CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

>>
Title: Production of biodiesel using Jatropha in Mozambique
Version: 1.0
Date: 4 December 2008

A.2. Description of the project activity:

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Mozambique boasts substantial energy resources including hydroelectric potential and significant offshore natural gas deposits in the Inhambane region located in south eastern part of the country.

However, the country is grossly deficient in petroleum-based transportation fuels. This is due to the fact that the country's only refinery in Matola is no longer in operation. At the same time, all non-oil producing developing countries are suffering from current oil price hike. Mozambique is not an exception as most of the fossil fuels is imported, causing the deterioration of trade balance.

In the light of the situation described above, the project activity aims to produce biodiesel from oil seeds of *Jatropha curcas* and displace fossil fuel-based petrodiesel currently being used by the bus fleet of the public bus company of Maputo, the capital city of Mozambique. Jatropha will be cultivated in dedicated plantations with the total area of 29,000ha in the counties of Mabalane, Bilene, Chibuto and Manhiça in the Gaza Region. Biomoc S.A., a special purpose company (SPC) set up by Petróleos de Moçambique, S.A. (Petromoc) and Sinanen Co., Ltd. (Sinanen) in Japan. Petromoc is the biggest petroleum company in Mozambique with 34% share of the market. Petromoc together with Sinanen will directly establish and operate the plantation totalling 13,000 ha in Mabalane while the SPC will enter into contractual agreements with a number of farmers to establish and operate the plantations in Bilene, Chibuto and Manhiça. Biomoc will also establish and operate the milling plant, biodiesel production plant, solid fuel production plant using biodiesel by-product of glycerine as well as blending facility in Matola near the capital city of Maputo. The biodiesel fuel (BDF) produced will be supplied to TPM, a public bus company in Maputo at 20% mixture ratio (B20), displacing petrodiesel which is currently used for the bus fleet. The project activity, through use of carbon-neutral energy source as transport fuel, will reduce the amount of CO_2 emitted by petro diesel-fuelled buses that will continue to be operated in the absence of the project activity.

Jatropha curcas is an indigenous crop simply known as Jatropha. There are several crops such as coconut, sunflower, african palm, sweet sorghum, sugar cane, and cassava which can be grown and utilized relatively easily in Mozambique as feedstock to produce biodiesel. Amongst them, Jatropha is gaining popularity as one of the most promising feedstock

There are no data on the agro-ecological suitability of Jatropha in Mozambique or a history of its production and commercialization. Even so, the country has engaged in a veritable national campaign to plant and cultivate Jatropha, heeding President Guebuza's call to propagate the plant as a source of fuel.

The Project will contribute to sustainable development in the following ways.

Reduction of greenhouse gas emissions and improvement of air quality

Air pollution in Maputo is worsening by day due to the increase in the number of vehicles in recent years. The use of biodiesel will not only reduce greenhouse gas emission and thus prevent global warming, but will also reduce pollutants with hazardous health effects emitted into the atmosphere when conventional fossil fuel-based transport fuel is burnt, thereby improving the local living environment.

Stabilization of fuel supply and prevention of foreign currency outflow

Mozambique, which imports almost all of its petroleum products, has been badly hit by the global oil price hike. The decision in February 2008 by public minibus operators to raise their fares led to a riot and their operation has since been barely sustainable with the help of the government subsidy for fuel purchase. Even after the incident, the fuel price continues to remain high. The gasoline and diesel prices are higher than the prices in neighboring South Africa. The project activity that introduces alternative fuels will help maintain the operation of public transport vehicles that is essential in people's daily lives.

Creating rural employment, closing the gap between city and rural areas and improvement of household environment

The project activity will hire local famers in the rural area to cultivate jatropha. The new economic activity introduced by the project activity will increase farmers' cash income, thereby improving their living standards. Also, the waste produced from the crushing process of jatropha seeds and glycerine, the by-product of BDF production, will be combined to produce solid fuel. This fuel will be provided to the residents of local community at no or very low price. The project activity will greatly contribute to decrease the need for logging activities, which is a serious problem in Mozambique where 80% of primary energy source is wood.

The Project also complies with the following four objectives of Mozambique's national energy policy formulated in 2008.

