CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: BASELINE (CDM-NMB)
Version 02 - in effect as of: 15 July 2005

CONTENTS
PROPOSED NEW METHODOLOGY: BASELINE (CDM-NMB)

SECTION A. Methodology title and summary description

Methodology title:

>>
Production of biodiesel from perennial non-edible oil crops for use as fuel

NM0108-rev
Version 01
02 January 2006

Summary description:

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This methodology is applicable to project activities involving construction and operation of a plant for production of biodiesel from non-edible, perennial oil crops. CERs accrue for the displacement of fossil fuels in mobile and stationary applications. The biodiesel may be supplied to identified consumers, or to unidentified consumers via identified retailers.

The baseline emissions include the CO_2 from the combustion of the fuel(s) that would most likely be used in the baseline scenario. The methodology ensures that the baseline fuel is petrodiesel, except in the case of pure biodiesel (B100) consumed by identified consumers as a transport fuel, since here also baseline fuels other than petrodiesel can be clearly established. Volumes of biodiesel which do not comply with these requirements are discounted from the CER calculation.

Project emissions include CO_2 from fuels and grid electricity consumed for the operation of the biodiesel plant, plus CO_2 from any fossilized carbon which the biodiesel may contain if fossil-fuel based alcohols are used for transesterification.

The methodology quantifies increases in emissions outside the project boundary due to (i) production of alcohols consumed for transesterification, (ii) emissions due to enhanced cycles of nitrogen (N) in crop plantations, and (iii) decreases in emissions related to avoided production of fossil fuels. Project participants can quantify leakages of type (ii) and (iii) by applying a combined default correction factor of 15% of the baseline emissions, if they can demonstrate that the default factor is applicable for their crop context. Alternatively, project participants can quantify these leakages using a combination of project-specific and default data.

The methodology is restricted to oil crops planted on severely degraded land, waste land, and marginal land such as land along roads, railroads and field boundaries, as well as crops collected from wild trees bearing oil seeds. To this end, project participants must demonstrate that the processed oil crops are not the most economically attractive cultivation option on land of normal fertility. This restriction prevents leakage from deforestation of land for new oil crop plantations, because deforested land is fertile. Any remaining releases of carbon due to initial clearing of the degraded lands are assumed to be so small that they will be compensated by the growing perennial oil trees within a few years. Project participants must also demonstrate that the biodiesel production does not displace any existing uses of the oil crop.

Emission reductions are discounted for any biodiesel produced from ineligible crops, as well as for any amounts of biodiesel exported abroad. Double-counting of emission reductions between the producer and consumers of the biodiesel is prevented through contractual arrangements. Likewise, double-counting of CERs between the supplier of the alcohol and the biodiesel producer is prevented.

If this methodology is a based on a previous submission, please state the previous reference number (NMXXXX/AMXXXX) here:

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NM0108

SECTION B. Applicability/ project activity

Methodology procedure:

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This methodology is applicable to project activities which meet the following conditions:

1. Biodiesel plant:
   a) The project activity involves construction and operation of a biodiesel plant for (trans-) esterification[1] of biogenic oils and fats, using alcohols such as methanol or ethanol.
   b) The biodiesel plant includes an expeller[2] for extraction of oils from seeds, and / or it processes oils expelled elsewhere.
   c) Storage and treatment of feedstocks and products of the plant do not result in any methane emissions. In particular, seed cake produced at the plant is either treated aerobically (e.g. returned to field directly, or after composting), or the methane resulting from anaerobic treatment is completely captured and combusted (e.g. in a biodigester for energy generation).

2. Consumers:
   a) The biodiesel is supplied to identified consumers, and / or to identified retailers for on-sale to unidentified consumers.
   b) For biodiesel supplied to identified consumers, the following conditions apply:
   – If used as a transport fuel, the biodiesel may be consumed pure (B100) or as a blend with petrodiesel (e.g. B5, B10, etc.). If consumed as blend, the baseline fuel must be petrodiesel;
   – If used in stationary combustion, the baseline fuel must be petrodiesel;
   c) For biodiesel supplied to unidentified consumers via retailers, the following conditions apply:
   – The biodiesel is consumed as a blend with petrodiesel, and the blending proportion is low enough to ensure that the price and technical performance characteristics of the blend do not differ significantly from those of pure petrodiesel. The default value for the maximum allowable blending proportion for this purpose is 10% by volume (B10).
   – Blending is done by the producer or a third party who is contractually bound to the producer (e.g., the retailer), to ensure that blending proportions can be verified.
   d) Export of the biodiesel to another country is prevented:
   – The identified consumers operate in the host country, and are contractually obliged to consume the biodiesel in the host country;
   – Retailers are contractually obliged to sell the biodiesel blend in the host country;
   – Any biodiesel volumes exported abroad by the producer are clearly identified and discounted in the calculation of emission reductions.

[1] Esterification denotes the formation of an ester compound from a carbon acid and an alcohol. Transesterification denotes the exchange of one alcohol in an ester against another (for example glycerol against methanol). In this methodology, "esterification" is used to denote both esterification and transesterification for simplicity.

[2] Expeller denotes the installation used to extract the oil from the seeds.

3. Crops:
   a) The plant processes mainly oils and seeds from non-edible, perennial crops such as *Pongamia pinnata* and *Jatropha curcas*.
   b) The feedstocks are either acquired from identified contracted farmers, or from unidentified sources via traders, or a combination thereof.
   c) There is sufficient information available to determine in a conservative way, for the region from which the plant procures its feedstock:
      - Whether the processed crops are available in surplus; and
      - Whether use of the crops for biodiesel production is likely to displace any existing uses; and
      - Whether the processed crops are the most economically attractive cultivation option on fertile (= non-degraded) agricultural lands.
   d) Nitrogen (N) inputs into plantations of each processed oil crop can either be monitored, or there is sufficient information available to determine in a conservative way whether the average total amount of nitrogen (N) input into the plantations of each oil crop is likely to exceed 120 kg N per metric tonne of oil produced in the region where the biodiesel plant procures its feedstock.
   e) Annual and edible crops, such as sun flower and soybean, as well as waste oils and fats from industrial processes may be processed, but will not generate CERs.

4. CER Ownership:
   a) Project participants claim CERs only for the direct CO_2 emissions from fossil fuels displaced by the biodiesel. They do not claim CERs for the following: (i) Biodiesel consumed for non-energy purposes; (ii) Reductions in life-cycle emissions associated with the production of the displaced fossil fuels; and (ii) Utilization of the by-products of biodiesel production, such as glycerol and de-oiled seed cake.
   b) Project participants have contractually arranged with their identified biodiesel consumers and retailers that the latter will not claim CERs for the displaced fossil fuels.
   c) Where the biodiesel plant uses alcohols derived from biomass for esterification, project participants either prove that the producer of the alcohol does not claim CERs, or the CERs relating to these alcohols are discounted.
   d) This methodology does not prejudice the ability of project participants or other parties to claim removals by sinks associated with plantations of perennial oil seed crops, using an approved methodology for afforestation/reforestation.

The project falls under the two following sectoral scopes:

– Scope 1: Energy industries (renewable/ non-renewable sources)

Explanation/justification:

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Ad 1. Biodiesel plant:

The main process steps, inputs and outputs in biodiesel production are shown in Table 1.

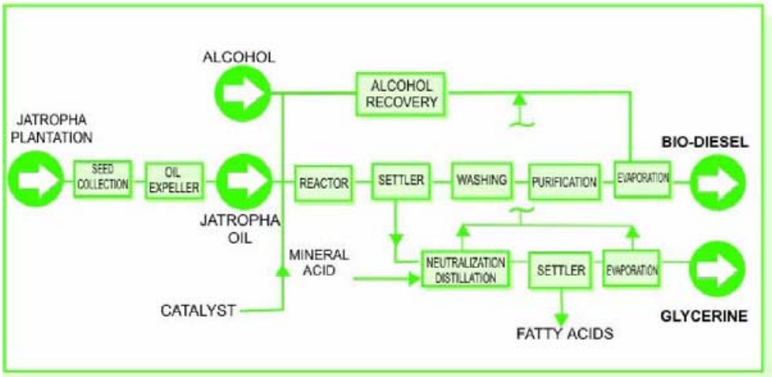

Table 1: Process steps in biodiesel production, using Jatropha as an example.
Source: India (2003)

Ad 2. Consumers:
Key objectives of these conditions are as follows:
– Enable unambiguous identification of the baseline scenario with respect to (i) fuel type, and (ii) energetic efficiency of the combustion technology;
– Avoid crediting of biodiesel exported to other countries.

The methodology meets these objectives as follows:
Ad b) Where the biodiesel is consumed by identified (= usually large) consumers such as bus companies, the baseline fuel type and technology (e.g., petrodiesel buses or CNG buses) can be readily identified and verified through e.g. interviews.

- Use as transport fuel: If the biodiesel is consumed as a petrodiesel blend, the methodology requires that the baseline fuel must be petrodiesel, because otherwise the calculation of project and baseline emissions would become more complex (see Section C for details).
- Use for stationary applications: Here the methodology likewise requires that the baseline fuel must be petrodiesel. The idea is again to minimize the complexity of the methodology, since otherwise special provisions would be required if e.g. on-site power generation with pure biodiesel displaces grid electricity.

The requirement that "the baseline fuel must petrodiesel" appears sufficiently practical and verifiable in the case of identified consumers. Where petrodiesel cannot be established as the baseline, the corresponding amount of biodiesel will be discounted in the emission reduction calculation. An even stricter approach would be to limit blends used for transport, as well as all stationary applications, to B10 as it is done for unidentified consumers. However, we believe that this would unnecessarily limit the applicability of the methodology.

