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

CONTENTS

SECTION A. Identification of methodology

A.1. Proposed methodology title:

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Baseline methodology for the production of sugar cane based bio-ethanol for transportation use

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

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Transport

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

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No approved methodology exists for the same, or similar, project activity conditions.

The methodology is applicable to project activities that reduce emissions through the production and sale of fuel bio-ethanol for use in transportation. The following conditions apply to the proposed methodology:

1. The relevant national fuel bio-ethanol market is production constrained, and therefore the factor prohibiting the use of fuel bio-ethanol is lack of supply.

2. There does not exist an effectively enforced mandate on the use of bio-ethanol in transportation in the relevant national market.

3. It can be readily verified that the bio-ethanol will be used as a transportation fuel within the relevant national market.

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

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The proposed methodology is complete as it considers lifecycle emissions. The baseline scenarios are robust and clearly allow us to show how and why the project activity is additional. The clarity in the determination of additionality allows for easy replication as the data required should be readily available.

The scope of the project boundary and a lifecycle approach mean that leakage (increased emissions outside of the project boundary) is not envisaged. A possible weakness relates to the use of externally sourced lifecycle emissions data. These data however have been used conservatively and are derived from reputable sources.

SECTION B. Overall summary description:

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The first step in the methodology is to determine the applicability conditions apply:

The methodology is applicable to circumstances where a lack of supply of bio-ethanol fuel is the factor constraining its use. This ensures that it is the act of producing bio-ethanol that leads to emission reductions - a project activity that produces bio-ethanol fuel that will substitute for a non-renewable fuel in transportation will result in emission reductions. As a guideline for a production constrained system, a 75% rule is proposed. Under this rule, if existing capacity for bio-ethanol fuel production within the national market exceeds 75% of the maximum demand level, the system is not deemed production constrained. The maximum demand level for a bio-ethanol is defined in litres and is derived from the

maximum blend of bio-ethanol in gasoline and total gasoline consumption in the national market. The maximum blend of bio-ethanol is the lower of any national imposed ceiling and the commonly applied 20% technical ceiling. It should be noted that this applicability criteria is distinct from the determination of common practice, which is a separate step contained in the additionality section.

The second applicability condition relates to a mandate. Whilst the determination of additionality contains an analysis of regulatory conditions, the importance of a mandate deems that its absence be a specific applicability condition. Where an effectively enforced mandate on bio-ethanol fuel use exists, market mechanisms should ensure its production up to the level of the mandate without the assistance of the CDM. Although a mandate may be lower than a maximum demand level, the difficulty of separating out which production units supply the mandate level suggests the existence of a mandate should rule out use of this methodology. This is conservative.

The third applicability criterion is a simple procedural matter of ensuring the possibility of accurate verification that the bio-ethanol has been used as a transport fuel.

Having determined that the methodology is applicable, the next step of the methodology is to determine the feasible baseline scenarios. These will usually be restricted to the *status quo* or "non-project" option and the project option, which is the investment in bio-ethanol fuel production facilities. The methodology then utilises the tools developed by the Methodology Panel at its 11th meeting to determine whether the project is not the baseline and is thus additional.

The determination of baseline emissions and project emissions follows a fuel life-cycle approach. This is deemed complete and addresses specific concerns that may be raised over bio-ethanol life-cycle emissions. Baseline emissions are defined as the emissions that would result from the production and combustion of the substituted non-renewable fuel, whilst project emissions are defined as net emissions from the production and combustion of the bio-ethanol used. Carbon uptake during the growth of the bio-ethanol feedstock (sugar-cane) will cancel out CO_2 emissions from its combustion, and hence project emissions are restricted to those related to the cultivation of sugar cane and production of bio-ethanol.

As the methodology utilise a life-cycle approach, leakage is not envisaged.

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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C.1. General baseline approach:

□ **Existing actual or historical emissions, as applicable;**

□√ **<u>Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;</u>**

□ 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.

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

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Approach 48b is selected because the "non-project" baseline is considered the economically attractive course of action. Under this scenario, transportation fuel would be the identified conventional non-renewable fuel and would not include the volume of bio-ethanol produced by the project activity.

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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The baseline scenarios set out are the project and non-project options, the non-project option being that the volume of bio-ethanol produced by the project activity is not produced and not utilised as a transportation fuel, and therefore that the existing conventional fossil-fuel based transportation fuel mix remains. Under the baseline scenario, baseline emissions are those associated with the production and combustion of the identified conventional transportation fuel replaced by bio-ethanol. That the investment in the bio-ethanol production facility and the subsequent production of bio-ethanol is not the baseline scenario is determined using the tools developed by the Methodology Panel at its 11th meeting.