- Promotion of afforestation to secure household fuel.
- Promotion of investment projects in development of energy sources and private sector participation
- Increasing energy export
- Promotion of environmentally friendly alternative energy including solar, wind and biomass energy

A.3. Project participants:

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Table 1: List of project participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)

Mozambique (host)	Biomoc S.A.	**No**
	Petróleos de Moçambique, S.A. (Petromoc)	**No**
Japan	Sinanen Co., Ltd. (Sinanen)	**No**

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

>>
Mozambique

A.4.1.2. Region/State/Province etc.:

>>
Plantation
Gaza

BDF Production plant
Maputo

BDF consumption area
Maputo

A.4.1.3. City/Town/Community etc.:

>>
Plantation

Plantation directly operated by Petromoc

Mabalene

Plantation operated by contract farmers

Manhiça
Bilene
Chibuto

BDF Production plant
Matola

BDF consumption area
Maputo

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

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Location of the plantation sites and geographical coordinates:

Plantation directly operated by Biomoc

The directly operated plantation will be established along the farm road and railway in Mabalane with a river on its western side.

Mabalene (S23° 54'22", E32° 39'09", EL:91m)

Plantation operated by contract farmers

Manhiça *(Geographical coordinates to be filled in later)*
Bilene *(Geographical coordinates to be filled in later)*
Chibuto *(Geographical coordinates to be filled in later)*

Location of the oil extraction sites and geographical coordinates:

S25° 57'19", E32° 29'56", EL:20m

Location of the biodiesel production plant and geographical coordinates:

Same as the location of oil extraction site.

Location of the biodiesel production plant and geographical coordinates:

The BDF plant will be installed inside the existing storage facility of Petromoc.
See map below.

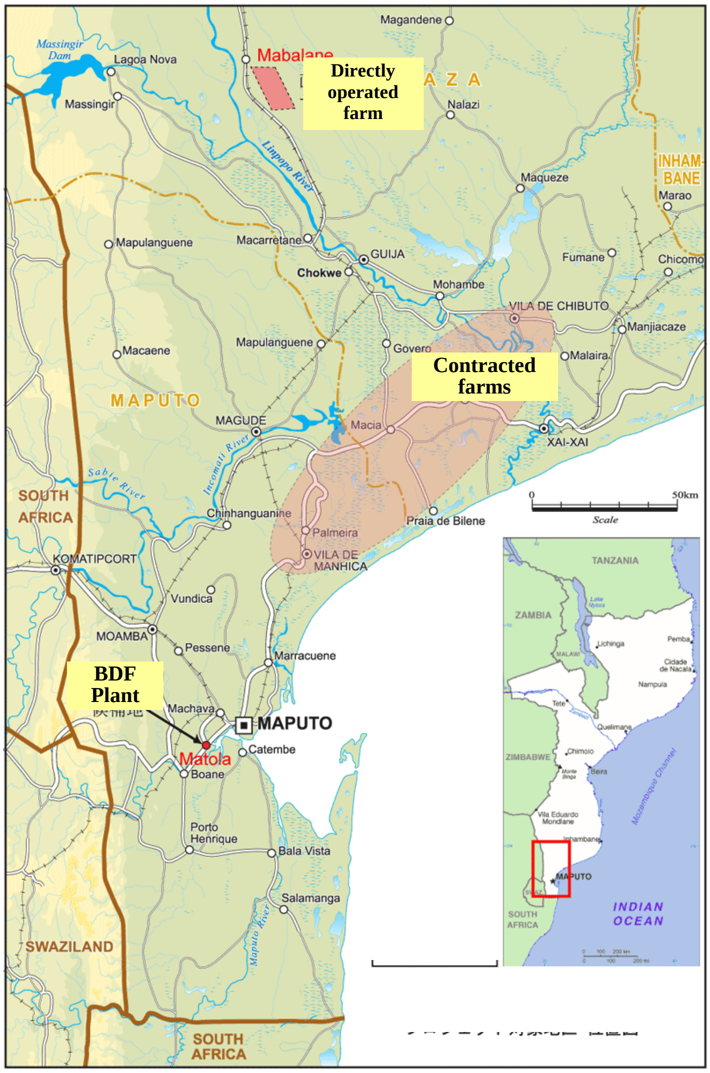

Figure 1: Map of the project sites

A.4.2. Category(ies) of project activity:

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Energy Industries (renewable/non renewable sources)

A.4.3. Technology to be employed by the project activity:

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As stated in Section A.2., the purpose of the project activity is to reduce CO2 emissions currently emitted into the atmosphere by the use of petrodiesel by bus fleet by displacing it with BDF. The Project involves cultivation of Jatropha in dedicated plantations, production of BDF at the BDF production plant and supplying the BDF to as well as its usage by the public bus fleet of Maputo operated by TPM.

The core technology to be introduced by the Project is the BDF production plant which will be operated for 24 hours a day 330 days per year to process 129,000 tons of seeds and produce 33,000 tons of final

BDF products annually. The Project is a green-field activity where BDF production plant will be newly installed. There are no similar facilities prior to the start of the project activity which is the same as the baseline scenario in this case.

