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

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SECTION A. Identification of methodology

A.1. Proposed methodology title:

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Biodiesel production and switching fossil fuels from petro-diesel to biodiesel

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

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This methodology is applicable to project activities under fuel switch category. Fuel switch activities will come under sectoral scope number 7 : Transport, since, main application of the biodiesel is the transport sector.

According to the small scale modalities and procedures, the category of fuel switch activities will come under III.B: Switching fossil fuels.

However, this methodology is developed specifically for fuel switch activities that switch from petro-diesel to biodiesel.

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

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The methodology is applicable to CDM project activities …

a) that partially or fully substitute petro-diesel with biodiesel in mobile combustion for road and rail transport
b) that include biodiesel production plant within the activity and the biodiesel plant developer owns emission credits since the emission reductions are generated solely by the initiative of the project developer. This happens when the biodiesel production plant is first of its kind or one of the first few cases. Project proponents shall enter into agreement with biodiesel consumers such that additional revenues from the sale of emission reductions by project proponents will be passed on to biodiesel consumers as subsidy on the sale price of biodiesel. This arrangement will avoid duplication of ownership of emission reductions. The technology used in the biodiesel production plant shall be esterification or transesterification using ethanol or methanol.
c) that use various feedstocks such as edible / non-edible oils derived from oil bearing seeds such as pongamia pinnata, jatropha curcas, soyabean, sunflower etc., waste oils, fatty acids, etc. which are otherwise neglected or dumped.
d) that do not claim emission reductions from chemical fertiliser replacement with oil cake and from carbon sequestration from new plantations grown for biodiesel production or any other emission reductions.
e) where no regulations exist in host countries on biodiesel use
f) having vehicles that substitute petro-diesel by the biodiesel, as the baseline.

Further the methodology is applicable to all proposed CDM project activities under the above mentioned category in regions where a specific target engine types and engine technologies can not be identified and biodiesel consumption is anticipated across a wide range of vehicle types and technologies.

This methodology is not applicable to

a) fuel switching activities in existing industrial facilities where specific engine type and technology can be identified and emission reductions represent the existing actual and historic emissions
b) fuel switching activities in existing diesel electricity generating sets where a more conservative electricity emission factor is available

c) where there are other alternative fuels such as CNG, LPG, LNG as baseline scenarios for fuel switching

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

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The strength of the methodology is the conservative approach adopted for estimation of emissions reductions. The methodology does not take into account the atmospheric carbon sequestered by tree species in new plantations. Another conservative approach taken is using emission factors specified by IPCC for developed countries. These factors also represent transparency in developing the baseline. Thus, the GHG emissions in the BAU are estimated at a lower value than those prevailing in developing countries.

The methodology is very simple, lacking complex computations for estimation of emissions.

Weakness of the methodology lies in considering a common emission factor for all vehicle engine types and technologies.

Another weakness of the methodology is its limited applicability across the similar project activities.

SECTION B. Overall summary description:

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This methodology is developed for fuel switch activities that partially or fully substitute petro-diesel with biodiesel. Hence, the methodology considers anthropogenic greenhouse gas emissions avoided by substituting petro-diesel with biodiesel as baseline emissions. Burning of petro-diesel in combustion engines releases emissions such as carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), methane (CH_4), nitrous oxide (N_2O) and non-methane volatile organic compounds (NMVOCs). This methodology is considers greenhouse gas emissions of CO_2, CH_4 and N_2O only and is applicable to project activities that produce biodiesel and result in fuel switch from petro-diesel to biodiesel.

The methodology first determines whether the proposed project is additional and not the baseline through application of consolidated tools on additionality[1] proposed by the CDM Executive Board. This consolidated additionality tool is a step by step approach that determines that the project activity will not occur without CDM registration.

The methodology then determines the baseline emissions as the existing actual emissions caused by burning of petro-diesel. These are related to the carbon content and oxidisation factor of the petro-diesel. For this purpose, the methodology proposes to estimate the CO_2e emission factor for the petro-diesel based on the carbon content or IPCC emission factors where applicable and then baseline emissions considering the quantity of petro-diesel substituted by the biodiesel.