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

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The main features of the proposed methodology are its ease of application and conservative approach to calculating the emission reductions from the project activity. The methodology can also be adapted for other liquid bio-fuel types. The baseline methodology has drawn on approved methodologies and the relevant guidance given by the Executive Board and Methodology Panel.

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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This section replicates the guidance provided at the 11th Methodology Panel meeting, "Draft consolidated tools for demonstration of additionality", Annex 3.

Step 0: Preliminary screening of projects started after 1 January 2000 and prior to December 2005

The Marrakech Accords and COP 9 decisions provide guidance on the eligibility of proposed CDM project activities started before registration. Assuming project construction started during the eligible time frame, evidence should be publicly provided that the incentive provided by the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official) documentation clearly showing that the CDM incentive played a role at or before the moment of decision making. Without any such evidence, the authenticity of which can be verified by the DOE, the project is not additional. If the project participants can provide adequate evidence, the project activity shall proceed through the steps below.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations.

Define realistic and credible alternatives to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

Sub-step 1a. Define alternatives to the project activity:

1. Identify realistic and credible alternative(s) for the project participants that provide outputs or services comparable with the proposed CDM project activity[3]. These alternatives should include:

- The proposed project activity not undertaken as a CDM project activity;
- All other plausible and credible alternatives to the project that deliver similar outputs and services in a comparable service area; and,
- Continuation of the current situation (no project activity or other alternatives undertaken).

Sub-step 1b. Compliance with applicable laws and regulations:

2. The alternative(s) should be in compliance with all applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution. (This sub-step does not consider national and local policies that do not have legally-binding status.)

3. If an alternative does not comply with all applicable regulations and legislation, then do (i) and (ii) every time the crediting period is renewed:

(i) Show, based on an examination of current practice in the country or region in which the law or regulation applies, that the non-complying element of the alternative is currently widespread. Provide documented evidence. If it cannot be shown that the noncompliance is widespread, then eliminate the alternative from further consideration;

(ii) Include, in the monitoring methodology, a component that monitors whether the noncomplying element of the alternative continues to be widely implemented or widely occurs.

4. If applicable regulations can reasonably be expected to change in a way that might render any alternatives non-compliant:

- Include in the monitoring methodology a component that monitors applicable regulations to determine if they change in a manner that would render emission reductions achieved by the project activity no longer additional, from the time of such determination onward.

5. If the proposed project activity is the only alternative that is in compliance with all regulations with which there is general compliance, then the proposed CDM project activity is not additional.

Proceed to Step 2 (Investment Analysis) or Step 3 (Barrier Analysis). (Project participants may also select to complete both Steps 2 and 3.)

Step 2. Investment Analysis

If this step is used, determine whether the proposed project activity is economically or financially attractive without the revenue from sale of CERs. To conduct the investment analysis, use the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

1. Determine whether to apply investment comparison analysis or benchmark analysis (sub-step 2b). (Production of sugar cane based bio-ethanol for use in transportation will provide other financial or economic benefits other than CDM related income, and therefore a simple cost analysis in not appropriate.) If the plausible alternative(s) include(s) investments of comparable scale to the project activity, then use the investment comparison analysis (Option I). If the proposed project and plausible baseline alternative do not involve investments of comparable scale [or timing], use the benchmark analysis (Option II).

Sub-step 2b – Option I. Apply investment comparison analysis
3. Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ) most suitable for the project type and decision context.

Sub-step 2b – Option II. Apply benchmark analysis
4. Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ) most suitable for the project type and decision context. Identify the relevant benchmark value, such as the required rate of return (RRR) on equity. The benchmark should represent standard returns in the market, considering the specific risk of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer. Benchmarks can be derived from:

- Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert, or
- Estimates of the cost of financing and required return on capital (e.g. commercial lending rates and guarantees required for the country and the type of project concerned), based on bankers views and private equity investors/funds' required return on comparable projects.

Sub-step 2c. Calculation and comparison of financial indicators:
5. Calculate the suitable financial indicator for the proposed CDM project activity and, in the case of Option I above, for the other alternatives. Include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but including subsidies/fiscal incentives where appropriate), and, as appropriate, non-market cost and benefits in the case of public investors.