The technology to be introduced will be a state-of-the-art technology and will also be environmentally safe and sound. There will be significant technology transfer in all stages of project implementation including installation, operation and maintenance. The staff training will be provided according to the standards employed by the manufacturer.

The BDF plant consists of the following facilities/equipment .

Stockyard

The Jatropha seeds as delivered by freight rail as well as seed cake produced from the milling process will be stored in the stockyard.

Oil expeller

The pre-treatment of the seeds, pressing and oil extraction will be carried out by the oil expeller. Highly efficient oil extraction will be implemented using the hot-press method while heating the seeds by boiler steam.

BDF equipment

The BDF equipment is continuous. Firstly, pre-treatment of the oil will remove low-boiling substances and impurities. Degumming and deacidification are carried out the same time. The oil is then sent to reaction container, heated to 60-80 degrees and methyl-esterification is carried out after adding methanol and alkaline catalyst (potassium hydrate). After the reaction, the oil is laid still to cool down after which glycerine will be separated. Methanol will be recovered from glycerine. Glycerine will later be used as fermentation material for compost.

The BDF layer will be combined with water for cleansing and then again laid still to separate BDF layer from water layer. This “wet” method of cleansing the BDF layer is employed to thoroughly remove impurities and minimize the cost of flocculants. The wastewater from this process will be used for fermentation of compost as it contains high level of organic materials. The cleansed BDF layer is then once again removed of low-boiling substances and de-hydrated as the final BDF product.

Storage tank

Stainless-steel tanks for Jatropha crude oil and BDF product will be utilized.

Use of by-products

Jatropha seed cake will be used in the following three ways.

(1) Boiler fuel required for the operation of oil expeller and BDF equipment
(2) Sold as solid fuel to local communities.
(3) Mixed with glycerine and wastewater from the cleansing process to produce compost.

The facilities and equipment used and their specifications are summarized in the following table.

Table 2: List of equipment and their specifications

Facility/equipment	Specification	Unit	Number of units
Jatropha stockyard	60 x 130 x 3	m^3	1
Oil expeller	110	ton/day	5
BDF plant	100	ton/day	1
Jatropha crude oil tank	133	m^3	4
BDF product tank	100	m^3	6
Diesel generator	1000	kW	3
Composting facility	51	ton/day	2
Solid fuel production facility	102	ton/day	1

The BDF production process is summarized in the diagram below.