Ad c) Where the biodiesel is consumed by unidentified small consumers (especially individual vehicle drivers), the methodology ensures that the baseline fuel is petrodiesel, by requiring blends of petrodiesel of B10 or lower. Under this condition, it seems very unlikely that the project activity would induce any significant switching from other fuels (e.g., gasoline or CNG) to biodiesel, because the fuel properties of the blend are very similar to normal petrodiesel. The same applies also for stationary applications in e.g. diesel generator sets. For illustration, Table 2 shows that the technical properties of Jatropha biodiesel differ by less than 10% from most European specifications for petrodiesel. Consequently, B10 blend is expected to differ by less than 1% from pure petrodiesel with respect to these parameters. The same considerations apply for price differentials. Biodiesel blends may be sold at a slight discount compared to petrodiesel (say of 1 cent per liter) to attract petrodiesel consumers, but this will not cause a relevant switch from other fuels (e.g. petrol) to biodiesel blends.

Ad d) Export of the biodiesel must be prevented to avoid double-counting of emission reductions between the host country and Annex I countries. In the case of identified large consumers such as bus or rail companies, this can easily be ensured since these typically operate in a confined area. In the case of blends sold to small consumers by retailers, the approach is to contractually prevent retailers and any involved third parties from exporting.

Other comments:
The following applicability conditions were also evaluated:

– Restriction to biodiesel supplied to identified consumers (exclusion of retailing): This condition was not adopted because it could effectively bind a biodiesel producer to a single or a few large consumers, and thereby distort the market. Instead, the restriction to B10 or lower blends was chosen to ensure that the baseline scenario for small consumers can be identified with adequate certainty.
– Restriction to transport applications (exclusion of stationary uses): This restriction cannot be enforced if the biodiesel is sold to unidentified consumers (retailing). Instead, the restriction that petrodiesel must be established as the baseline fuel was introduced for stationary applications by identified consumers.

Characteristic	*Jatropha* bio-diesel	European standard
Density (g cm^{-3} at 20°C)	0.87	0.860–0.900
Flash point (°C)	191	>101
Cetane no. (ISO 5165)	57–62	>51
Viscosity (mm^2/s at 40°C)	4.20	3.5–5 (40°C)
Net cal. val. (MJ/L)	34.4 (or 39.5 MJ/g)	–
Iodine No.	95–106	<120
Sulphated ash	0.014	<0.02
Carbon residue	0.025	<0.3

Table 2: Technical properties of Jatropha biodiesel, and European specifications for petrodiesel. Source: Francis et al. 2005

Ad 3. Crops:

Biodiesel plants are typically able to process oils from various crops. The feedstocks (oil seeds and / or oils) are acquired from a variety of sources. Except if grown by contract farmers, the precise origin of the oil seed (down to each farmer) cannot always be identified. This can prevent comprehensive monitoring of leakages related to the crop cultivation. Instead, the conditions on crops aim to prevent unaccounted leakages. See Sections H and I for details.

Ad a) The restriction to perennial crops (= trees or large bushes) ensures a substantial above-ground biomass on plantations, which will usually far outweigh initial emissions related to land clearing within a period of a few years, on the condition that biomass stocks on the land are limited, as is it the case on severely degraded land.

Ad c) This condition aims to ensure that utilisation of the oil crop for biodiesel production does not displace any existing uses of the crop. It also the basis for preventing direct deforestation for new oil crop plantations, as well as displacement of other crops by oil crops, which could lead to deforestation elsewhere. See Sections H and I for details.

Ad d) This condition ensures that net crop leakage from the project activity does not exceed the default value of 15% provided in Section H, or that alternatively net crop leakage can be quantified on a project-specific basis.

Ad e) CER generation from waste oils and fats is excluded for simplicity, since the distinction between "waste" and "non-waste" feedstocks may be difficult in practice.

Ad 4. CER Ownership:
Ad a) The restriction to direct emission reductions associated with the displaced fossil fuels is conservative and helps to keep the complexity of the methodology to a minimum.

Ad b) The goal of this criterion is to prevent double-counting of emission reductions between biodiesel producers and consumers, without prejudicing against the development of other methodologies tailored for consumers of biodiesel. The condition 1.a (project activity must involve construction and operation of a biodiesel plant) implies already that consumers of biodiesel cannot claim CERs on their own under this methodology. Nevertheless, the methodology introduces a second safeguard against double-counting by requiring the project participants to show contractual evidence that their identified consumers and retailers will not claim CERs. This further enhances the robustness of the methodology regarding double-counting.

Consumers of biodiesel wishing to claim CERs may still develop a dedicated methodology for this purpose. However, they should be required to demonstrate that their biodiesel comes from a plant which is not registered as a CDM activity.

Ad c) This criterion serves to avoid double-counting between the producers of biodiesel and alcohol. See Section G for details.

Ad d) The methodology does not claim CERs for removals by sinks, nor uses such removals to offset leakages other than those from limited initial clearing of land. See Section I for details.

SECTION C. Project Boundary

Methodology procedure:

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The spatial extent of the project boundary includes:

a) The biodiesel production plant, comprising the esterification unit, plus expeller unit (if applicable), plus other installations on the site (e.g. storage, refining, blending, etc.);
b) Upstream expeller plants supplying oil to the biodiesel production plant (if any);
c) Vehicles and stationary combustion installations where the biodiesel is consumed.

Relevant emission sources within this boundary include (see table below for details):

- Fuel and electricity consumed at the biodiesel plant;
- Electricity consumed by upstream expellers;
- Emissions from combustion of the biodiesel.

Emissions associated with the cultivation of the oil crops are excluded from the project boundary, but accounted for as leakage. The same applies for the emissions associated with the production of alcohols used for esterification. See Section H for details.

The following processes are excluded from the project boundary:

- Transports of feedstocks to the biodiesel plant, and of biodiesel to consumers / retailers;
- Emissions from preparation of other inputs for the biodiesel plant (e.g., solvents used for extraction of oil);
- Downstream use of by-products of the biodiesel plant (Glycerol, seed cake).

	Source	Gas	Included?	Justification / Explanation
Baseline	Vehicles & stationary combustion installations consuming biodiesel	CO_2	Yes	Main source of baseline emissions
		CH_4	No	Small emissions source, and no systematic difference to project activity
		N_2O	No	
Project Activity	Biodiesel plant energy consumption	CO_2	Yes	On-site fuel consumption plus production of grid electricity
		CH_4	No	Only negligible emissions associated with on-site fuel consumption and grid electricity
		N_2O	No	
	Upstream expeller	CO_2	Yes	Electricity consumption included, using default value
		CH_4	No	Negligible
		N_2O	No	Negligible
	Vehicles & stationary combustion installations consuming biodiesel	CO_2	Yes	Fossil carbon contained in alcohols used for esterification. Other biodiesel carbon is climate-neutral (renewable biomass).
		CH_4	No	Small emissions source, and no systematic difference to baseline scenario
		N_2O	No	

Table 3: Emissions sources included in or excluded from the project boundary

Explanation/justification:

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The project boundary includes all greenhouse gas emissions that are significant, reasonably attributable to the project activity, and which can be monitored with adequate accuracy and at reasonable costs. Emissions associated with the cultivation of the biodiesel crops are treated under Leakage in Section H.

Emissions of CH_4 and N_2O upon combustion of biodiesel (project scenario) and fossil fuels (baseline scenario) are excluded from the project boundary, in line with recommendations by the Meth Panel to the first version of this methodology. This is justified because these emissions together typically account for only a few percent of the total GHG emissions from combustion (the large rest being CO_2), and because no material differences in CH_4 and N_2O emissions are expected between the baseline and the project scenario.

In cases where the biodiesel is consumed as a blend with petrodiesel, the methodology requires that the baseline fuel must be petrodiesel (see applicability conditions). Therefore, it is justified to exclude the

fraction of petrodiesel in the blend from the calculation of the project emissions, and limit the baseline emissions to the amount of fuel corresponding to the biodiesel fraction in the blend (see Sections F and G for details on calculations). This also ensures that the biodiesel producer cannot claim CERs relating to the diesel fraction in the blend, if e.g. the baseline fuel has higher specific emissions per vehicle-kilometer.

Solvents such as hexane are sometimes used for enhanced extraction of oil from the seeds. These solvents are used in a closed loop, and net solvent consumption per unit biodiesel produced is therefore small. Correspondingly, our data indicates that CO_2 emissions from consumption of solvents is well below 1% of the baseline emissions. In addition, not all expeller units use solvents. Finally, enhanced extraction of oil from the seeds will reduce leakage related to cultivation of the seeds. Therefore, it is justified and conservative to exclude solvent consumption from the project boundary.

D. Baseline Scenario

Methodology procedure:

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Project participants should use Step 1 of the latest version of the "Tool for demonstration and assessment of additionality" [3] to identify all realistic and credible baseline alternatives. In doing so, all relevant policies and regulations related to transport fuels and biodiesel should be explicitly identified and taken into account. These may include, but are not limited to e.g. :

- Regulations restricting the use of certain fuels in the transport sector;
- Air pollutant emission standards for vehicles;
- Regulations requiring blending of petrodiesel with a certain amount of biodiesel;
- Regulations requiring biodiesel production from certain crops;
- Regulations on crop types eligible for biodiesel production;
- Regulations for minimum offtake prices for biodiesel;
- Regulations on biodiesel composition and performance characteristics.

The most likely baseline scenario in the absence of the CDM project activity should be established separately for (i) the biodiesel production plant ("Producer"), and (ii) identified consumers of the biodiesel ("Consumers"). The range of evaluated scenarios should include at least those identified in Table 4 below. Eliminate the scenarios which are not plausible or technically, economically or legally feasible, using test questions such as those indicated below. Then rank the scenarios according to their overall feasibility to determine the most likely scenario. Note that scenarios P1 and C1 (project activity undertaken without CDM) are listed for completeness only. The question whether the project activity is the most likely baseline scenario should be analyzed in detail in accordance with Section E below.

For unidentified consumers supplied via retailers, the scenarios C1-C5 listed in Table 4 are not applicable. Instead, project participants should demonstrate that the supplied blend of biodiesel is below the maximum allowed proportion (B10 or lower), and that pure petrodiesel is therefore the baseline fuel. If this cannot be demonstrated, this methodology is not applicable for the respective amount of biodiesel.