6. Present the investment analysis in transparent manner and provide all the relevant assumptions in the CDM-PDD, so that a reader can reproduce the analysis and obtain the same results. Clearly present critical techno-economic parameters and assumptions (such as capital costs, fuel prices, lifetimes, and discount rate or cost of capital). Justify and/or cite assumptions in a manner that can be validated by the DOE. In calculating the financial indicator, the project's risks can be included through the cash flow pattern, subject to project-specific expectations and assumptions. By applying conservative assumptions, one can incorporate the project risks.

7. The financial indicator is calculated conservatively if assumptions tend to make the CDM project's indicator more attractive and if assumptions tend to make the alternatives' indicators less attractive. Conservatism of such assumptions can be ensured or confirmed by obtaining expert opinions. Assumptions and input data for the investment analysis should not differ across the project and its alternatives, unless differences can be well substantiated.

8. Present in the CDM-PDD submitted for validation a clear comparison of the financial indicator for the proposed CDM activity and

(a) the alternatives, if Option I (investment comparison analysis) is used. If one of the other alternatives has the best indicator (e.g. highest IRR), then the CDM project activity cannot be considered as the most financially attractive. If all alternatives that are more financially attractive emit less than the proposed project activity then the project activity is not additional;

(b) the financial benchmark, if Option II (benchmark analysis) is used. If the CDM project activity has a lower indicator (e.g. lower IRR) than the benchmark, then the CDM project activity cannot be considered as financially attractive.

Sub-step 2d. Sensitivity Analysis

9. Include a sensitivity analysis that shows whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favour of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive (as per step 2(c)8(a)) or is unlikely to be financially attractive (as per step 2(c)8(b)).

If after the sensitivity analysis it is concluded that the proposed CDM project activity is unlikely to be the most financially attractive (as per step 2 c 7 (a)) or is unlikely to be financially attractive (as per step 2 c 7 b), then proceed to Step 4 (impact of CDM registration).

Otherwise, unless barrier analysis below is undertaken and indicates that the proposed project activity faces barriers that do not prevent the baseline scenario(s) from occurring, the project is considered not additional.

Step 3. Barrier Analysis

If this step is used, determine whether the proposed project activity faces barriers that do not prevent the baseline scenario(s) from occurring. Use the following sub-steps:

Sub-step 3a. Identify barriers that would prevent the proposed project from being carried out:

1. Establish that there are barriers that would prevent the proposed project activity from being carried out if the project were not registered as a CDM activity. Such barriers may include, among others:

- Investment barriers, other than the economic/financial barriers in Step 2 above, e.g.:
  -Real and/or perceived risks associated with the unfamiliar technology or process are too high to attract investment
  - Funding is not available for innovative projects.

- Technological barriers, e.g.:
  - Skilled and/or properly trained labour to operate and maintain the technology is not available, leading to equipment disrepair and malfunctioning.

- Barriers due to prevailing practice, e.g.:
  - There is little willingness to change the current operating practice in the country or region.
  - Developers lack familiarity with state-of-the-art technologies and are reluctant to use them.
  - The project is the "first of a kind".

- Other barriers, e.g.:

  - Management lacks experience using state-of-the-art technologies, so that the project receives low priority by management.
  - The local community may fail to see the environmental benefits of the project and so may oppose project.

The identified barriers are sufficient grounds for additionality only if they would prevent potential project proponents from carrying out the proposed project activity were it not registered as a CDM activity.

2. Provide transparent and documented evidence, and offer conservative interpretations of this documented evidence, as to how it demonstrates the existence and significance of the identified barriers. Anecdotal evidence can be included, but alone is not sufficient proof of barriers.

Sub-step 3 b. Show that the identified barriers would not also prevent all of the alternative(s) a identified in step 1a (excepted the proposed project activity already considered in step 3a):
3. If the identified barriers also affect other alternatives, explain how they are affected less strongly than they affect the proposed CDM project activity. In other words, explain how the identified barriers are not prohibitive to these alternatives. Any alternative that would be prevented by the barriers identified in Sub-step 3a is not a viable alternative, and should be eliminated from consideration. At least one viable alternative shall be identified.

If both Sub-steps 3a – 3b are satisfied, proceed to Step 4
If one of the Sub-steps 3a – 3b is not satisfied, the project is not additional.