Finally the methodology determines the project emissions that are occurring within the project boundary and leakage emissions occurring outside the project boundary. Emission reductions are estimated as the difference of baseline emissions, project emissions and emissions of leakage.

SECTION C. Choice of and justification as to why one of the baseline approaches listed in paragraph 48 of CDM modalities and procedures is considered to be the most appropriate:

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[1] Consolidated tools for demonstration of additionality is presently under the draft form. Once approved by the board, this base methodology uses the approved consolidated tool for additionality.

C.1. General baseline approach:

☑ 48(a). Existing actual or historical emissions, as applicable;

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

☐ 48(c). 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).

C.2. Justification of why the approach chosen in 3.1 above is considered the most appropriate:
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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. petro-diesel.

SECTION D. Explanation and justification of the proposed new baseline methodology:

D.1. Explanation of how the methodology determines the baseline scenario (that is, indicate the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity):
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This methodology is developed only for fuel switch activities substituting petro-diesel with biodiesel and is not applicable for other activities substituting with fuels such as CNG, LNG and LPG. This is due to the fact that petro-diesel substitution with CNG, LNG or LPG requires entirely a different set of data and procedures for estimation of emissions. Hence, this methodology examines only two plausible baseline scenarios as follows.

a) Substituting petro-diesel with biodiesel, not undertaken as a CDM activity and
b) Continuation of existing practice of using petro-diesel

While determining the baseline scenario that reasonably represents the anthropogenic greenhouse gas emissions in the absence of the project activity, national circumstances and sectoral policies such as mandatory biodiesel production targets, national policy on biodiesel utilisation, national auto fuel policy etc. shall be taken in to account.

In case the national circumstances and policies describe the biodiesel production and use is the only alternative, then the project activity is same as the baseline. Otherwise, continuation of existing practice of using petro-diesel shall be considered as the baseline scenario for the proposed CDM projects. In case,

national circumstances and policies describe development and use of CNG, LNG or LPG as the most attractive option for fuel switching, then a separate methodology shall be developed.

One key assumption in the methodology is that the project activity is not aimed at substituting petro-diesel in any single class of vehicles or a single transport fleet. This necessitates considering a wide variety of vehicles, technology levels, operating conditions etc. Estimating emission reductions for such situations is a very complex exercise that requires consideration of many parameters such as …

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- Transport class
- Fuel consumed
- Operating characteristics
- Emission controls
- Maintenance procedures
- fleet age etc.

The need for data on several parameters and the wide variety of conditions that can affect the performance of each category of emission source makes it very difficult to generalise their emission characteristics. Also within the transport sector, the primary measure of activity is less likely than in other sectors. Hence, the methodology suggests using a common emission factor for GHG emissions from transport vehicles rather than estimating and measuring the actual emissions for each class of vehicles and technologies. This emission factor together with the quantity of petro-diesel substituted will reasonably represent the baseline emissions in the absence of the proposed CDM project activity.

D.2. Criteria used in developing the proposed baseline methodology:

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The main criterion considered in developing the methodology is conservatism since the methodology does not consider emission reductions from sources such as chemical fertilizer replacement, methane avoidance from dumping of waste oils, CO_2 sequestration from new plantations etc.

Another conservative measure is that the methodology considers developed country emission factors for developing countries. This is based on an assumption that developing country emission factors are higher than the developed country emission factors. Hence, considering developed country emission factors result in lower emission reductions than actually occurred.

Another criterion considered is of transparency. The proposed methodology is highly transparent and all data used in the baseline are furnished within the methodology document. There are no proprietary data used in the methodology.

Applicability of the methodology to similar project activities is also considered while developing the methodology. The methodology could be applied to several similar project activities irrespective of the country or region.

D.3. Explanation of how, through the methodology, it can be demonstrated that a project activity is additional and therefore not the baseline scenario (section B.3 of the CDM-PDD):

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Additionality of the proposed CDM project activity shall be demonstrated using the consolidated tools for additionality as approved by the CDM Executive Board[2]. The consolidated tools comprise a stepwise

[2] Annex 3 of Report of 15th meeting of Executive Board. Presently, the consolidated tool for additionality is in its draft form. Once, approved by the CDM EB, the consolidated additionality tool becomes the final additionality tool for application in this methodology.

approach and the proposed project activity must pass through various sequential steps as given below in order to become an additional project.