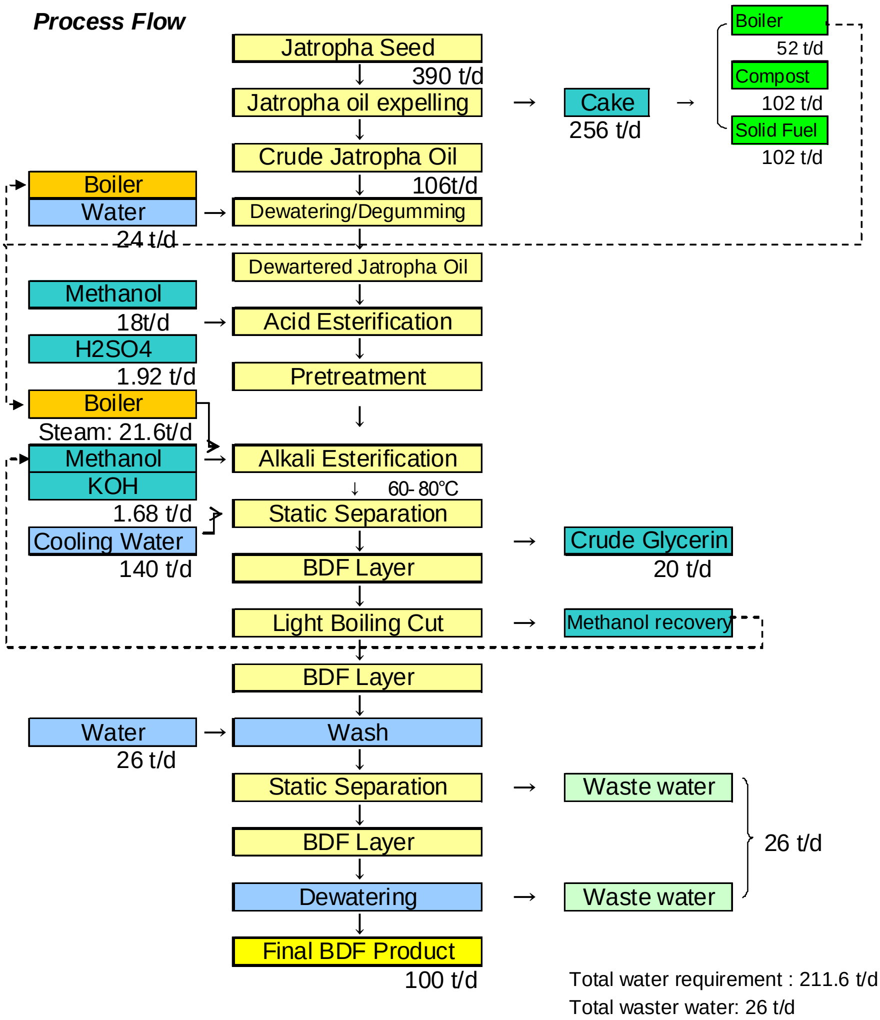

Figure 2: BDF production process

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

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Table 3: Ex-ante estimation of emission reductions

Year	Estimation of overall emission reductions (tCO_2)
Year 1	12,867
Year 2	26,338
Year 3	39,507
Year 4	52,676
Year 5	65,847
Year 6	65,847
Year 7	65,847

Total estimated reductions (tonnes of CO_2)	328,929
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period	46,990

A.4.5. Public funding of the project activity:

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The project involves no ODA or public funding from Parties that are Annex I signatories to the Kyoto Protocol.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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The baseline and monitoring methodologies which are applicable to the project activity are as follows:

Draft revision to the approved baseline and monitoring methodology AM0047 ver. 03[1]
"Production of biodiesel based on waste oils and/or waste fats from biogenic origin or from oil seeds cultivated in dedicated plantations for use as fuel"

The methodology also refers to the latest version of the following tools:

• "Tool for the demonstration and assessment of additionality" ver. 05.2;
• "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" ver. 01;
• "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" ver. 02;
• "Tool to determine project emissions from flaring gases containing methane".

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

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Draft revision to the approved baseline and monitoring methodology AM0047 ver. 03 is applied to the Project that reduces emissions through the production, sale and consumption of blends of petrodiesel with biodiesel to be used as fuel, where the biodiesel is produced from oil seeds cultivated in dedicated plantations on severely degraded land or on under-utilized agricultural land[2].

For the purpose of this methodology, the following definitions apply:

・Petrodiesel is 100% fossil fuel diesel;
・Biodiesel is 100% trans-esterified biofuel diesel; and

[1] MP 30 Meeting Report Annex 06, http://cdm.unfccc.int/Panels/meth/MP30_repan06_AM0047_ver03

[2] The final PDD will apply the latest approved version of AM0047 when proceeding for validation by DOE.

- Blended biodiesel is defined as any blending fraction of petrodiesel with biodiesel greater than 0 and less than 100%;
- Esterification denotes the formation of an ester compound from carbonic acid and 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;
- Crop is used in this methodology for both annual and perennial plants;
- Dedicated plantations are plantations that are newly established as part of the project activity for the purpose of supplying feedstock to the project plant;

The methodology ensures that the CERs can only be issued to the producer of the biodiesel and not to the consumer.

The produced blended biodiesel will be consumed through distribution line of the Petromoc who is one of the owners of the Project.

The Project meets the following applicability conditions of the methodology:

Table 4: Applicability conditions for AM0047 ver.03 [3]

Applicability condition		**Project case**
Feedstock inputs	a) If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations, volumes of biodiesel produced from feedstock, which do not comply with the criteria for the dedicated plantations, are discounted in the calculation of emission reductions;	The feedstock utilized by the Project will be planted only on underutilized agricultural land that meets the criteria for dedicated plantations, newly established plantations for the purpose of supplying feedstock to the project plant.
	b) The alcohol used for esterification is methanol from fossil fuel origin. Volumes of biodiesel produced with alcohols other than methanol (for example, ethanol) are discounted not included in the quantity of biofuel claiming emissions reduction.	The Project utilizes only the methanol from fossil fuel origin for esterification purpose. There will be no use of alcohols other than methanol in the biodiesel production process in the Project.
Dedicated plantations	a) The dedicated plantations are designed so as to avoid displacement of pre-project activities. To this end, the plantations are established on land which was, prior to project implementation: - Severely degraded land; OR - Under-utilized agricultural land. - Has been used for agricultural purposes, provided the project participants can demonstrate that no natural forests exists in the host country.3	The Project is designed so as to utilize dedicated land area leased from the government of Mozambique The land to be used will thoroughly be under-utilized, idle agricultural land. Therefore, displacement of pre-project activity will not take place.