Step 4. Impact of CDM Registration
Explain how the approval and registration of the project as a CDM activity, and the attendant benefits and incentives derived from the project activity, will alleviate the economic and financial hurdles (Step 2) or other identified barriers (Step 3) and thus enable the project to be undertaken. The benefits and incentives can be of various types, such as:

- The financial benefit of the revenue obtained by selling the CO_2-equiv emissions reductions.
- Attracting new players who are not exposed to the same barriers, or can accept a lower IRR (for instance because they have access to cheaper capital),
- Attracting new players who bring the capacity to implement a new technology, and
- Reducing inflation /exchange rate risk affecting expected revenues and attractiveness for investors.

Step 5. Common Practice Analysis
The above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region. This test is a credibility check to complement the investment analysis (Step 2) or barrier analysis (Step 3). Identify and discuss the existing common practice through the following sub-steps:

Sub-step 5a. Analyse other activities similar to the proposed project:
1. Provide a comprehensive analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity. Projects are considered similar if they are in the same country and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Provide quantitative information where relevant.

Sub-step 5b. Discuss any similar options that are occurring:
2. If similar activities are widely observed and commonly carried out, it calls into question the claim that the proposed project activity is financially unattractive (as contended in Step 2) or faces prohibitive barriers (as contended in Step 3). Therefore, if similar activities are identified above, then it is necessary to demonstrate why the existence of these activities does not contradict the claim that the proposed project activity is financially unattractive or subject to prohibitive barriers. This can be done by comparing the proposed project to the other similar activities, and pointing out and documenting essential distinctions between them that explain why the similar activities enjoyed certain benefits that rendered it financially attractive (e.g., subsidies or ODA resources) or did not face the prohibitive barriers to which the proposed project is subject.

3. Essential distinctions may include a serious change in circumstances under which the proposed CDM project will be implemented when compared to circumstances under which similar projects where carried out. For example, new barriers may have arisen, or promotional policies may have ended, leading to a situation in which the proposed CDM project would not be implemented without the incentive provided by the CDM. The change must be fundamental and verifiable.

If Sub-steps 5.a and 5.b are satisfied, the proposed CDM project activity is not the baseline scenario. If Sub-steps 5.a and 5.b are not satisfied, the proposed CDM project activity is not additional.

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

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National policies have been directly incorporated into the demonstration of additionality and the applicability criteria for the methodology. Any subsidies will be incorporated within the financial analysis, whilst if there is an effectively enforced mandate on the use of bio-ethanol fuel the methodology is not applicable as established in the general applicability conditions.

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

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The methodology follows a lifecycle approach and therefore the project boundary encapsulates the production and combustion of bio-ethanol fuel and includes emissions relating to both the cultivation of the sugar cane feedstock and its further processing to bio-ethanol. The core gas considered is CO_2, however N_2O and CH_4 emissions from any crop burning are also considered as are N_2O soil emissions.

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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The first step in determining the baseline scenario and associated emissions is identification of the fuel that will be replaced by the bio-ethanol. This will typically be gasoline although MTBE may also be displaced. MTBE has higher lifecycle emissions than gasoline, and therefore taking gasoline as the basis for baseline emissions is conservative.

Having identified the baseline fuel type, lifecycle emissions of this fuel type must be established. The use of lifecycle baseline emissions is concomitant to the lifecycle approach used to evaluate project emissions.

Project participants have the opportunity to calculate lifecycle emissions for the specific country of the project activity. However, this may be difficult in many countries, and may increase transaction costs. Therefore the methodology suggests use of a proxy based on a reputable study carried out by L-B-Systemtechnik GmbH (http://www.lbst.de/gm-wtw/) “GM well-to-wheel analysis of energy use and greenhouse emissions of advanced fuel/vehicle systems – a European study”. GM, BP, ExxonMobil, Shell and TotalFinaElf participated in the study, the results of which were presented in 2002. The study is based on the situation in Europe, and its applicability to the emerging markets that host CDM projects is considered conservative. If local data are available, these can be combined with the findings of the LBST study as applicable. The LBST study breaks well-to-wheel (WTW) emissions down into well-to-

tank (WTT) and tank-to-wheel (TTW). For a conventional gasoline car, the following key data are provided:

Life-Cycle Stage	Product/vehicle	GHG emissions
Well-To-Tank	Gasoline (sulphur content <10 ppm), crude based pathway	13.2 gCO_2e/MJ
Tank-To-Wheel	Gasoline (MTA)	185 gCO_2e/km (best estimate)

Fuel economy in the LBST study is given as 8.15 l/100 km, whilst a Net Calorific Value for gasoline is given as 31.756 MJ/l. The use of these conversion factors allows for the following calculation of a lifecycle carbon dioxide emission factor for gasoline.

