to be much smaller than the uncertainty range of emission reductions).

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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Project emissions within the project boundary in a certain year *y* is given by:

$$PE_y = \sum_i FF^{BFP}_{i,y} * COEF^{FF}_i + BF^{mass}_y * COEF^{FS} + PE^{Tarnsp1}_y + PE^{Tarnsp2}_y + PE^{Plantation}\_N2O_y + PE^{Plantation}\_CO2_y$$

where

$FF^{BFP}_{i,y}$: Fossil fuel *i* combusted at the Bio-Fuel production plant [physical unit/yr]

$COEF^{FF}_i$: LCA CO_2 emission factor of the fossil fuel i (*incl.* oxidization factor) [tCO_2/physical unit]

BF^{mass}_y : Bio-Fuel sold or utilized in a certain year (in mass) [ton-BioFuel/yr]

$COEF^{FS}$: CO_2 emission factor of the non-bio feedstock contained in the Bio-Fuel [tCO_2/ton-BioFuel]

$PE^{Tarnsp1}_y$: Transportation-related CO_2 emissions from plantation site to the project site
$= \sum_{transportation\ mode1} EN^{TR}_{mode1,y} * COEF^{TR}_{mode1}$ [tCO_2/yr]

$PE^{Tarnsp2}_y$: Transportation-related CO_2 emissions from project site to the fuel supply facilities
$= \sum_{transportation\ mode2} EN^{TR}_{mode2,y} * COEF^{TR}_{mode2}$ [tCO_2/yr]

where $EN^{TR}_{modei,y}$: energy used for transportation mode i,
$COEF^{TR}_{modei}$: CO_2 emission coefficient for transportation mode[10] i.

$PE^{Plantation}\_N2O_y$: N_2O emissions from fertilizer use at plantation site (direct)
$= Fertilizer^{in}_y * UREA\_EQ^{in} * COEF^{Direct}\_N2O * GWP\_N2O$ [tCO_2eq/yr]

where $Fertilizer^{in}_y$: fertilizer input to the plantation site [ton-fertilizer/yr],
$UREA\_EQ^{in}$: urea-equivalence factor of the fertilizer for N-component [ton-urea/ton-fertilizer],
$COEF^{Direct}\_N2O$: direct N_2O emission factor of the fertilizer (=1.0%) [tN_2O/ton-urea],
GWP_N2O: GWP potential for N_2O (=310 for 1st Commitment Period) [tCO_2eq/tN_2O]

$PE^{Plantation}\_CO2_y$: CO_2 emissions from fossil fuel use at plantation site
$= \sum_i FF^{Plantation}_{i,y} * COEF^{FF}_i$

where $FF^{Plantation}_{i,y}$: fossil fuel i combusted at the plantation site [physical unit/yr]

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B1. BF_y	*Bio-Fuel sold or utilized in a certain year*	-	*[GJ]*	*c*	*daily*	*100%*	*electronic*	$BF_y = BF^{vol}_y * Density_y * HV_y$

[10] "Transportation mode" implies ship, railway, truck, *etc.*

	(thermal content)							
B2. BF^{vol}_{y}	*Volume content of* BF_y	*Volumeter*	*[m^3]*	*m*	*daily*	*100%*	*electronic*	*Check against* BF^{mass}_{y} *and fuel sales record. More accurate one is prioritized.*
B3. $Density_y$	*Mass density of the Bio-Fuel*	*Densimeter*	*[ton/m^3]*	*m*	*monthly*	*sampling*	*electronic*	*In the early stage of project implementation, more frequent sampling should be done in order to assess fluctuation*
B4. HV_y	*Thermal content of the Bio-Fuel per unit of mass*	*See comment*	*[GJ/ton]*	*m/c*	*monthly*	*sampling*	*electronic*	*Chemical component analysis or combustion test is applied in the beginning. Later,* $Density_y$ *is used to approximate this value. In the early stage of project implementation, more frequent sampling should be done in order to assess fluctuation*
B5. $COEF^{FF}$	*Life-cycle* CO_2 *equivalent emission factor of the fossil fuel, which the Bio-Fuel substitutes*	*Fuel supplier, statistics, and/or scientific literature*	*[tCO_2/ physical unit]*	*c*	*Once in the beginning of the crediting period*	*100%*	*electronic*	*See P2.*
B6. δ	*Adjustment factor related to the difference of fuel efficiency for km drive per GJ*	*Academic literature/ reports*	*No dimension*	*e*	*Once at PDD drafting*	*100%*	*electronic*	*Project participants shall provide related objective information, such as scientific documents/paper. If* δ *is obtained as a significant value, such value is used for calculation. The appropriateness of the information is judged by the OE, as a validator, considering the cases applied beforehand.* *In case that such fuel is used by minor modes such as agriculture machinery,* δ *is set*