[3] MP 30 Meeting Report Annex 06, http://cdm.unfccc.int/Panels/meth/MP30_repan06_AM0047_ver03

	b) Severely degraded land would, in absence of the project activity, not have been used for any other agricultural or forestry activity. One or more of the following indicators can be used to demonstrate that the land degraded: i. Vegetation degradation, e.g., - Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities; ii. Soil degradation, e.g., - Soil erosion has increased in the recent past; - Soil organic matter content has decreased in the recent past. iii. Anthropogenic influences, e.g., - There is a recent history of loss of soil and vegetation due to anthropogenic actions; and - Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.	n/a
	c) Plantations established on under-utilized agricultural land shall comprise one of the following activities: i. Introduction of a second crop per year on agricultural land previously lying idle for part of the year; OR ii. Liberation of under-utilized grazing land for conversion[4] to dedicated oil seed plantations, by increasing the livestock density on other existing grazing land in the project boundary. Livestock is not displaced to land areas outside the project boundary. Permanent losses in carbon stocks through over-utilization of the remaining grazing land must be prevented by respecting the maximum allowable livestock densities.	*To be filled in later*
	d) The site preparation does not cause longer-term net emissions from soil carbon. Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human	The site preparation will employ techniques that will not cause any long-term net emissions from soil carbon. In the absence of the project activity, carbon stocks in soil organic matter,

	intervention or increase less in the absence of the project activity;	litter and deadwood can be expected to decrease due to soil erosion and human intervention.
	e) The land area of the dedicated plantations will be planted by direct planting and/or seeding;	Direct-planting method will be adopted in the project plantations.
	f) After harvest, regeneration will occur either by direct planting, seeding or natural sprouting;	After harvest, regeneration will occur by direct planting or seeding.
	g) The project activity does not lead to an increase in livestock numbers in the project area. In case of dedicated plantations established on severely degraded land, no grazing will occur.	There will be no increase in livestock numbers in the project area due to the project activity.
Biodiesel Plant and Product outputs	a) The petrodiesel, the biodiesel and their blends comply with national regulations (if existent), or with suitable international standards such as ASTM D6751, EN14214, or ANP42 24.11.2004;	Mozambique does not have national standards for petrodiesel, biodiesel or their blends. The relevant oils will comply with suitable international standards.
	b) The project activity involves construction and operation of a biodiesel plant for (trans-) esterification of animal and vegetable oils and fats;	A biodiesel plant for trans-esterification of Jatropha seed oil will be installed in the project activity.
	c) Storage and treatment facilities of feedstocks and products of the plant are designed in a way to 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). If waste water anaerobic treatment does not capture and combust the methane generated, methane emissions should be accounted as per this methodology;	Storage and treatment facilities of Jatropha seeds and oil will be designed in a way that does not lead to any methane emissions. Some of the seed cake produced at the plant will be used as fuel for the on-site boiler. The remaining seed cake will be used to make compost after aerobic treatment and also used to make solid fuel for households after crushing and compressing together with glycerine to make solid fuel for households. These processes will not lead to any methane emissions. There will be no methane emissions from wastewater as all wastewater will be recycled within the BDF production process.
	d) The by-product glycerol is not disposed of or left to decay. It should be either	Glycerol will be used as raw material for solid fuel which will consist both of

	incinerated or used as raw material for industrial consumption.	glycerol and seed cake.
Consumption of biodiesel	a) The blended biodiesel is supplied to consumers within the host country whose existing stationary installations or vehicles, that actually combust the blend, are included in the project boundary.	The consumer of the blended biodiesel in the project activity is a public bus company which only operates within the country of Mozambique and its buses are included in the project boundary.
	b) The consumer (end-user) of blended biodiesel in the transport sector is a captive fleet.	All buses that will be supplied with the biodiesel produced in the project activity are owned by a single bus company.
	c) The consumer and the producer of the blended biodiesel are bound by a contract that allows the producer to monitor the consumption of blended biodiesel and states that the consumer shall not claim CERs resulting from its consumption.	The consumer and the producer of blended biodiesel will be bound by a contract that stipulates the producer's obligation in monitoring and that the consumer will not claim CERs from the same project activity.
	d) No major modifications in the consumer stationary installations or in the vehicles engines are deemed necessary to consume/combust the blended biodiesel. In case of stationary installations, the blending fraction can have any value between 0 and 100%. In case of vehicles use, the blending proportion must be low enough to ensure that the technical performance characteristics of the blended biodiesel do not differ significantly from those of pure petrodiesel. The default value for the maximum allowable blending proportion is 20% by volume (B20)[5]. If the project participants use a blending proportion more than 20%, they shall justify in the PDD that the technical performance characteristics of the blended biodiesel do not differ significantly from those of pure petrodiesel.	The blending proportion for the project activity will be 20% which will not require any major modifications in buses using biodiesel.
	e) Blending is done by the producer, the consumer or a third party who is contractually bound to the producer to ensure that blending proportions and amounts are monitored and meet all regulatory requirements.	Blending will be done by Petromoc, the parent company of the SPC and blending proportions and amounts will be monitored accordingly.
Activities for which CERs are claimed	a) Project participants claim CERs only for the CO_2 emissions from petrodiesel displaced by the biodiesel.	CERs will only be claimed for the reduction in CO_2 emissions by displacing petrodiesel by biodiesel.
	b) Project participants **do not** claim CERs	CERs will not be claimed for anything