Life-Cycle Stage	GHG emissions
Well-To-Tank	419.18 gCO_2e/litre
Tank-To-Wheel	2269.93 gCO_2e/litre
Well-To-Wheel	**2689.11 gCO_2e/litre**

The lifecycle carbon dioxide emissions factor for gasoline, termed EFB_y, is therefore 2.68911 tonnes CO_2e/kilolitre of bio-ethanol.

As mentioned, the project participant may use local data if available, or may combine local data with the above LBST data. However at all times the principle of conservativeness should be adhered to. The baseline fuel emissions factor should be re-calculated at the end of each crediting period based on up to date analysis and/or studies.

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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Lifecycle GHG emissions from the project activity can be characterised as relating to five separate categories:

1. CO_2 flows associated with the uptake of atmospheric carbon by photosynthesis and its release by oxidation. This includes uptake during crop growth, release during combustion of crop residues and release during combustion of the bio-fuel in vehicle engines.

2. CO_2 emissions arising from the use of fossil fuel in the production of the bio-ethanol feedstock (sugar cane). This will include diesel oil used in agricultural operations, fertilisers, lime and energy in the production of agro-chemicals and seeds, and energy for the production and maintenance of equipment and labour.

3. CO_2 emissions arising from the use of fossil fuel in the industrial production of the bio-ethanol. This will include electricity, energy required for the production of inputs (chemicals, lubricants) and energy required for the manufacture of equipment, construction of buildings and their maintenance.

4. Other GHG emissions – CH_4 and N_2O emissions from any burning of crop residues. N_2O soil emissions. Release of other (non-CO_2) GHG during combustion of the bio-fuel in vehicle engines.

5. Transport emissions from the bio-fuel plant to the place of blending/distribution.

The net impact of category 1 is zero, reflecting the renewable nature of bio-fuels. Thus project emissions are restricted to categories 2, 3, 4 and 5. As with baseline emissions, project participants may either calculate project emissions directly or utilise proxy data from a reputable source. The LBST study only provides data for sugar beet based ethanol, which has a markedly different emissions profile to sugar cane based ethanol. Therefore the methodology suggests use of Macedo *et al* (2004)[1]. This study is up-to-date and is clearly applicable to bio-ethanol produced from sugar cane.

The Macedo *et al* study provides the following GHG emissions data for categories 2, 3, and 4 above(table 4 page 19 and conversion efficiency page 28):

Fossil fuels used	223.26 gCO_2e/litre
CH_4 and N_2O from trash burning	104.65 gCO_2e/litre
Soil N_2O emissions	73.26 gCO_2e/litre
Total lifecycle emissions	**401.16 gCO_2e/litre**

The lifecycle carbon dioxide project emissions factor, termed EFP_y, is therefore 0.40116 tonnes CO_2e/kilolitre of bio-ethanol.

Emissions associated with the transport of the bio-ethanol from the distillery to the place of blending/distribution (category 5) are not included in Macedo *et al*. The methodology states that these emissions are to be added to the project lifecycle emissions only if the current distribution of the displaced gasoline does not involve similar transport of fuel to a blend/distribution location. Transport emissions are calculated from the volume of bio-ethanol transported and the fuel efficiency and appropriate CO_2 emissions factor of the transport vehicle. (The CO_2 emissions factor is taken from the IPCC again adding to the conservatism of the methodology.) As these transport emissions are only be included if the current distribution of gasoline does not involves the transport of fuel to a blend/distribution location, the variable TEC_y is set to 1 if the calculation is required under this test and 0 if their calculation is not required, the calculation of transport emissions are carried out through the following equation:

$$TE_y = \frac{D_y}{FE}.CEF_t.TEC_y \qquad (1)$$

Where:

TE_y = Additional emissions from the transportation of bio-ethanol to the blend/distribution location, tCO_2e
D_y = Distance travelled by transporters in year y, km
FE = Fuel efficiency of transporter, km/l
CEF_t = Carbon emissions factor, tCO_2/l
TEC_y = whether the calculation of transport emissions required

[1] Assessment of greenhouse gas emissions in the production and use of fuel ethanol in Brazil. Isaias de Carvalho Macedo, Manoel Regis Lima Verde Leal, João Eduardo Azevedo Ramos da Silva. Government of the State of São Paulo, 2004.