Step 0: Preliminary screening of the project activity for starting date
Step 1: Identification of alternatives to the project activity
Step 2: Investment analysis or Step 3: Barrier analysis
Step 4: Common practice analysis
Step 5: Impact of CDM registration

For information and guidance on each of the above steps, Annex 3 of the Report of 15^{th} meeting of the Executive Board may be referred.

At the time of proposing the methodology, the consolidated tools for additionality are under revision by the meth panel and once approved by the Executive Board, this baseline methodology adopts the approved consolidated additionality tool for demonstration that the project activity is additional and not the baseline scenario.

D.4. How national and/or sectoral policies and circumstances can been taken into account by the methodology:

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The methodology takes into account all national and sectoral policies and circumstances.

The methodology considers national and sectoral policies, if available, such as host country priorities, regulations for use of biofuels / alternative fuels, mandatory targets for biodiesel production, vehicular emission control norms, national auto fuel policy and whether any regulations are in force for setting up of biofuel projects to meet the mandatory emission targets etc. in order to determine the project activity whether same as the business as usual scenario.

D.5. Project boundary (gases and sources included, physical delineation):

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Project boundary is the physical project site within which the biodiesel production plant is constructed. Inclusion of biodiesel production plant within the project boundary enables to ensure that all emissions caused during the manufacture of biodiesel are considered as project emissions. Transportation of biodiesel from the project to filling stations, transportation of feedstocks, chemicals and other process inputs are included within the project boundary, in order to include transportation emissions in project emissions. Project boundary also includes combustion sources where the petro-diesel is substituted by biodiesel and GHG emissions are avoided due to fuel switch.

In other words, the spatial extent of the project boundary includes

a) the biodiesel production plant site
b) transportation of biodiesel and feedstocks
c) combustion sources or vehicles that substitute petro-diesel with biodiesel

Sources of feedstocks such as waste oils, fatty acids, etc. and sources of chemicals such as methanol are located outside the project boundary. Increase in emissions outside the project boundary due to the consumption of methanol are considered as leakage emissions in this methodology.

Similarly, extraction of raw oils, edible / non-edible oils from oil bearing seeds and growing of new plantations are not included in the project boundary. Oil cake produced during extraction of raw oil from seeds is a rich nitrogenous fertilizer that can replace chemical fertilizers. New plantations sequester additional carbon dioxide from the atmosphere. However, since oil extraction and new plantations are

located outside the project boundary, these emissions are not accounted for in the methodology, though they occur because of the biodiesel production plant.

D.6. Elaborate and justify formulae/algorithms used to determine the baseline scenario. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

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Estimation of baseline emissions comprises two steps viz. determination of CO_2e emission factor for the petro-diesel and estimation of the anthropogenic greenhouse gas emissions avoided by the biodiesel.

Determination of CO_2e emission factor

If country specific CO_2e emission factors are available for the petro-diesel the same has to be used in the estimation of baseline emissions. Otherwise, one of the following two approaches can be selected.

Based on the carbon content of petro-diesel. In the IPCC guidelines[3], CO_2 emission factors are developed on the basis of the carbon content of fuels. If country specific carbon content of petro-diesel and oxidisation factor is available the following formula to be used.

CO_2 Emissions	=	Carbon content in petro-diesel	x	Oxidisation factor	x	Conversion factor
tCO_2 / t fuel		*tC / t fuel*		*%*		*tCO_2 / tC*

If emission factors for CH_4 and N_2O are available then CO_2-equivalent emission factor shall be determined using global warming potentials of CH_4 and N_2O. Otherwise, the CO_2e emissions of CH_4 and N_2O may be neglected, since, they contribute to only 3% of the CO_2e emissions[3].

Based on developed country emission factors. Where country specific emission factors or carbon content are not available, most conservative emission factors specified by IPCC guidelines[4] such as those specified for US and European countries can be used. This is based on an assumption that combustion system designs are superior in developed countries than developing countries, meaning that developed country emission rates are lower than those of developing countries. A table of IPCC emission factors specified for US and European countries is furnished in Appendix 1, for reference. While using developed country emission factors, justification shall be included in the PDD on why national emission factors can not be developed and how developed country emission factors are conservative.