	for the following: (i) Net removal by sinks; (ii) Biodiesel consumed for non-energy purposes; (iii) Utilization of by-products such as glycerol; (iv) Avoidance of methane emissions from waste water treatment due to the reduction of waste oil in waste water.	other than what is stated above.

B.3. Description of the sources and gases included in the project boundary:

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The spatial extent of the project boundary encompasses:

• Transportation of feedstock to the biodiesel plant. If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations, the transportation from the field to the crude vegetable oil production plant (off-site) should be included;

• Biodiesel production plant at the project site, comprising the esterification unit plus other installations on the site (e.g. storage, refining, blending, etc.); if the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations, the crude vegetable oil production plant (onsite or off-site) should also be included;

• Transportation of biodiesel to the facility where the biodiesel is blended with petrodiesel;

• Facility where the biodiesel is blended with petrodiesel; (regardless of the ownership of the blending facility);

• Transportation of the blended biodiesel to the final consumer (end-user);

• Vehicles and existing stationary combustion installations where the blended biodiesel is consumed;

• If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations the geographic boundaries of the dedicated plantations including the grazing lands with increased livestock densities.

• Emissions from combustion of petrodiesel and biodiesel, taking into account the fossil carbon contained in methanol used in biodiesel production;

• Emissions from fuel and electricity consumed in the production of biodiesel;

• Emissions from the transport of feedstock to the biodiesel plant;

• Project emission sources related to the production of the biomass.

Emissions associated with the production of methanol used for esterification are excluded from the project boundary, but are accounted for as leakage.

Table 5: Summary of gases and sources included in the project boundary, and justification /explanation where gases and sources are not included.

	Source	Gas	Included?	Justification/Explanation
Baseline	Vehicles and stationary combustion sources consuming petrodiesel	CO_2	Yes	Main source of baseline emissions
		CH_4	No	Excluded for simplification. CH_4 and N_2O emissions are assumed to be very small. No systematic difference to project activity
		N_2O	No	
Project Activity	On site fossil fuel consumption at biodiesel production plant	CO_2	No	The project activity does not involve any use of fossil fuel at BDF production plant.
		CH_4	No	Excluded for simplification. CH_4 and N_2O emissions are assumed to be very small. No systematic difference to baseline scenario
		N_2O	No	
	On site electricity consumption at biodiesel production plant	CO_2	Yes	May be a significant emissions source. Electricity will be used in the project activity for operation of the expeller.
		CH_4	No	Excluded for simplification. CH_4 and N_2O emissions are assumed to be very small. No systematic difference to baseline scenario
		N_2O	No	
	Transportation of feedstock to project site	CO_2	Yes	May be a significant emissions source
		CH_4	No	Excluded for simplification. CH_4 emissions are assumed to be very small.
		N_2O	No	Excluded for simplification. N_2O emissions are assumed to be very small.
	Transportation of biodiesel to blending facility	CO_2	No	Omitted as transportation of petrodiesel in the baseline case involves similar transportation.
		CH_4	No	Excluded for simplification. CH_4 emissions are assumed to be very small.
		N_2O	No	Excluded for simplification. N_2O emissions are assumed to be very small.
	Combustion of fossil fuel derived methanol in the biodiesel ester	CO_2	Yes	Fossil carbon contained in methanol used for esterification. It is a significant source of emissions. Other biodiesel carbon is climate neutral.
		CH_4	No	Excluded for simplification. CH_4 and N_2O emissions are assumed to be very small. No systematic difference to baseline scenario
		N_2O	No	
	Anaerobic wastewater treatment in crude vegetable	CO_2	No	Excluded for simplification. CO_2 emissions are assumed to be very small.
		CH_4	No	All wastewater will be recycled in the BDF plant.