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

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The combined impact of the life-cycle approach and wide project boundary mean that no potential for leakage is envisaged. Moreover, the use of the production constrained applicability condition ensures that the project activity will not crowd out other bio-ethanol production.

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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To determine emission reductions, a net CO_2e emission reduction coefficient is calculated by deducting the bio-ethanol lifecycle emissions factor from the baseline gasoline lifecycle emission factor. This is then multiplied by the volume of bio-ethanol produced by the project activity and sold for use in transportation. The net CO_2e emission reduction coefficient is defined as:

$$NEF_y = EFB_y - EFP_{y_y} \qquad (2)$$

Where:

NEF_y = Net emissions reduction coefficient, tCO_2e/l
EFB_y = Baseline lifecycle emissions coefficient, tCO_2e/l
EFP_y = Project lifecycle emissions coefficient, tCO_2e/l

And hence emission reductions are calculated as:

$$CER_y = BFP_y.NEF_y - TE_y \qquad (3)$$

Where:

BFP_y = Bio-fuel production and sale for use in transportation, l
NEF_y = Net emissions reduction coefficient, tCO_2e/l
TE_y = Additional emissions from the transportation of bio-ethanol to the blend/distribution location, tCO_2e

Under the methodology EFB_y is equal to 2.68911 tonnes CO_2e/kilolitre bio-ethanol and EFP_y is equal to 0.40116 tonnes CO_2e/kilolitre of bio-ethanol. This yields a net CO_2e emission reduction coefficient, NEF_y for the methodology of 2.28795 tonnes CO_2e/kilolitre of bio-ethanol.

SECTION E. Data sources and assumptions:

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

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The core assumption of the methodology is that the lifecycle emissions calculated in the highlighted studies are applicable to other national circumstances. In the case of gasoline, the use of European data is deemed conservative as European gasoline and vehicles will tend to exhibit lower GHG emissions than those prevalent in CDM host countries. The methodology is explicitly applicable only to bio-ethanol production from sugar cane, and hence the use of the Brazilian sugar cane study is considered accurate.

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:

Data	Type	Source	Reference	Appropriateness
EFB_y	Baseline (gasoline) lifecycle emissions coefficient	LBST Report. Data taken from pages 42, 80, 86, 91	GM well-to-wheel analysis of energy use and greenhouse emissions of advanced fuel/vehicle systems – a European study. (http://www.lbst.de/gm-wtw/)	This study is based on European data, and its use for CDM host countries is deemed conservative.
EFP_y	Project (sugar cane based bio-ethanol) lifecycle emissions coefficient	Macedo *et al*	Assessment of greenhouse gas emissions in the production and use of fuel ethanol in Brazil. Macedo *et al*. Government of the State of São Paulo, 2004. (http://www.unica.com.br/i_pages/files/pdf_ingles.pdf)	Although base on Brazilian data, the study is directly applicable to bio-ethanol based on sugar cane, and is up-to-date.
CEF_t	CO_2 emission factor transportation vehicle fuel	IPCC	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual	
D_y	Haulage distance to blend/distribution location	Proprietary data		Primary data used to calculate transport emissions, verified annually
FE	Fuel efficiency of haulage vehicles	Manufacturers' data	Will be taken from vehicle model used for transportation.	Obtaining vehicle specific data will provide the most exact measure of these sources of emissions.
TEC_y	Whether the calculation of transport emissions is required	Proprietary date	Taken from location of depots and blending stations	
BFP_y	Volume of bio-fuel produced and sold for use in transportation	Proprietary data		Primary data used to calculate baseline emissions, verified annually.

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

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Data	Vintage	Relative to start date
EFB_y	2002	
EFP_y	2004	
CEF_t	2002	
D_y		0 years before as updated annually
FE		Depends on age of vehicle and fuel efficiency figures
TEC_y		0 years before as update annually
BFP_y		0 years before as update annually

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

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Data	Spatial level
EFB_y	International
EFP_y	International
CEF_t	International
D_y	Project specific
FE	National/International
TEC_y	Project specific
BFP_y	Project specific

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

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The key potential uncertainties are the extent to which the production of bio-ethanol will lead to reduced emissions and the level of emissions associated with the production of ethanol. The applicability criteria for the methodology and the use of a lifecycle approach we believe deal with these uncertainties in a conservative manner.

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 use of pre-defined emission factors and the methodology panel's draft consolidated tools for additionality allow for conservative and transparent baseline determination.