The following formula can be used to determine the CO_2e emission factor for the petro-diesel.

CO_2e Emission Factor	=	CO_2 emission Factor	+	CH_4 emission factor	x	GWP of CH_4	+	N_2O emission factor	x	GWP of N_2O
tCO_2e / t fuel		*tCO_2 / t fuel*		*tCH_4 / t fuel*		*tCO_2e / tCH_4*		*tN_2O / t fuel*		*tCO_2e / tN_2O*

Estimation of baseline emissions

Once the CO_2e emission factor for the petro-diesel is determined, then baseline emissions are to be estimated based on the quantity of petro-diesel substituted by the biodiesel. This methodology considers that petro-diesel substitution is through complete substitution by biodiesel or partial substitution by blending of biodiesel. In both situations, the quantity of actual petro-diesel substituted becomes the basis for estimation of baseline emissions. This methodology also considers that all the biodiesel manufactured[5]

[3] IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
[4] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual
[5] in one biodiesel production plant or more similar biodiesel production plants if included in the CDM project

will be used for substitution of equal quantity of petro-diesel. This is due to the fact that biodiesel ages more quickly than petro-diesel and hence should not be stored in a fuel tank or storage tank for more than 6 months[6]. This restriction for storage of biodiesel makes it not suitable as stored carbon or bunker fuel. Further, biodiesel has no applications other than using as a renewable fuel for energy applications. Hence, actual biodiesel produced shall be considered as used for petro-diesel substitution and can be used in estimation of baseline emissions instead of the quantity of petro-diesel substituted. The following formula can be used to estimate baseline emissions.

Baseline emissions (tCO_2e / yr)	=	Biodiesel produced (t / yr)	x	CO_2e Emission factor (tCO_2e / t fuel)

D.7. Elaborate and justify formulae/algorithms used to determine the emissions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

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Since, the source[7] of biodiesel is renewable, the anthropogenic greenhouse gas emissions caused in fuel switch or during combustion of biodiesel are to be considered as nil. Hence, no project emissions are generated from the activity within the project boundary.

However, since the biodiesel production plant is also included within the project boundary, all emissions caused during the manufacture of biodiesel are to be considered as project emissions. The following greenhouse gas emissions are identified within the project boundary.

a) Emissions from electricity consumed by the biodiesel production plant
b) Off-site transport emissions for transport of biodiesel, raw materials and other inputs

The above project emissions are to be estimated as follows.

Emissions from electricity consumption :

Emissions from the electricity consumption can be estimated based on the grid electricity emission factor as follows.

Emissions from electricity tCO_2/yr	=	electricity consumed MWh / yr	x	grid emission factor tCO_2/MWh

This methodology considers that where grid electricity emission factor is not available, assuming electricity generated from a coal fired power plant and using the corresponding emission factor is conservative than the grid emission factor. This assumption avoids the need for estimating grid electricity emission factor and the assumption is justifiable since the electricity consumption per ton of biodiesel produced is very less. The following formula may be used in case grid emission factor is not available.

CO_2 Emissions = (tCO_2/yr)	Electricity Consumed by project (TJ)	x	Carbon emission factor (IPCC) (tC/TJ)	x	Mass conversion factor (tCO_2/tC)	/	Thermal cycle efficiency %

[6] Report of the committee on development of bio-fuel
[7] Oil bearing seeds, waste oils, fatty acids etc.

Off-site transport emissions:

Off-site transportation comprises the following.

a. Transportation of biodiesel from the biodiesel production plant to filling stations
b. Transportation of raw vegetable oils and other process inputs to the plant

Light to medium duty diesel trucks are considered to be employed for transportation of the above materials. Anthropogenic greenhouse gas emissions caused during the transportation shall be estimated based on the total diesel consumed for transportation. This is similar to estimating baseline emissions as described in section D.6. The following formula can be used to estimate the off-site transport emissions.

Baseline emissions (tCO_2e / yr)	=	Petro-diesel consumed (t / yr)	x	Emission factor (tCO_2e / t fuel)

Where transportation is contracted out to a third party then petro-diesel consumption reported by the contractor shall be used in the calculation. In the above formula, emission factor is estimated in section D.6.