3 Please refer to: <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

No.	Producer Scenario Description	Test Questions e.g.	Conditions / Remarks
P1	Project activity undertaken without CDM	--	Analyzed in detail in Section E.
P2	Biodiesel plant operates on alternative feedstocks (e.g. waste oils or residues of edible crops)	Are alternative feedstocks available which are technically and economically viable?	Scenario implies that no CERs accrue if the alternative feedstocks are renewable.
P3	Biodiesel plant built with other size	Could plant be sized smaller to operate on restricted set of crops, and is this economically viable?	Scenario implies that CER volume needs to be reduced.
P4	Biodiesel plant not built	--	--

No.	Consumer Scenario Description	Test Questions e.g.	Conditions / Remarks
C1	Project activity undertaken without CDM	--	Analyzed in detail in Section E.
C2	Alternative biodiesel supply	Is biodiesel from an alternative supplier available at an economically attractive price, and in sufficient quantities? Is the alternative supplier a CDM project activity?	Scenario implies that biodiesel is the baseline fuel, unless: – other barriers prevent the use of biodiesel, OR – the alternative supplier is a CDM project activity.
C3	Consumer continues to use current fuel	Is the current fuel the most economically attractive? Does it comply with existing regulation? Is this likely to change in the next 1-3 years? Are there supply shortages?	--
C4	Consumer switches to other fuel (e.g., petrol or CNG)	Are alternative fuels available? Do air pollution standards require fuel switch?	Alternative fuels will differ with respect to specific consumption per distance, and C content.
C5	Consumer partly or fully discontinues transport operations	--	Scenario implies that CER volumes need to be reduced.

Table 4: Minimum set of potential baseline scenarios to be considered for the biodiesel producer (P1-4) and identified consumers (C1-5)

Explanation/justification:

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No explanations.

SECTION E. Additionality

Methodology procedure:

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Additionality of the proposed CDM project activity shall be demonstrated using the latest version of the “Tool for demonstration and assessment of additionality”.

Additionality is assessed only for the project activity, i.e. the construction and operation of the biodiesel plant. Specific instructions for some steps of the consolidated additionality tools are provided below. Additionality is established ex ante for the full duration of the crediting period, i.e. the relevant parameters are not subject to monitoring.

Step 1: Identification of lawful alternatives to the project

This step serves to demonstrate that construction and operation of the biodiesel plant (Scenario P1, and the associated Scenario C1) is not the only alternative in compliance with all applicable regulations with which there is general compliance in the project region or country. The assessment in this step builds on the analysis of the most likely baseline scenario according to Section D above, and should take into account the types of policies and regulations listed there. The project developer must bear in mind the relevant clarifications on the treatment of national and/or sectoral policies and regulations in determining a baseline scenario.[4]

Step 2: Investment Analysis

The participants shall first identify the highest average price (the "maximum price") which the producer can reasonably expect to obtain for his biodiesel output. This will typically be the market price of the baseline fuel, minus a discount required by consumers and retailers to cover extra costs for introducing and handling biodiesel as well as perceived risks related to technical performance of the fuel.

The maximum price should be calculated separately for each year of the lifetime of the biodiesel plant. If the plant supplies more than one consumer / retailer, the maximum price should be a weighted average of the maximum prices obtainable from each consumer / retailer.

The calculation of the maximum price should take into account all factors which influence the relative economics of biodiesel and the baseline fuel, such as:

- Any investments required on the part of the biodiesel consumers in both the project activity scenario and the baseline scenario, such as: investments for engine modifications, new vehicles, fuel storage, etc.;
- Differences in vehicle mileage per fuel unit;
- Differences in vehicle maintenance costs;
- Discounts required by the consumers to compensate for technical performance risks;
- Expected future changes in the price of the baseline fuel, to the extent that the consumer can be reasonably expected to consider such changes in his decision-making. Price trends may be derived e.g. from national projections or from publications of the International Energy Agency (World Energy Outlook);
- Investments and operating costs on the part of retailers (if applicable), to cover e.g. fuel storage and blending installations, handling charges, and discounts required to compensate for technical performance risks;
- National policies on off-take prices to be paid by retailers, taking into account the relevant EB guidance on the treatment of national policies as specified above.

The time series of annual "maximum prices" for biodiesel should then be used as an input variable for the investment analysis of the biodiesel plant as required in Step 2 of the consolidated additionality tools.

Step 3: Barrier Analysis

Barrier analysis may take into account, but should not be limited to, the following types of barriers:

- Oil seed supply chain risk due to e.g. annual variations in harvest yields;
- Technological barriers with respect to e.g. performance of biodiesel from different crops;

4 See EB16 Report Annex 3, EB 22 Report Annex 3, and other forthcoming guidance on this subject.

– Biodiesel sales price risk due to e.g. volatile prices of fossil fuels.

Explanation/justification:

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The methodology assumes that consumers will switch to biodiesel (or blend) if the price is below a certain threshold, called the “maximum price”. They key question in the additionality assessment is therefore whether the biodiesel production is economically viable at this competitive price level, taking into account the costs of biodiesel handling by the retailers.

SECTION F. Baseline emissions

Methodology procedure:

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Baseline emissions from displaced fossil fuels are determined for each baseline fuel i using the following equation:

$$(1) \qquad E_{BL\_y} = \sum_i M_{BD\_i\_y} \cdot efm\_m_i \cdot EF_i \cdot 44/12$$

where:

E_{BL_y}	*Baseline emissions in year y (t CO_2)*
$M_{BD\_i\_y}$	*Amount of biodiesel (pure, i.e. before blending) substituting baseline fuel type i (t)*
efm_m_i	*Efficiency multiplier (mass basis) for baseline fuel i vs. biodiesel (kg/kg)*
EF_i	*Carbon content of baseline fuel i (t C /t fuel)*
44/12	*Molar weight ratio to convert tonnes of carbon to tonnes of CO_2*

The carbon contents of the baseline fuels EF_i should be based on either national statistics or IPCC default values.[5]

For blends of biodiesel with petrodiesel, and generally whenever the baseline fuel is petrodiesel, the efficiency multiplier efm_m_i shall be calculated based on the respective net calorific values of biodiesel and petrodiesel, as shown in Equation (2):

$$(2) \qquad efm\_m_i = \frac{NCV_{BD}}{NCV_{PD}}$$

where:

NCV_{BD}	*Net calorific value of biodiesel (GJ/t)*
NCV_{PD}	*Net calorific value of petrodiesel (GJ/t), determined from national statistics at start of project activity*

If the baseline fuel is different from petrodiesel (only allowed for pure biodiesel used as transport fuel by identified consumers), the efficiency multiplier shall be calculated based on the specific fuel consumptions in the baseline scenario and the project activity scenario, as shown in Equation (3). The specific

[5] See Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, p.1.13

consumption of the baseline fuel s_{BL} shall be defined at the start of the project activity, based on historic data on fuel consumption and mileage covering at least 3 years prior to the start of the project activity (or prior to the date when the respective consumer first starts using the biodiesel). The historic consumption data must be representative for the type of vehicles and traffic conditions where the biodiesel will be used. If adequate historic consumption data are not available, vehicle manufacturer data shall be used.

$$(3) \qquad efm\_m_i = \frac{s_{BL\_fuel\_i}}{s_{BD}}$$

where:

s_{BL} *Specific consumption of baseline fuel i (kg fuel /vehicle-km)*
s_{BD} *Specific consumption of biodiesel (pure, in kg fuel /vehicle-km)*

If the biodiesel plant produces different types of biodiesel (i.e. from different crops or with different alcohols), project participants shall ensure that the efficiency multipliers are representative for their production mix, or account for each type of biodiesel separately.

Explanation/justification:

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The calculation of the baseline emissions from displaced fossil fuels does not involve any substantial sources of uncertainty.

With respect to the efficiency multiplier *efm_i*:

- The proposed approximation based on NCVs in Equation (2) is sufficiently accurate because the specific fuel consumption is unlikely to change substantially on an energy basis (i.e., in GJ /vehicle-km) when the combustion technology remains the same and the fuels are very similar.
- The calculation based on specific fuel consumption avoids gaming of the baseline by requiring 3 years of representative historic data for $s_{BL\_fuel\_i}$. Using manufacturer data is even more conservative, because real life fuel consumption tends to exceed the values specified by the manufacturer due to sub-optimal driving styles, traffic conditions, maintenance levels, etc.

SETION G. Project activity emissions

Methodology procedure:

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Project activity emissions include three components: CO_2 from consumption of fuels and electricity in the biodiesel plant, and CO_2 emissions from combustion of fossil carbon contained in the alcohol which is chemically bound in the biodiesel during the esterification process, and released upon combustion. The remaining CO_2 emissions resulting from the combustion of the biodiesel are considered climate-neutral. In the case of blends, the petrodiesel fraction in the blend is excluded from the calculations.

$$(4) \qquad E_{P\_y} = E_{P\_fuel\_y} + E_{P\_elec\_y} + E_{P\_alc\_y}$$

where:

E_{P_y} *Project activity emissions in year y (t CO_2)*
$E_{P\_fuel\_y}$ *Emissions from combustion of fuels in the biodiesel plant (t CO_2)*

$E_{P\_elec\_y}$ *Emissions from electricity consumption in the biodiesel plant (t CO_2)*
$E_{P\_alc\_y}$ *Emissions from combustion of fossil carbon contained in biodiesel ester alcohols (t CO_2)*

Emissions from fuel combustion are calculated based on the measured consumption of heating fuel(s) on the biodiesel production site, as shown in Equation (5). In addition, a correction factor is introduced to take into account fuel consumed by upstream expellers which supply the biodiesel plant with oil.

$$(5) \qquad E_{P\_fuel\_y} = \sum_i (M_{P\_fuel\_expel\_i\_y} \cdot \frac{M_{Oil\_ester\_y}}{M_{Oil\_expel\_y}} + M_{P\_fuel\_other\_i\_y}) \cdot EF_i \cdot 44/12$$

where:

$M_{P\_fuel\_expel\_i\_y}$	*Fuel of type i consumed on-site for expeller (t)*
$M_{Oil\_ester\_y}$	*Total amount of oil processed (esterified) on-site (t)*
$M_{Oil\_expel\_y}$	*Amount of oil expelled on-site (t)*
$M_{P\_fuel\_other\_i\_y}$	*Fuel of type i consumed on-site other than for expeller (t)*
EF_i	*Carbon content of fuel i (t C/t)*

Emissions from electricity consumption are calculated based on the measured electricity consumption on the biodiesel production site. In addition, a correction factor is introduced to take into account electricity consumed by upstream expellers which supply the biodiesel plant with oil.

$$(6) \qquad E_{P\_elec\_y} = (Q_{p\_elec\_expel\_y} \cdot \frac{M_{Oil\_ester\_y}}{M_{Oil\_expel\_y}} + Q_{P\_elec\_other\_y}) \cdot EF_{Elec}$$

where:

$Q_{P\_elec\_expel\_y}$	*Electricity consumed on-site for expeller (MWh)*
$Q_{P\_elec\_other\_y}$	*Electricity consumed on-site other than for expeller (MWh)*
EF_{Elec}	*Emission factor for electricity (kg CO_2 /MWh)*

If the project activity plant does not include an expeller, the electricity consumption for expelling the processed oil should be calculated based on the specific consumption of a representative sample of the expellers supplying the plant.