								as zero considering the scarcity of data and insignificant contribution to whole emission reductions.

[note] At the PDD level, some emissions or parameters are not needed to be monitored. In this case, the project participants shall demonstrate its rationale (*e.g.*, by showing the rough estimation of such emissions to be much smaller than the uncertainty range of emission reductions).

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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The baseline emissions BE_y within in the boundary in a certain year y is given by:

$$BE_y = BF_y * COEF^{FF} * (1 + \delta)$$

where

BF_y : Bio-Fuel sold or utilized in a certain year (thermal content) [GJ/yr]

$= BF^{vol}_y * Density_y * HV_y$

where : BF^{vol}_y: Volume content of BF_y [m^3/yr],

$Density_y$: Mass density of the Bio-Fuel [ton/m^3]

HV_y: Thermal content of the Bio-Fuel per unit of mass [GJ/ton]

$COEF^{FF}$: Life-cycle CO_2 equivalent emission factor of the fossil fuel, which the Bio-Fuel substitutes [tCO_2eq/GJ]

δ : Adjustment factor related to the difference of fuel efficiency for km drive per GJ

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

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B.3.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

referencing to table B.7)								

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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B.4. Treatment of leakage in the monitoring plan:

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B.4.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
L1. EL_y	*Electricity consumed at the Bio-Fuel production plant*	*Wattmeter*	*[MWh]*	*m*	*monthly*	*100%*	*electronic*	*Check against the power purchase receipt*
L2. $COEF^{EL}{}_y$	*CO_2 emission factor of the used electricity*	*Statistical data*	*[tCO_2/MWh]*	*c/e*	*yearly*	*100%*	*electronic*	*$COEF^{EL}{}_y$ is obtained by using the calculation method of OM specified in ACM0002, if grid electricity is used, while in case for the self-generation facility being used, apply the CO_2 emission factor of the facility.* *In order to justify the usage of OM, the project participants shall obtain the signed letter of the person who is in charge of*

								the power development plan of the power company that the power development plan is never affected by the existence/non-existence of the facility.
L3. $Loss_y$	*Transmission loss of the grid, if grid electricity is used*	*Statistical data*	*[no dimension]*	*c/e*	*yearly*	*100%*	*electronic*	*Statistical data is applied for the latest year.*
L4. BE_N2O_y	*N_2O emissions substituted by bio-based fertilizer (by-product of the Bio-Fuel)*	-	*[tCO_2eq]*	*c*	*yearly*	*100%*	*electronic*	BE_N2O_y = $BioFertilizer^{out}_y$ * $UREA\_EQ^{out}$ * $COEF\_N2O$ * GWP_N2O [tCO_2eq/yr]
L5. $BioFertilizer^{out}_y$	*Bio-based fertilizer sold out in the market*	*Weight meter*	*[t-(bio-fertilizer)]*	*m*	*monthly*	*100%*	*electronic*	*Check against the sales record*
L6. $UREA\_EQ^{out}_y$	*Coefficient to convert from bio-based fertilizer to synthetic urea fertilizer*	*Calculation*	*[ton-urea/ton-fertilizer]*	*c*	*yearly*	*100%*	*electronic*	*Calculated by using the data of fertilizer*
L7. $PE^{Indirect}\_N2O_y$	*Indirect N_2O emissions from fertilizer use at plantation site (emitted at the fertilizer production facility) in PJS*	-	*[tCO_2eq]*	*c*	*yearly*	*100%*	*electronic*	$PE^{Indirect}\_N2O_y$ = $Fertilizer^{in}_y$ * $UREA\_EQ^{in}_y$ * $COEF^{Indirect}\_N2O$ * GWP_N2O
L8. $PE^{Feedstock}_y$	*Indirect GHG emissions of feedstock used at the Bio-Fuel production facility (emitted at the feedstock*	*Calculation*	*[tCO_2eq]*	*e*	*yearly*	*100%*	*electronic*	*If some significant contribution is shown in some literature, this emission should be assessed to be calculated.*