The biodiesel production plant includes a small boiler to generate process steam at low pressure and temperature. Due to its small capacity and quantity, it is assumed that the boiler uses only biodiesel as the fuel for steam generation.

D.8. Description of how the baseline methodology addresses any potential leakage of the project activity:

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Fuel switching from petro-diesel to biodiesel will not cause any emissions outside the project boundary. However, biodiesel production process uses methanol for trans-esterification process, thus manufacturing of biodiesel creates additional demand for the methanol. This additional demand results in an increase of anthropogenic greenhouse gas emissions during the methanol manufacturing process. Hence, this increase in emissions is attributable to the biodiesel production and shall be considered as leakage.

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To estimate the leakage due to increased demand for methanol, IPCC emission factors may be used as follows.

Methane Emissions	=	Methanol consumed by project	x	Methane Emission factor	x	GWP of methane
tCO_2e / yr		*t/yr*		*tCH_4 / t of methanol*		*tCO_2/tCH_4*

IPCC has specified an emission factor of 0.002 tCH4/t of methanol[8] produced. Hence, the above formula is re-written as

Methane Emissions	=	Methanol consumed by project	x	0.002	x	21
tCO_2e / yr		*t/yr*				

[8] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual

D.9. Elaborate and justify formulae/algorithms used to determine the emissions reductions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

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Emission reductions by the project activity during a given year is the difference between the baseline emissions, project emissions and emissions due to leakage, as follows:

Emission Reductions tCO_2e	=	Baseline Emissions tCO_2e	-	Project emissions tCO_2e	-	Emissions due to leakage tCO_2e

Baseline emission, project emissions and emissions of leakage are to be estimated per sections D.6, D.7 and D.8 of this methodology.

SECTION E. Data sources and assumptions:

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E.1. Describe parameters and or assumptions (including emission factors and activity levels):

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The methodology considers that significant quantity of biodiesel manufactured will be sent to the transport sector with only a small fraction sent to stationery combustion applications such as industrial thermal, electricity generation and off-road mobile combustion applications such as agriculture etc. Although, combustion efficiencies and controls differ widely between various applications, the methodology assumes that they are the same as that of the transport sector. This assumption will not significantly influence the quantity of emission reductions due to the major share for the transport sector. Hence, this methodology centres around the application of biodiesel to the transport sector.

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One key assumption underlying the methodology is that the project activity is not aimed at substituting fossil fuel in any single class of vehicles or a single transport fleet. This necessitates considering a wide variety of vehicles, technology levels, operating conditions etc. Estimating emission reductions for such situations is a very complex exercise that requires consideration of many parameters such as …

- Transport class
- Fuel consumed
- Operating characteristics
- Emission controls
- Maintenance procedures
- fleet age etc.

The need for data on several parameters and the wide variety of conditions that can affect the performance of each category of emission source makes it very difficult to generalise their emission characteristics. Also within the transport sector, the primary measure of activity is less likely than in other sectors. Hence, the methodology suggests using national emission factors for GHG emissions from transport vehicles rather than estimating the emission factors. Hence, the methodology has an assumption in that is the availability of national data on emission factors of GHG from petro-diesel oil use in transport vehicles. In cases where national emission factors are not available, the methodology suggests using conservative emission factors of road vehicles specified by IPCC for European countries. It is assumed that emission factors of European countries are conservative[9] than those of developing countries mainly due to the following reasons.

[9] Refer Appendix 1, table of emission factors for classes of vehicles of US and European countries.

- In highly populated developing countries, the estimated emissions are higher due to inferior technology level being used compared to developed countries and
- The operating conditions in developing countries are quite different than those of developed countries. For instance, vehicles in developing countries may have larger number of accelerations, decelerations, idling etc. than those of developed countries resulting in higher emissions.

In view of the above, where national data on generalised emission factors are not available, the methodology suggests using conservative emission factors specified by IPCC for GHG emissions in road vehicles of European countries.

For estimation of project emissions, IPCC data sources are used for factors such as methane emission factors, carbon emission factors etc. However, project emissions are considered to be very small compared to the baseline emissions, hence, using factors other than IPCC sources results in insignificant variations.