The emission factor EF_{Elec} shall be calculated in accordance with the latest version of the following approved methodologies:

- ACM0002 if the consumption exceeds 15 GWh /yr;
- AMS 1.D if the consumption does not exceed 15 GWh /yr.

Emissions from combustion of alcohols are based on the measured consumption of alcohols in the biodiesel plant, and the mass fraction of fossil carbon in the alcohols, as shown in Equation (7). The alcohol consumption should be net of any water content, but including volumes spilled and evaporated.

Methanol is normally produced from natural gas, hence the carbon is fossil. Other alcohols, especially ethanol, can be of biomass origin. The mass fraction of fossil carbon in such alcohols may be considered zero if the following conditions are met:

- The plant producing the alcohol and the corresponding biomass feedstock are identified; and

– The biodiesel producer can show contractual or other evidence showing that the alcohol producer does not claim any CERs. “Other evidence” includes e.g. a proof that none of the alcohol plants in the region where the biodiesel plant procures its feedstock has been approved as a CDM activity in or before the reporting year y.

$$(7) \qquad E_{P\_alc\_y} = \sum_i M_{Alc\_i\_y} \cdot EF_{Alc\_i} \cdot 44/12$$

where:
$M_{Alc\_i\_y}$ *Amount of alcohol i consumed in biodiesel plant (t)*
EF_{Alc_i} *Mass fraction of alcohol that is fossil carbon (t C/t)*
EF_{Alc} is 12/32 for methanol, and 24/46 for fossil-based ethanol.

Explanation/justification:

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The calculation of the baseline emissions from displaced fossil fuels does not involve any substantial sources of uncertainty. All required parameters can be readily monitored on-site during the crediting period.

With respect to fuels and electricity consumed for expelling the oil seeds, the idea is to prevent leakages and avoid a penalty for expelling on-site as opposed to purchasing oil from upstream expellers. Extrapolating on-site fuel and electricity consumption based on the proportion of total processed vs. expelled oil seems a reasonable simplification for this purpose, given that the overall emissions due to these sources are small.

The use of alcohols derived from biomass can create room for double-counting if both the producers of the alcohol and the biodiesel claim CERs (the ethanol producer would have to claim using a different methodology). The most accurate approach would be to deduct any CERs accruing to the alcohol producer from those accruing to the biodiesel producer, and in turn grant CERs to the biodiesel producer for the renewable byproduct glycerol (which is a C3-alcohol released during biodiesel transesterification). In practice, however, this detailed approach would seem too complex given the relatively small amounts of CERs involved (approx. 10% of the total CERs accruing to the biodiesel plant). Instead, this methodology uses a more simple but conservative approach whereby no CERs accrue for the glycerol, and the carbon in the alcohol is considered as fossil unless double-counting of CERs with alcohol producers can be ruled out.

SECTION H. Leakage

Methodology procedure:

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1. Overview

This methodology distinguishes five major categories of negative[6] leakage for biodiesel project activities, of which three (b-d) are related to the plantation and harvesting of the oil seeds:

a) Emissions associated with the production of alcohols used for esterification;

[6] “Negative” leakage means that the project activity leads to increased emissions outside the project boundary.

b) Leakage of N_2O emissions associated with enhanced nitrogen- (N) cycles and application of N-fertilizers in oil crop plantations;
c) Deforestation and land clearing as a result of new oil crop plantations;
d) Displacement of existing uses of oil crops, which may result in enhanced demand for fossil fuels, or enhanced deforestation elsewhere;
e) Export of biodiesel to Annex 1 countries, which can lead to double-counting.

On the other hand, biodiesel project activities will likely create positive leakages of the following types:
f) Reduction in precombustion emissions associated with the displaced production of fossil fuels;
g) Sequestration of carbon in oil crop plantations (removals by sinks).

This methodology accounts for the leakages of type a, b and f. The other categories of negative leakage (c, d and e) are prevented by means of the applicability conditions and discounts in the emission reduction calculation (see Sections B and I for details). Carbon removals by oil crops (g) are not accounted for. This creates a substantial further buffer against negative leakages and also helps to avoid double-counting with respect to afforestation / reforestation CDM projects involving oil crops.

Leakage from enhanced N cycles (type b) and positive leakage due to reduction of fossil fuel precombustion emissions (type f) are netted against each other. The resulting net difference is called "Net crop leakage" $L_{Crop\_net\_y}$. In quantifying the leakage $L_{Crop\_net\_y}$, project participants can choose between a simplified approach using a default factor, and a more comprehensive approach based on project-specific data, as described below.

(8) $$L_Y = L_{MeOH\_y} + L_{Crop\_net\_y}$$

where:
L_y *Total leakage from the project activity (t CO_2e)*
L_{MeOH_y} *Leakage from production of alcohols consumed by the biodiesel plant (t CO_2e)*
$L_{Crop\_net\_y}$ *Net leakage from production of oil crops (t CO_2e)*

2. Leakage from Alcohol Production L_{MeOH_y}

Leakage due to production of alcohols is quantified based on the measured consumption of methanol, and a default emission factor of 2.0 t CO_2 /t methanol, as shown in Equation (9). Leakage related to consumed ethanol is considered zero because production of ethanol is far less energy-intensive, and because this relatively low energy consumption will be offset at least partly by the energy value of the byproduct glycerol for which no CERs are claimed under this methodology. If project participants use alcohols other than methanol or ethanol for esterification, they shall derive an adequate precombustion emission factor and justify their choice.

(9) $$L_{MeOH\_y} = M_{MeOH\_y} \cdot EF_{MeOH\_PC}$$

where:
M_{MeOH_y} *Consumption of methanol in the biodiesel plant (t)*
EF_{MeOH_PC} *Precombustion emission factor for methanol production (t CO_2 /t methanol, see Table 5)*

3. Net Crop Leakage $L_{Crop\_net\_y}$: Default Approach

In the default approach, the net crop leakage is quantified as 15% of the baseline emissions E_{BL_y} (see Equation (1) for details on E_{BL_y}):

$$L_{Crop\_net\_y} = E_{BL\_y} \cdot 0.15 \qquad (10)$$

Project participants may choose to apply this default approach on the condition that they can demonstrate that the average annual total N input into the plantations of all crops processed by the biodiesel plant $N_{Crop\_average\_y}$ is unlikely to exceed the threshold value of 120 kg N per metric tonne of oil over a period of 10 years from the date of plantation (or from the starting date of seed collection, if the oil trees already exist). Total N input includes inputs via synthetic and organic fertilisers, as well as the mass of N contained in crop residues which are returned to the plantation soils, such as deoiled seed cake and seed shells. Leaves of deciduous oil trees are not considered a residue and their N content need not be considered in this calculation. Likewise, N-fixation by oil crops need not considered.

If the plant processes oils from more than one crop, the N input shall be determined as the average, weighted by the mass of oil processed from each crop, and their respective N inputs, as shown in Equation (11). Only crops eligible for CER crediting under this methodology should be considered (ineligible crops should be neglected).

$$N_{Crop\_average\_y} = \frac{\sum_i M_{Oil\_ester\_i\_y} \cdot N_{Crop\_i}}{M_{Oil\_ester\_y}} \qquad (11)$$

where

$N_{Crop\_average\_y}$ *Weighted standard N input for the oil crop mix processed in year y (kg N /ha.yr)*
$M_{Oil\_ester\_i\_y}$ *Amount of oil from crop i esterified (t)*
N_{Crop_i} *Standard N input for oil crop i (kg N /ha.yr)*

For the analysis of likely ("standard") N inputs N_{Crop_i}, project participants shall rely on data representative for the region where the plant will procure its feedstock. Eligible data sources include, but are not limited to the following:

- Recommendations on N fertilizer application from recognized agricultural research institutions;
- Publications on de facto fertilization practices;
- Publications on the mass of crop residues and their N contents.

If the average N input exceeds the threshold value, project participants shall quantify net crop leakage based on the project-specific approach described below, either for all processed crops, or for the most N-intensive crops with application of the default factor for the remaining crops.

4. Net Crop Leakage $L_{Crop\_net\_y}$: Project-Specific Approach

Under this approach, project participants can quantify the net leakage from the production of their oil crops using a combination of monitored data and default values. Participants may choose this approach to demonstrate that the net crop leakage is smaller than the default fraction listed above. The project-specific approach may also be applied in parallel with the default approach, for a part of the total biodiesel production of a plant. Net crop leakage $L_{Crop\_net\_y}$ cannot be smaller than zero, i.e. no CERs can accrue for net reductions in leakage under this methodology.