		N_2O	No	Excluded for simplification. N_2O emissions are assumed to be very small.
Project Activity (If the feedstock is vegetable oils and / or fats from crops produced in dedicated plantations)[7] [8]	Fossil fuel consumption during agriculture operations	CO_2	Yes	May be a significant emissions source.
		CH_4	No	Excluded for simplification. CH_4 and N_2O emissions are assumed to be very small. No systematic difference to baseline scenario
		N_2O	No	
	Electricity consumption during agriculture operations	CO_2	No	May be a significant emissions source
		CH_4	Yes	Excluded for simplification. CO_2 emissions are assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Application of fertilizers	N_2O	Yes	May be a significant emissions source
	Production of synthetic fertilizer	N_2O	Yes	May be a significant emissions source

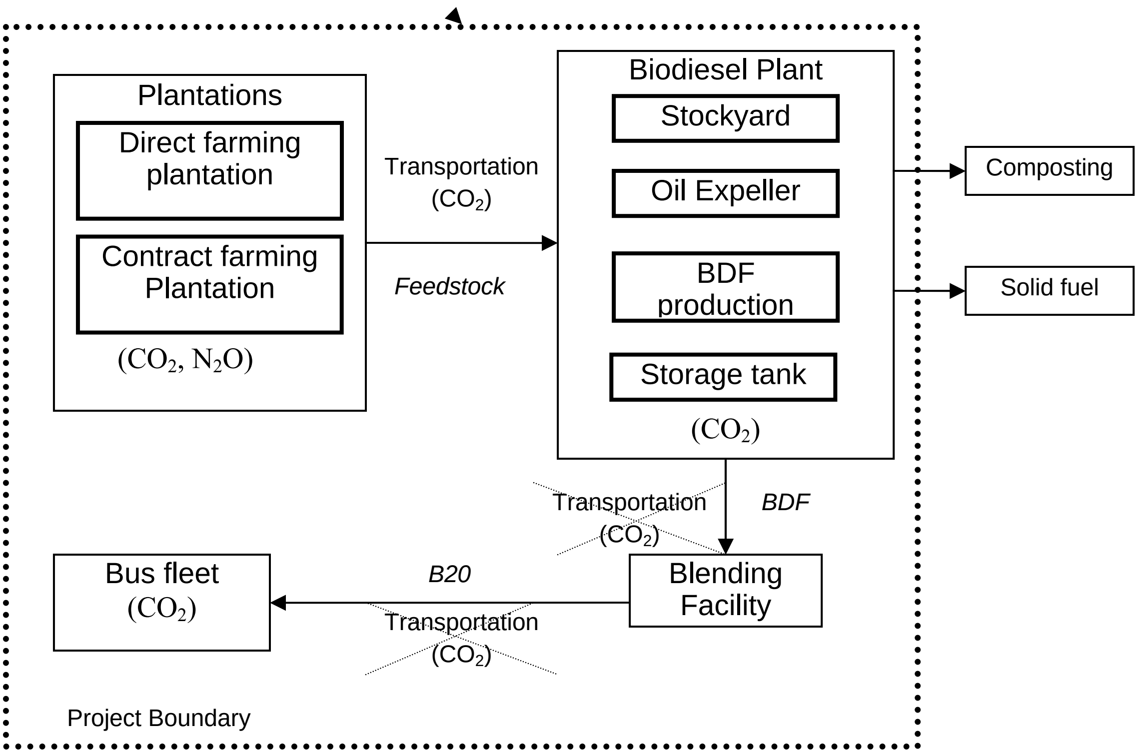

Figure 3: Project Boundary

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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As the methodology indicates for biodiesel produced from oil seeds cultivated in dedicated plantations on under-utilized agricultural land as in the case of the project activity, the following element should be taken into account:

• **Production of fuels (P):** What would have happened at the production level in the absence of the CDM project activity?
• **Consumption (C):** Which fuel would have been consumed in the absence of the CDM project activity?
• **Land used for plantations (L):** What would be the land use in the absence of the CDM project activity?

Baseline scenario for production of fuels (P):

As per the methodology, the most likely baseline scenario among all realistic and credible alternatives is identified by applying steps of the "Tool for the demonstration and assessment of additionality (version 05.2)". Step 2 is not carried out as the option to carry out Step 3 is selected. As per the methodology, Step 3 can be used as Biomoc is not producing any other type of fuel.

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

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

At the production level, the following realistic and credible alternatives are identified:

P1 Continuation of current practices with no investment in biodiesel production capacity (continued production of petrodiesel);
P2 The project activity implemented without the CDM; and
P3 Investment in any other alternative fuel, such as CNG or LPG replacing partially or totally the baseline fuel.

Sub-step 1b: Consistency with mandatory laws and regulations:

All three alternatives scenarios are in compliance in existing laws and regulations of Mozambique.

Step 2: Investment analysis:

Step 2 is not carried out as the option to carry out Step 3 is selected. As per the methodology, Step 3 can be used as Biomoc is not producing any other type of fuel.