E.2. List of data used indicating sources (e.g. official statistics, expert judgement, proprietary data, IPCC, commercial and scientific literature) and precise references and justify the appropriateness of the choice of such data:

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The methodology considers national data sources or official statistics wherever available. Only when no national data is available, the methodology considers using default emission factors specified by IPCC.

The following data is used in the methodology.

Quantity of biodiesel produced	: Proprietary (Project proponents)
Methanol consumed during biodiesel production	: Proprietary (Project proponents)
CO_2e emission factor for petro-diesel	: National / official statistics
Carbon content	: National / official statistics
Oxidisation factor	: National / official statistics
CO_2, CH_4 and N_2O emission factors for petro-diesel	: Revised 1996 IPCC guidelines for NGGI
Methane emission factor for methanol production	: Revised 1996 IPCC guidelines for NGGI

Justification of using IPCC emission factors is given in Section D.6. and D.7.

E.3. Vintage of data (e.g. relative to starting date of the project activity):

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Vintage of the data corresponds to the year of production of the biodiesel and the time of occurring of fuel switching. Generally, national data / official statistics / IPCC default factors will not undergo any significant changes with time. Hence, these may be considered as independent of vintage.

E.4. Spatial level of data (local, regional, national):

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For national data / official statistics, the spatial level comprises the entire host country, since, generally country level emission factors will be available.

SECTION F. Assessment of uncertainties (sensitivity to key factors and assumptions):

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The methodology has an uncertainty in respect of the carbon content of petro-diesel and oxidisation factor. Generally, carbon content may be of less uncertain since each country will have test results of

fuels but the oxidisation factors differ significantly across various technologies. Mostly national emission factors and carbon content are determined as normative parameters, hence, inaccuracy or uncertainty level with these data may be considered as low.

The significant uncertainty is the accuracy level of emission factors used for estimating baseline emissions and the applicability of IPCC emission factors specified for developed countries. The general view is that vehicle designs, stringency and enforcement of emission standards are less in most of the developing countries. Hence, even though this is an uncertainty, it leads to a conservative baseline.

SECTION G. Explanation of how the baseline methodology allows for the development of baselines in a transparent and conservative manner:

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The baseline methodology allows for the development of baselines in a transparent and conservative manner, since, it considers national circumstances and data as the first choice. The methodology allows development of conservative baselines since it considers only CO_2, CH_4 and N_2O emissions from petro-diesel substitution and emissions such as carbon sequestered by new plantations, methane emissions avoided from dumping of waste oils and emissions from replacement of chemical fertiliser are not considered, even though they occur because of the project activity. Another conservative measure is using IPCC emission factors of developed countries. Developed country emission factors results in lesser number of emission reductions than those actually occurred in developing countries.

Appendix 1

IPCC emission factors for US and European Countries

IPCC EMISSSION FACTORS (g/kg of fuel)					
Greenhouse gas	CO_2	CH_4	N_2O	tCO_2e	IPCC Ref
US Diesel passeger cars					
Uncontrolled	3172.31	0.06	0.09	3201.47	Table 1-30
Moderate control	3172.31	0.08	0.13	3214.29	Table 1-30
Advanced control	3172.31	0.12	0.14	3218.23	Table 1-30
US Light duty diesel trucks					
Uncontrolled	3172.31	0.08	0.23	3245.29	Table 1-31
Moderate control	3172.31	0.08	0.60	3359.99	Table 1-31
Advanced control	3172.31	0.10	0.24	3248.81	Table 1-31
US Heavy Duty diesel vehicles					
Uncontrolled	3172.31	0.14	0.08	3200.05	Table 1-32
Moderate control	3172.31	0.16	0.08	3200.47	Table 1-32
Advanced control	3172.31	0.18	0.09	3203.99	Table 1-32
European Vehicles					
European diesel passenger cars	3140.00	0.08	0.20	3203.68	Table 1-37
European light duty diesel trucks	3140.00	0.06	0.20	3203.26	Table 1-38
European heavy duty diesel trucks	3140.00	0.20	0.10	3175.20	Table 1-39

Source : Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual
(5th and 6th columns are added)

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