(12) $$L_{Crop\_net\_y} = E_{P\_N\_y} - E_{BL\_PC\_y} \qquad L_{Crop\_net\_y} \geq 0 \ !$$

where:

$E_{P\_N\_y}$ *GHG emissions due to enhanced N-cycles in the project activity scenario (t CO_2e)*

$E_{BL\_PC\_y}$ *Precombustion emissions from production of fossil fuels in the baseline scenario (t CO_2e)*

The steps for quantifying $E_{P\_N\_y}$ and $E_{BL\_PC\_y}$ are detailed below.

4.a) N-Leakage ($E_{P\_N\_y}$)

Leakage due to enhanced N cycles is calculated for each oil crop i processed by the biodiesel plant on a per hectare basis:

(13) $$E_{P\_N\_y} = \sum_i \frac{M_{Oil\_ester\_i\_y}}{Y_{i\_y}} \cdot EF_{N\_i\_y}$$

where:

Y_{i_y} *Specific oil yield for crop i (t oil /ha)*

$EF_{N\_i\_y}$ *Emission factor for enhanced N cycle for crop i (t CO_2e /ha)*

The emission factor $EF_{N\_i\_y}$ is composed of three components: Fertilizer N converted to N_2O when applied to the soil, energy consumption for production of synthetic N-fertilizers, and crop residue N converted to N_2O after being returned to the soil.

(14) $$EF_{N\_i\_y} = EF_{FN\_i\_y} + EF_{FP\_i\_y} + EF_{RN\_i\_y}$$

where:

$EF_{FN\_i\_y}$ *Emission factor for N_2O emissions from fertilizer N applied to soil (t CO_2e /ha)*

$EF_{FP\_i\_y}$ *Emission factor for GHG emissions associated with N-fertilizer production (t CO_2e /ha)*

$EF_{RN\_i\_y}$ *Emission factor for N_2O emissions from crop residue N returned to soil (t CO_2e /ha)*

The N_2O emission factor for fertilizer N, $EF_{FN\_i\_y}$ is calculated based on the amounts of organic and synthetic fertilizer applied to oil crop i, and a default emission factor EF_1, in accordance with Equation (15).

The emission factor for production of synthetic fertilizer, $EF_{FP\_i\_y}$ is calculated based on monitored consumption of both synthetic and organic fertilizer for crop i, and adjusted for residue N exported as fertilizer to other farmers $m_{RNEX\_i\_y}$, in accordance with Equation (16). Organic fertilizers such as animal manure (but not residues from the oil crops) are included because such fertilizers are usually scarce; hence consumption for the oil crops will likely induce higher consumption of synthetic fertilizers elsewhere. Residue N exported to other farmers (especially deoiled seed cake) is deducted because these residues will likely displace synthetic fertilisers elsewhere, based on the same logic.

The N_2O emission factor for residue N returned to soils, $EF_{RN\_i\_y}$ is calculated from the total amount of residue N from crop i that is returned to (any) soil $m_{RN\_i\_y}$, minus the amount of residue N exported as fertilizer to other farmers $m_{RNEX\_i\_y}$. The deduction for exported N is again based on the assumption that these exports will displace other fertilizers, which would result in the same N_2O emissions in the baseline scenario. The total amount of residue N $m_{RN\_i\_y}$ is defined by the mass of the residues returned to soils and their respective N-contents. It includes deoiled cake as well as any other residues of relevant volume and N content which are returned to soils, such as e.g. shells, but not the leaves shed by deciduous trees.

(15) $$EF_{FN\_i\_y} = (m_{ON\_i\_y} + m_{SN\_i\_y}) \cdot EF_1 \cdot 44/28 \cdot GWP_{N2O}$$

(16) $$EF_{FP\_i\_y} = (m_{ON\_i\_y} + m_{SN\_i\_y} - m_{RNEX\_i\_y}) \cdot EF_2$$

(17) $$EF_{RN\_i\_y} = (m_{RN\_i\_y} - m_{RNEX\_i\_y}) \cdot EF_1 \cdot 44/28 \cdot GWP_{N2O}$$

where:

$m_{ON\_i\_y}$ *Organic manure-N (excluding crop residues) applied to crop i in year y (kg N /ha)*
$m_{SN\_i\_y}$ *Synthetic fertilizer-N applied to crop i in year y (kg N /ha)*
EF_1 *Fraction of fertilizer N converted to N_2O-N (kg /kg; see Table 5)*
44/28 *Molar weight ratio of N_2O and 2 x N*
GWP_{N2O} *Global warming potential of N_2O (= 310 t CO_2e /t N_2O)*
$m_{RNEX\_i\_y}$ *Residue-N from crop i exported as fertilizer (= not returned to crop plantation i) (kg N /ha)*
EF_2 *Upstream emissions from production of synthetic fertilizer (kg CO_2e /kg N; see Table 5)*
$m_{RN\_i\_y}$ *Amount of residue-N from crop i that is returned to any soil (kg N /ha)*

Parameter	Value	Source, Comments
EF_{MeOH_PC}	2.0 t CO_2 /t methanol	Specific primary energy consumption in methanol plants is assumed as 30 GJ /t MeOH (Source: http://edj.net/sinor/SFR4-99art7.html; modern plants reach 29 MJ /t MeOH). CO_2 emission factor is assumed as 65 kg CO_2 / MJ (average of IPCC emission factors for natural gas and diesel oil).
EF_1	0.0125 kg N_2O-N /kg N	IPCC 1996 Revised Guidelines for National GHG Inventories, Reference Manual, p.4.89
EF_2	2.2 kg CO_2 /kg N	Average emission factor for production of N fertilizer, assuming primary energy demand of 38.9 MJ /kg N and natural gas as the primary energy source. Source: http://www.fao.org/wairdocs/lead/x6113e/x6113e09.htm
EF_{FF_PC}	0.5 t CO_2e /t fossil fuel	Swiss EcoInventory of Energy Systems, 2nd Edition, Vol. 1, 1995, p.245

Table 5: Default values for the calculation of N-leakage

4.b) Leakage from Production of Fossil Fuels ($E_{BL\_PC\_y}$)

Leakage associated with production of fossil fuels is calculated based on the amount of displaced fossil fuels, and an emission factor for the precombustion emissions. The amount of displaced fossil fuels is quantified based on the respective amounts of biodiesel and the relevant efficiency multipliers efm_m_i, as defined in Equation (1) above:

(18) $$E_{BL\_PC\_y} = \sum_i M_{BD\_i\_y} \cdot efm\_m_i \cdot EF_{FF\_PC}$$

where

$M_{BD\_i\_y}$	*Amount of biodiesel (pure, i.e. before blending) substituting baseline fuel type i (t)*
efm_m_i	*Efficiency multiplier (mass basis) for baseline fuel i vs. biodiesel (kg/kg)*
$EF_{FF\_PC\_y}$	*Emission factor for precombustion emissions from production of fossil fuels (see Table 5)*

The default value for the emission factor EF_{FF_PC} is 0.5 t CO_2e /t of fuel. This is a conservative value applicable to all types of fossil fuels, in particular: petrodiesel, gasoline and kerosene. It covers emissions of CO_2 and CH_4 during all steps in the production chain of the fossil fuels until they reach the regional fuel distribution center, such as: exploration, production, refining, and the different transport steps.

The default value for EF_{FF_PC} is based on European data for petrodiesel. In practice, the true precombustion emissions will vary depending on the type of fuel and the host country, and may be substantially higher if highly refined fuels such as gasoline or low-sulfur diesel are the baseline fuels. Project participants may choose to apply another value for EF_{FF_PC} which is more adequate for their specific context. However, any such value must be derived from an independent, per-reviewed journal or a publication of comparable standard. In addition, allowance must be made for all leakages in the life-cycle of biodiesel which are not accounted for by this methodology, especially transports of oil seeds to the biodiesel plant.

Explanation/justification:

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Ad 1: Overview

A key concern of this methodology is to minimize the risk of leakage due to deforestation and land clearing for new oil crop plantations. This is achieved by effectively restricting the methodology to oil crops grown on severely degraded land, waste land, and marginal land such as e.g. strips along roads, railroads, field boundaries, etc. See Explanations in Section I for details on how this restriction is implemented.

Regarding the possible emissions from initial clearing of such degraded or waste lands, the assumption is that little vegetation exists on these lands (otherwise they would be fertile and not considered degraded). Hence the emissions from initial clearing (if any) will be outweighed by the carbon sequestered in the oil crop within the first few years of the crediting period. This is the main reason why the methodology is restricted to *perennial* crops, i.e. large shrubs or trees. For example, *Jatropha Curcas* grows to approx. 3-5 m height, and *Pongamia Pinnata* to approx. 8m and more.[7]

IPCC GPG-LULUCF (2003, p.3.88) provide default values for annual carbon sequestered in above-ground biomass of perennial crops, as shown in Table 6. In comparison, the maximum amount of carbon expected to be released during initial clearing of degraded and waste lands is estimated at 12.6 t C /ha. This is the IPCC default value for carbon stored in shrubland,[8] which is a conservative approximation of degraded and waste lands.

[7] Sources of tree data: National Biofuel Center, accessed 10 November 2005, and Winrock 1997.

[8] Source: Calculated from IPCC GPG-LULUCF Table 3A.1.13 (26.7 t biomass /ha), Table 3A.1.1.12 (multiplier of 1/0.95), and assuming a 45% weight fraction of carbon in the biomass (IPCC 1996 p.4.85).

The conclusion is that even under conservative assumptions, carbon released due to initial clearing of degraded lands and waste lands will be compensated (and subsequently over-compensated) by the growing oil plantation within a period of between 1.3 and 7 years.