	production process)							
L9. $PE^{Fertilizer}{}_{y}$	*Indirect GHG emissions of fertilizer used at the plantation site (emitted at the fertilizer production process)*	*Calculation*	*[tCO_2eq]*	*e*	*yearly*	*100%*	*electronic*	*If some significant contribution is shown in some literature, this emission should be assessed to be calculated. Some conservative estimation in the plural literatures can be used. Its appropriateness is checked by the validator.*

[note] At the PDD level, some emissions or parameters are not needed to be monitored. In this case, the project participants shall demonstrate its rationale (*e.g.*, by showing the rough estimation of such emissions to be much smaller than the uncertainty range of emission reductions).

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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Leakage L_y, as the net emission change in a certain year y, is given by:

$$L_y = EL_y * COEF^{EL}{}_{y} / (1 - \text{Loss}_y) - BE\_N2O_y + PE^{Indirect}\_N2O_y + PE^{Feedstock}{}_{y} + PE^{Fertilizer}{}_{y}$$

where

EL_y : Electricity consumed at the Bio-Fuel production plant [MWh/yr]

$COEF^{EL}{}_{y}$: CO_2 emission factor of the used electricity [tCO_2/MWh]

Loss_y : Transmission loss of the grid, if grid electricity is used [no dimension]

BE_N2O_y : N_2O emissions substituted by bio-based fertilizer (by-product of the Bio-Fuel)

$= BioFertilizer^{out}{}_{y} * UREA\_EQ^{out} * COEF\_N2O * GWP\_N2O$ [tCO_2eq/yr]

where: $BioFertilizer^{out}{}_{y}$: Bio-based fertilizer sold out in the market [t-(bio-fertilizer)/yr]

$UREA\_EQ^{out}{}_{y}$: Coefficient to convert from bio-based fertilizer to synthetic urea fertilizer [t-urea/t-(bio-fertilizer)]

$COEF\_N2O^{tot}$: N_2O emission factor of the synthetic urea fertilizer (direct + indirect) (=0.030) [tN_2O/t-urea]

GWP_N2O : GWP of N_2O (=310 in the 1st Commitment Period) [tCO_2eq/tN_2O]

$PE^{Indirect}\_N2O_y$: Indirect N_2O emissions from fertilizer use at plantation site (emitted at the fertilizer production facility) in PJS

$= Fertilizer^{in}{}_{y} * UREA\_EQ^{in}{}_{y} * COEF^{Indirect}\_N2O * GWP\_N2O$ [tCO_2eq/yr]

where $COEF^{Direct}\_N2O$: indirect N_2O emission factor of the fertilizer (=2.0%) for synthetic fertilizer only [tN_2O/ton-urea]

$PE^{Feedstock}_{y}$: Indirect GHG emissions of feedstock used at the Bio-Fuel production facility (emitted at the feedstock production process).

$PE^{Fertilizer}_{y}$: Indirect CO_2 emissions of fertilizer used at the plantation site (emitted at the fertilizer production process).

B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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Emission reductions ER_y is given by:

$$ER_y = BE_y - PE_y - L_y$$

using the notations defined above.

B.6. Assumptions used in elaborating the new methodology:

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No specific assumptions are set except for the applicability conditions.

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored:

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P1, P3, P6, P9, P12, P15, B2, L1, L5	*Low*	*Check against the sales/purchase receipts/records.*
Measurable parameters at the Bio-Fuel plant	*Low*	*Management system is settled.*
B5, B6	*Low to Middle*	*Thorough and comparable analysis is done for LCA part (for fertilizer (not specified as monitoring items) and fossil fuel)*

Basic approach is to double-check the measured value, not relied on a single value.

Every variable parameter with time dependence is to be depicted in a graph to avoid some human errors and/or accidental events.

Management system based on ISO9000 (if present) is to be established to maintain the credibility of the measured value.

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

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No.

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