Type of perennial crop	Annual carbon sequestered		Time to sequester C equivalent of shrubland (12.6 t C/ha)
	t C /ha.yr	t CO2 /ha.yr	yrs
Temperate (all moisture regimes)	2.1	7.7	6.0
Tropical, dry	1.8	6.6	7.0
Tropical, moist	2.6	9.5	4.8
Tropical, wet	10.0	36.7	1.3

Table 6: Carbon sequestered by perennial crops, and time to sequester the amount of carbon contained in shrubland (12.6 t C /ha). Values refer to above-ground biomass only. Data sources: see text

Ad 2. Leakage from Alcohol Production

Methanol is usually produced through steam reformation of methane. The associated energy requirements of about 30 GJ /t are non-negligible, and translate into a default precombustion emission factor of about 2.0 t CO_2 /t methanol. At a typical methanol consumption rate of 0.1 t /t biodiesel, the upstream emissions from methanol correspond to 0.2 t CO_2 or about 6.5% of the displaced CO_2 emissions from petrodiesel. The latter are estimated at 3.0 t CO_2 /t biodiesel, taking into account the differences in net calorific value between the two fuels.

Ethanol production from biomass feedstocks is substantially less energy-intensive than methanol production, but the reported energy requirements vary in a wide range, depending on the type of process and feedstock, the degree of energy recovery, and the assumptions taken in the life-cycle assessment. IFEU (2004a) have compiled the results of 63 LCA analyses of renewable transport fuels (the 63 studies were selected out of approx. 550 publications). Their results indicate that the primary energy requirements of ethanol production from sugar cane and molasse range between –6 and + 11 GJ /t ethanol, i.e. at least 3 times lower than those of methanol (see IFEU 1994a p. A97; negative values indicate a net surplus of renewable energy generated from the feedstock).

Given this large uncertainty range at relatively low absolute levels, it seems justified to neglect the precombustion emissions of ethanol production. In addition, it is noteworthy that methanol predominates in biodiesel esterification today, and that the energetical value of the by-product glycerol (for which no CERs are claimed) will likely more than offset any leakage related to production of ethanol.

Ad 3. Default Approach for Net Crop Leakage

N_2O emissions are potentially an important source of leakage in the production of oil crops. N_2O emissions result not only from application of organic and synthetic manure, but also from crop resides returned to the field, and generally from intensified N-cycles. Production of synthetic fertilizers applied to oil crop plantations is an additional source leakage. On the other hand, displacement of fossil fuels also lead to positive leakage in the form of avoided pre-combustion emissions in the fossil fuel supply chain.

The main rationale behind this methodology is the following:

- Avoid the need for comprehensive monitoring of leakage, by providing a conservative default factor which is based on typical maximum N inputs. Mandatory comprehensive monitoring of N-leakage (e.g. of fertilizer use etc.) would often create excessive transaction costs for project participants, due to the complexity of N-cycles and the large cultivation areas involved.[9] In addition, reliable monitoring of N-leakage will be virtually impossible in cases where the biodiesel producer procures his feedstock from market intermediaries, i.e. where the suppliers of the oil feedstock cannot be clearly identified.

- Allow for project-specific quantification and monitoring of leakage in cases where this is feasible for the project participants. This will allow participants to increase the volume of CERs in cases where the default factor is too conservative, for example in cases where the oil seeds are collected from wild or otherwise non-fertilized trees. The proposed leakage default factor of 15% is stringent enough to encourage monitoring efforts where such monitoring can be achieved at reasonable costs. The data compiled in this way will also help to improve the data situation on fertilizer use and N-leakage from perennial crops, which is rather poor at present.[10]

- Require project-specific quantification and monitoring in cases where leakage is likely to exceed the default value.

Table 7 shows the calculations underlying the default factor for net crop leakage. They are based on data for *Jatropha Curcas*, but are believed to be representative also for other perennial, non-edible oil trees such as *Pongamia Pinnata* and *Neem*. The calculations basically follow the IPCC guidance on quantification of emissions due to enhanced N-cycles. IPCC default values are used where available.

The key factors influencing net crop leakage are the amount of N-fertilizer applied, and the oil yield per hectare. Both factors can vary in a very large range, depending on the type of agricultural practices, type of soil, plant cultivars, etc. To illustrate the impact of this uncertainty, we analyze three scenarios for low, high and best estimate emissions, respectively. The scenarios assume that higher fertilizer applications will generally go along with higher oil yields. The scenarios also reflect uncertainty ranges with respect to other parameters, such as the oil content of Jatropha seeds, NCV of oil, and N content of the seed cake. Some specific comments on the data and calculations are as follows:

- Crop data: Oil production from Jatropha plantations is reported to vary between 500 and 3,000 t per hectare. Our best estimate of 1,320 kg oil /ha is comparable to the value assumed by the Planning Commission of India (India 2003).

- Petrodiesel data: Petrodiesel is assumed as the baseline fuel. The precombustion emission factor of petrodiesel is assumed as 500 kg CO_2e per tonne of diesel. This value is based on comprehensive life cycle data compiled in the Swiss Ecoinventory of Energy Systems (1995). As mentioned above, it covers emissions of CO_2 and CH_4 during all steps in the production chain of the fossil fuels until they reach the regional fuel distribution center, such as: exploration, production, refining, and the different transport steps. The 500 kg are the lower bound for a range of different fuels, as shown in Table 9. It is representative for diesel with sulfur content as used in the early

[9] For illustration: Land requirement for biodiesel production is typically between 0.5 and 2 ha per annual tonne of biodiesel, or about 10,000 ha for a medium sized biodiesel plant with a capacity of 30 tonnes per day. Assuming an average cultivation area of 1 ha per farmer, this corresponds to about 10,000 farmers involved on the supply side.

[10] For example, no comprehensive LCA analysis of biodiesel production from Jatropha has been published to date, according to IFEU 2004 (p.55).

1990ies. Ultra-low sulfur diesel requires more refining and therefore has higher precombustion emissions. Comparison with other LCA studies confirms that the 500 kg are a conservative value. For example, Sheehan et al. (1998) assume precombustion emissions of 640 kg CO_2 /t petrodiesel for the U.S.

– N_2O from fertilizer usage: 10% of the applied fertilizer N is assumed to volatilize (IPCC default). Since perennial oil crops will usually qualify as forests, the fraction of N removed via leaching and run-off is assumed as zero, as required by IPCC GPG for LULUCF (for annual crops the IPCC default factor for N leaching and run-off would be 30%). The remaining 90% of N are assumed to stay in the soil.
IPCC default factors are then applied for the fractions of N which are converted to N_2O. These are 1.00% of the volatilized N and 1.25% of the N staying in the soil. In comparison, the IPCC default factor for leached N would be 2.50%. This means that our assumption to treat perennial oil crops as forests (with fraction of leached N = 0%) leads to somewhat lower emissions than for annual crops (where default fraction of leached N would be 30%). Nevertheless, we believe that our approach to assume leached N = 0% is sufficiently conservative, given that the IPCC 1996 default N_2O conversion factor of 2.50% for leached N is generally perceived as (too) high, according to IPCC 2003 p.3.46. In addition, our approach is more conservative than the recently approved AR-AM0001 in that we apply an N_2O conversion factor of 1% to volatilized N, while the same N is neglected in AR-AM0001. In any case, the impact of leached N is within the uncertainty range of the overall calculation.
The N_2O emission factors derived above are then multiplied with the amount of fertilizer N to calculate absolute N_2O emissions per hectare. The Low GHG Scenario assumes zero fertilizer application, which is an approximation for poor rural communities with very limited access to fertilizer, and for picking from wild oil trees. The High GHG Scenario assumes 300 kg fertilizer N per hectare and year, which would represent very intensive agriculture. For comparison, LCA studies typically assume 150 – 200 kg N /ha for intensive rape seed plantations in western countries (see e.g. Elsayed et al. 2003 p.B.3 and IFEU 2004a p.45). The Best Estimate Scenario assumes 60 kg N /ha, based on a fertilizer recommendation for Jatropha published by the Tamil Nadu Agricultural University (Paramathma et al. 2004). However, it should be noted that de facto fertilizer applications in e.g. India are reported to remain substantially below the recommended values due to the scarcity of organic manure and high cost of synthetic fertilizers (personal communication, Mr. Prabhakar, ICRISAT).

– N_2O from crop residues returned to soils: We assume the amount of crop residues as equal to the difference between seed and oil mass, and multiply with the value of 3.5% N content for deoiled Jatropha seed cake reported by Heller (1996). The 3.5% value exceeds the highest IPCC default values for N in residues of different crops by more than 50% (see IPCC 2000 p.4.58). Our calculation is therefore very conservative even when considering possible uncertainties regarding residue mass.

– GHG from synthetic fertilizer production: We calculate an emission factor of 2.2 kg CO_2e /kg N for fertilizer production, based on the average primary energy requirement of 38.9 MJ /kg N reported for the Netherlands in 1994 (FAO 2005), and assuming natural gas as the primary energy source. This emission factor is consistent with those used in LCA studies (see e.g. Elsayed et al. 2003, p.B.3). It is more conservative than the values of 1.8 – 1.9 t CO_2 /kg ammonia N provided by IPCC (1996, p.2.16; ammonia is the dominant N fertilizer worldwide). Generally, the calculation of emissions from fertilizer production is very conservative in that all fertilizers applied are assumed to be synthetic, while in practice some of it will be animal manure etc.

Emissions from fertilizer N, residue N and fertilizer production are then added to yield gross crop leakage (see second part of Table 7). Subtraction of the precombustion emissions of petrodiesel yield net crop leakage. The best estimate value for net crop leakage is 11%. In order to be conservative, we propose the higher default factor of 15%. The safety margin of 4% is sufficient to cover any remaining uncertainties regarding e.g. non-N fertilizers as well as transport of oil crops. A discount of 10-15% of the direct GHG benefits of biodiesel is consistent with the results of comprehensive LCA studies. It falls into the lower range of results determined for biodiesel produced from more N-intensive crops, such as rape seed (see IFEU 2004a p.A.99).

The sensitivity of the best estimate value for net crop leakage is analyzed in Table 8. Variation of N input by ± 10 kg/ha.yr changes net crop leakage by ± 2% from the best estimate value of 11%. Variation of seed yield by ± 500 kg/ha.yr changes net crop leakage by ± 1.5%. Again, it should be noted that higher N inputs will tend to result in higher oil seed yields.

Crop Leakage: Jatropha Curcas (Non-N-fixing crop)

Crop data		**Low GHG**	**High GHG**	**Best estimate**	**Source**
Crop (= seed) biomass	kg DM /ha.yr	1'500	10'000	4'000	Becker & Francis; Duke 1983; own assumptions
Oil content of crop	%	35%	30%	33%	Biodiesel Compendium 2004, and TNAU 2005
Oil production (= biodiesel production)	kg oil /ha	525	3'000	1'320	Calc. India (2003) assumes 1.25 t biod. /ha
NCV of oil (=NCV of biodiesel)	GJ /t	41.8	39.6	40.7	Bagani 1992
Oil production in energy equivalents	GJ /ha	22	119	54	Calculated

Petrodiesel data (= baseline fuel)		**Low GHG**	**High GHG**	**Best estimate**	**Source**
Substitution ratio petrodiesel : biodiesel	GJ /GJ	1.0	1.0	1.0	Own assumption
NCV petrodiesel	GJ/t	43.3	43.3	43.3	IPCC 1996 p.1.23
Efficiency multiplier (mass) petro- vs. biodiesel	t PD /t BD	0.97	0.91	0.94	Calculated as NCV BD : NCV PD
Substituted petrodiesel	t /ha	0.5	2.7	1.2	Calculated
Emission factor petrodiesel - combustion	kg CO2 /GJ	74.0	74.0	74.0	IPCC 1996 p.1.13
CO2 emissions petrodiesel - combustion	**t CO2 /ha**	**1.6**	**8.8**	**4.0**	**Calculated**
CO2 emissions petrodiesel - combustion	t CO2 /t biodiesel	3.1	2.9	3.0	Calculated
Emission factor petrodiesel - precombustion	kg CO2e /t petrod	500	500	500	SEES Vol. 1, p.245
CO2e emissions petrodiesel - precombustion	**t CO2e /ha**	**0.25**	**1.37**	**0.62**	**Calculated**

N2O from fertilizer usage		**Low GHG**	**High GHG**	**Best estimate**	**Source**
N-fraction volatilized	%	10%	10%	10%	IPCC 2003 p.3.46 & IPCC 1996 p. 4.94
N-fraction leached	%	0%	0%	0%	IPCC 2003 p.3.46
N-fraction in soil	%	90%	90%	90%	Calculated
N-fraction converted to N2O - volatilized N	%	1.00%	1.00%	1.00%	IPCC 1996 p.4.105 (Table 4-23)
N-fraction converted to N2O - leached N	%	2.50%	2.50%	2.50%	IPCC 1996 p.4.105 (Table 4-23)
N-fraction converted to N2O - N in soil	%	1.25%	1.25%	1.25%	IPCC 2003 p.3.47
Molar weight ratio, N2O : N2	--	1.57	1.57	1.57	IPCC 2000 p.4.54 and 4.68
GWP N2O	--	310	310	310	
N2O emission factor - volatilized	kg CO2e/ kg N	0.5	0.5	0.5	Calculated
N2O emission factor - leached	kg CO2e/ kg N	0.0	0.0	0.0	Calculated
N2O emission factor - from soil	kg CO2e/ kg N	5.5	5.5	5.5	Calculated
Total N2O emission factor - fertilizer usage	kg CO2e/ kg N	6.0	6.0	6.0	Calculated
Amount of fertiliser applied	kg N /ha	0	300	60	Low: Own assumption; High: Pers. Com., Jain Irrigation Systems, 2005 Best estimate: Paramathma 2004
N2O emissions - volatilized	t CO2e /ha	0.00	0.15	0.03	Calculated
N2O emission factor - from soil	t CO2e /ha	0.00	1.64	0.33	Calculated
Total N2O emissions - fertilizer usage	**t CO2e /ha**	**0.00**	**1.79**	**0.36**	**Calculated**

N2O from crop residue returned to soil		**Low GHG**	**High GHG**	**Best estimate**	**Source**
Ratio of total residue : seed cake	t /t	1.0	1.0	1.0	"1" means seed cake is the only residue
Residue biomass returned to field	kg DM /ha	975	7'000	2'680	Calculated
N-content of residues	kg N /kg DM	0.032	0.038	0.035	Heller 1996 p.22
Fraction of crop residues burned in field	%	0%	0%	0%	Pers. comm., Jain Irrigation Systems, 205
Total N in residues returned to soils	kg N /ha	31	266	94	Calculated
N-fraction converted to N2O	kg N2O-N /kg N	1.25%	1.25%	1.25%	IPCC 1996 p. 4.89
N2O emission	**t CO2e /ha**	**0.19**	**1.62**	**0.57**	**Calculated**
Total N-input via fertilizer + residues	kg N /ha	31	566	154	Calculated
Total N-input per unit oil produced	**kg N /t oil**	**59**	**189**	**117**	**Calculated**
Synthetic N-input per unit oil produced	kg N /t oil	0	100	45	Calculated
Ratio of synthetic N : total N input	--	0.00	0.53	0.39	Calculated

GHG from synthetic fertilizer production (ammonia)		**Low GHG**	**High GHG**	**Best estimate**	**Source**
Fuel consumption for fertilizer production	MJ /kg N	38.9	38.9	38.9	FAO 2005b (Value for The Netherlands, 1994)
Emission factor of fuel	g CO2 /MJ	56	56	56	IPCC 1996 p.1.13 (default for natural gas)
Emission factor for N fertilizer	kg CO2e /kg N	2.2	2.2	2.2	Calculated
Synthetic fraction of total fertiliser applied	%	100%	100%	100%	Own assumption
GHG emissions from production of synth. fert.	**t CO2e /ha**	**0.00**	**0.66**	**0.13**	**Calculated**

Table 7: Background calculations for the default factor for net crop leakage $L_{Crop\_net\_y}$, using Jatropha Curcas as an example

Summary - absolute		Low GHG	High GHG	Best estimate	Source
N2O from fertiliser use - direct	t CO2e /ha	0.00	1.64	0.33	Calculated
N2O from fertiliser use - volatilized N	t CO2e /ha	0.00	0.15	0.03	
N2O from crop residues returned to soil	t CO2e /ha	0.19	1.62	0.57	
GHG from production of synthetic fertiliser	t CO2e /ha	0.00	0.66	0.13	
Total crop pre-combustion emissions	**t CO2e /ha**	**0.19**	**4.07**	**1.06**	
Precombustion emissions petrodiesel	t CO2e /ha	0.25	1.37	0.62	
Net crop leakage	**t CO2e /ha**	**-0.06**	**2.70**	**0.44**	

Summary - in % of petrodiesel combustion emissions		Low GHG	High GHG	Best estimate	Source
N2O from fertiliser use - direct	%	0%	19%	8%	Calculated
N2O from fertiliser use - volatilized N	%	0%	2%	1%	
N2O from crop residues returned to soil	%	12%	18%	14%	
GHG from production of synthetic fertiliser	%	0%	8%	3%	
Total crop pre-combustion emissions	**%**	**12%**	**46%**	**27%**	
Precombustion emissions petrodiesel	%	16%	16%	16%	
Net crop leakage	**%**	**-4%**	**31%**	**11%**	

Summary - in g CO2e /MJ biodiesel oil		Low GHG	High GHG	Best estimate	Source
N2O from fertiliser use - direct	g CO2e /MJ	0	14	6	Calculated
N2O from fertiliser use - volatilized N	g CO2e /MJ	0	1	1	
N2O from crop residues returned to soil	g CO2e /MJ	9	14	11	
GHG from production of synthetic fertiliser	g CO2e /MJ	0	6	2	
Total crop pre-combustion emissions	**g CO2e /MJ**	**9**	**34**	**20**	
Precombustion emissions petrodiesel	g CO2e /MJ	12	12	12	
Net crop leakage	**g CO2e /MJ**	**-3**	**23**	**8**	

Table cont.: Background calculations for the default factor for net crop leakage $L_{Crop\_net\_y}$, using Jatropha Curcas as an example

Seed yield (kg /ha.yr)	N-fertilizer (kg N/ha.yr) 50	60	70
3'500	11%	13%	15%
4'000	9%	11%	13%
4'500	8%	10%	12%

Table 8: Sensitivity of net crop leakage (in % of petrodiesel emissions) to changes in N fertilizer application and seed yield (Jatropha Curcas example)

Values in kg /t fuel, off regional fuel distribution center	Petrol unleaded Swiss	Petrol unleaded Europe	Diesel Swiss	Diesel Europe	Kerosene Swiss	Kerosene Europe
CO2 mobile comb.	75	82	72	78	62	63
CO2 process	140	146	130	134	128	132
CO2 stationary comb.	561	638	234	250	224	239
CH4	4.8	4.94	4.32	4.35	4.28	4.29
CO2e	**877**	**970**	**526**	**553**	**504**	**524**

Table 9 Precombustion GHG emissions associated with the production and transport of fossil fuels. Source: Swiss Ecoinventory of Energy Systems (1995), Vol. 1, p.245. "Europe" fuels are more refined (lower sulfur content) than "Swiss" fuels.

Ad 4. Project-Specific Approach for Net Crop Leakage

The project-specific quantification of net crop leakage is essentially consistent with the approach used to determine the default factor. Two differences are noteworthy:

- Volatilization of fertilizer N is neglected, i.e. all fertilizer N is assumed to remain in the soil. This is conservative because the IPCC default N_2O emission factor for N in soil (1.25%) is higher than for volatilized N (1.00%). The rationale is to simplify the calculations.
- Since oil crop farmers may sell some of their seed cake as fertilizer and use more manure or synthetic fertilizers instead, accounting for residue N exported as fertilizer ($m_{RNEX\_i\_y}$) is required.

SECTION I. Emission reductions

Methodology procedure:

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Emission reductions are calculated from the baseline emissions, the project emissions and leakage, and adjusted for the following:

- Fraction of biodiesel which is produced from ineligible crops; and
- Fraction of biodiesel which is exported to other countries.

(19) $$ER_y = (E_{BL\_y} - E_{P\_y} - L_y) \cdot (1 - f_{BD\_iec\_y}) \cdot (1 - f_{BD\_ex\_y})$$

where:

ER_y *Emission reductions from the project activity (t CO_2)*

$f_{BD\_iec\_y}$ *Fraction of biodiesel that is produced from ineligible crops (--)*

$f_{BD\_ex\_y}$ *Fraction of biodiesel that is exported abroad (--)*

Fraction of Biodiesel produced from Ineligible Crops

The fraction of biodiesel produced from ineligible crops is based on the comprehensive assessment of the crops processed by the biodiesel plant:

(20) $$f_{BD\_iec\_y} = \frac{\sum_i M_{BD\_iec\_i\_y}}{M_{BD\_y}}$$

where

$M_{BD\_iec\_i\_y}$ *Amount of biodiesel produced from ineligible crop i (t)*

M_{BD_y} *Total amount of biodiesel produced (t)*

In order to be eligible for CER generation, any crop processed by the biodiesel plant must meet the following criteria:

a) The crop must be perennial;
b) The oil must be non-edible, i.e. not suited for consumption by humans and livestock;
c) Use of the crop for biodiesel production must be unlikely to result in any of the following: deforestation, displacement of other crops, and displacement of other existing uses of the crop.

Compliance with these criteria must be demonstrated in the PDD for each crop planned to be utilized, and during the crediting period for each additional processed crop which was not covered in the PDD.

In order to demonstrate compliance with criterion c), project participants must demonstrate that the crop meets the following sub-criteria:

- The crop is available in surplus from natural or human plantations existing at the start date of the project activity. “Surplus” is given if the amount of crop available in the project area is at least 25% larger than the quantity of the crop that is utilized, including the project plant. Project area is defined as the area within which the crop can be transported to the biodiesel plant at costs which do not render the biodiesel plant (including CER revenues) uneconomical.

  OR:

- The oil from the crop has no existing alternative use; OR these alternative uses are more economically attractive than the use for biodiesel (e.g. medicinal use); AND
- The crop is not the most economically attractive for farmers on land of normal fertility (including freshly deforested) land; OR new plantations of the crop are legally restricted to waste land, severely degraded land, or marginal land such as strips along roads and railroads, fields boundaries, etc.

The compliance with criterion c) shall be determined using the flow-chart shown in Figure 1. The determination of whether a biodiesel crop is the most competitive crop on fertile land shall be based on a comprehensive cost-revenue comparison of the biodiesel crop with relevant alternative crops, which takes into account the following:

- Cost of seedlings, fertilizer, pesticides and other raw materials;
- Cost of equipment required;
- Labour costs;
- Sales revenues from the crops.

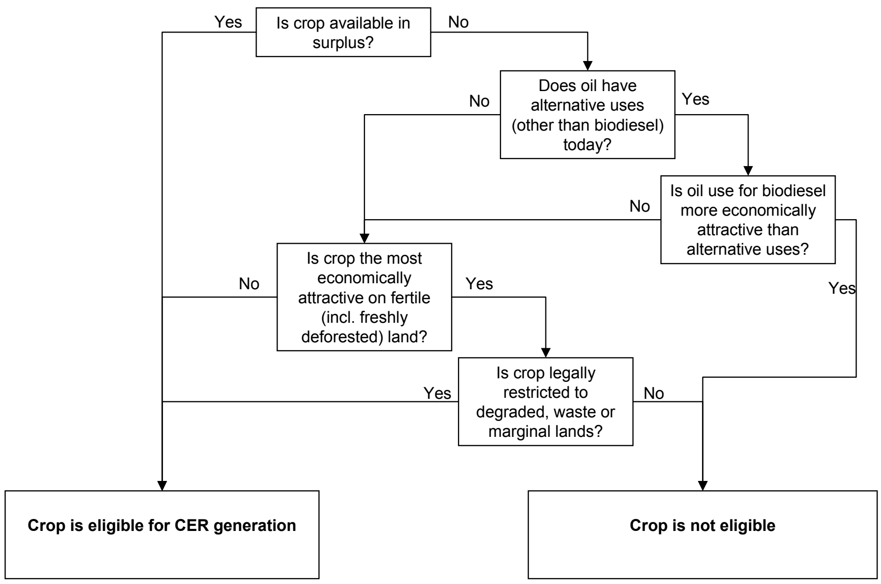

Figure 1: Flow chart for determination of crop eligibility.
Note: The criteria that crop most be non-edible and perennial are not shown.

Fraction of Biodiesel Exported

The fraction of exported biodiesel is calculated on a mass basis, as shown in Equation (21). Biodiesel supplied to consumers which do not comply with the applicability conditions specified in Section B shall be counted as exported (e.g. if blending proportion does not meet the requirements).

(21) $$f_{BD\_ex\_y} = \frac{M_{BD\_ex\_y}}{M_{BD\_y}}$$

where:

$M_{BD\_ex\_y}$ *Total amount of biodiesel exported abroad (t)*

Explanation/justification:

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Adjustment for Ineligible Crops

The objective of this adjustment is to prevent leakages from the project activity with respect to induced deforestation (land use changes), and displacement of other crop uses (e.g., use as traditional energy source).

Deforestation may occur directly if the land is deforested for cultivation of the oil crop, or indirectly if the oil crop displaces other crops on existing fertile farm land. The methodology is based on the assumption that both are unlikely to occur if (i) the crop is already available in surplus, or (ii) if the crop is less economically attractive than other (edible) crops on fertile land.

Regarding (i) surplus, it is worth noting that for example in India, oils from several existing species of trees are reported to be only minimally utilized today (Table 10). It seems likely that CDM activities would first focus on this potential, in which case induced land use changes would be virtually nil. The 25% threshold for the definition of surplus is taken from ACM006 (Version 01, p.35).

Regarding (ii), some non-edible oil crop such as *Jatropha Curcas* are reported to be ideally suited for dry and degraded land (see e.g. Becker & Francis). Requirement (ii) effectively limits the methodology to species which have competitive advantages on such degraded, waste or marginal lands. As a result, the risk of displacement of more profitable (e.g. edible) crops is eliminated. Likewise, direct deforestation can be expected to be negligible, since freshly deforested land would be usually fertile and therefore suited for the more competitive crops. See explanations in Section H regarding leakage due to limited initial clearing of degraded land.

	Production t/a	Current Utilization t/a	Utilization Rate %
Sal	2'500'000	2'788	0.1%
Neem	1'000'000	12'203	1.2%
Mahua	700'000	7'004	1.0%
Mango Kernel	500'000	8'062	1.6%
Pongamia	200'000	1'502	0.8%
Jatropha	100'000	0	0.0%
Kusum	80'000	572	0.7%
Pilu	50'000	0	0.0%
Tumba	50'000	0	0.0%
Rubberseed	33'000	0	0.0%
Dhupa	12'000	0	0.0%
Undi	10'000	0	0.0%
Nahor	9'000	0	0.0%
Cheura	5'000	0	0.0%
Kokum	2'000	245	12.3%
Wild Apricot	2'000	0	0.0%
Total	**5'253'000**	**32'376**	**0.6%**

Table 10: Utilization Rates of Trees Bearing Oilseeds in India[11]

SECTION J. Changes required for methodology implementation in 2nd and 3rd crediting periods (if relevant / optional)

Methodology procedure:

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No changes required. Compliance with the applicability conditions, baseline scenario (baseline fuels) and additionality all need to be fully revalidated upon renewal of the crediting period.

Explanation/justification:

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No explanations.

SECTION K. Selected baseline approach from paragraph 48 of the CDM modalities and procedures

Choose One (delete others):

☒ Existing actual or historical emissions, as applicable;

☐ Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

[11] Source: National Conference on Biodiesel: Compendium, July 2004. Center for Sustainable Development & Poverty Alleviation, Allahabad.

☐ The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

The approach selected for the project activity is 48(a).

Explanation/justification of choice:

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The project activity involves elements of both approaches 48(a) and 48(b). However, the approach 48(a) is considered as most appropriate since in the absence of the proposed CDM project the baseline scenario will be the continuation of the existing practice of using petro-diesel.

Similarly, the approach 48(b) also could be an appropriate option, since, in most cases; the economically attractive course of action may be the continuation of existing practice. However, in certain cases where other alternative fuels such as CNG, LPG, LNG etc. are available as baseline scenarios, the economically most attractive course of action may be switching to CNG, LPG or LNG. Hence, the approach 48(b) is considered not appropriate for project activity.

The approach 48(c) is not applicable for fuel switch activities, since, similar activities ultimately has the same baseline fuel i.e. petrodiesel.

SECTION I. Other Information

The methodology allows for development of baselines in a transparent and conservative manner as follows:

- Applicability conditions are restrictive;
- The baseline scenario is either predefined through the applicability conditions, or clear guidance is provided on how to identify the baseline scenario;
- Specific guidance is provided on how to apply the consolidated additionality tools;
- Project emissions are comprehensively accounted for on a life-cycle basis (partly under leakage);
- Leakage due to enhanced cycles of nitrogen (fertilizer etc.) is accounted for;
- Leakage due to deforestation is prevented via the restriction to crops which are not competitive on fertile land;
- Leakage due to limited initial clearing of degraded lands is compensated within a few years due to restriction to perennial crops;
- Double counting of emission reduction is prevented with respect to (i) users of the biodiesel, and (ii) producers of alcohols used for esterification.

Potential strengths are:

- The methodology is conservative;
- It keeps transaction costs for project participants to a minimum by providing conservative default factors, thereby ensuring viability for CDM. Alternatively participants can choose to expand their monitoring efforts for the benefit of larger CER volumes, where these can be established conservatively.

A potential weakness of the methodology is its restricted applicability. This is accepted for the benefit of conservativeness.

Explanation/justification:

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