Step 3: Barrier analysis:

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity

The following barriers have been identified as the realistic and credible barriers that would prevent the implementation of the proposed project activity from being carried out, in a CDM project activity.

- Investment barriers
- Technological barriers
- Barrier due to prevailing practice

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives.

In terms of the production of Jatropha biodiesel, Scenarios P2 and P3 face barriers in the following manner.

P1: Continuation of current practices with no investment in biodiesel production capacity (continued production of petrodiesel);

There are no barriers preventing the continuation of current practice as petrodiesel production or in the case of Mozambique, its import is an accepted practice that does not require any new investment or introduction of a new technology.

P2: The project activity implemented without the CDM

Production of Jatropha biodiesel without the support of the CDM framework faces investment and technological barriers as well as barrier due to prevailing practice.

Firstly, the profitability of the project activity falls short of what is considered benchmark as elaborated in Section B.5. Without the additional financial benefits from CER sales, there is no incentive for the project proponent, a private commercial entity to implement the Project. The increased revenue brought by the CDM status will also make the Project more attractive to financiers.

Secondly, the technology to produce BDF is still new in Mozambique. Although there are several projects underway, there are no projects that produce BDF commercially to domestic consumers to date. Many of the equipment have to be imported from abroad including the main equipment which will be imported from Japan. Extensive training will be required for the workers before the implementation of the Project. In all, the Project entails significant technological risks. Again, without the CDM status of the Project helping to overcome such risks, the project proponent will have no incentive to implement the project activity.

Thirdly, although it is expected to grow in the future, BDF production is not yet an accepted practice in Mozambique as previously explained. As this is a first-of-a-kind project activity, the risk is too great for the Project to be implemented without the support of the CDM framework.

P3: Investment in any other alternative fuel, such as CNG or LPG replacing partially or totally the baseline fuel.

Investing in CNG or LPG instead of BDF faces investment and technological barriers.

Mozambique has its own natural gas reserves and although CNG can be derived domestically, it is not a realistic move in the near future as the only existing pipeline is dedicated to exporting the gas to South Africa. The lack of necessary infrastructure has created a technological barrier for any project involving vehicles running on CNG.

As for the LPG, it is a petroleum derived product like petrodiesel. As previously mentioned, petroleum products are imported to Mozambique and are priced high. Again, without the benefits gained from the CDM status for which a LPG project will not qualify, there is no incentive for the project proponent to switch from petrodiesel, the current fuel of choice.

Based on the barrier analysis, only Scenario P1, continuation of current practice does not faces any barrier.

Baseline scenario for consumption of fuel (C):

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

As per the methodology, the following alternatives are considered in relation to the consumer. In the case of the project activity, the consumer is a local bus company of Maputo for blended biodiesel.

C1 Continuation of petroleum diesel consumption (continuation of current practice);
C2 Consumption of biodiesel from other producers;
C3 Consumption of other single alternative fuel such as CNG or LPG, etc;
C4 Consumption of a mix of above alternative fuels;
C5 Consumption of biodiesel from the proposed project plant.

Step 2:Eliminate alternatives that are not complying with applicable laws and regulations

All identified alternatives are in compliance with existing laws and regulations.

Step 3:Eliminate alternatives that face prohibitive barriers.

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity

The following barriers have been identified as the realistic and credible barriers that would prevent the implementation of the proposed project activity from being carried out, in a CDM project activity.

- Investment barriers
- Technological barriers
- Barrier due to prevailing practice

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives.

In terms of the consumption of Jatropha biodiesel, Scenarios C2, C3, C4 and C5 face barriers in the following manner.

Scenario C1: Continuation of petroleum diesel consumption (continuation of current practice)

The use of petrodiesel is by public buses is the conventional and accepted practice in Mozambique. There are no public or private incentives to switch to different fuel or vehicle type. Although BDF is produced and used on pilot project basis, it is not commercially available on large scale. There are no barriers facing the continued use of petrodiesel.

Scenario C2: Consumption of biodiesel from other producers

The consumer faces investment barrier under Scenario C2. The BDF market is not yet mature in Mozambique. Biofuel production so far has been on experimental or self-consumption basis. The two coconut oil-based BDF production facilities in Mozambique have either significantly reduced or terminated their production due to high price of coconut oil. Under these circumstances, the only avenue available for the consumer of the project activity, TPM, the local bus company of Maputo to source biofuel would be to import it from overseas implicating a huge increase in cost of fuel procurement. Also, TPM would be the first major-scale commercial user of biofuel for transportation in Mozambique. The barrier to engage in a “first-of-its-kind” project is considerably high without the support of the CDM framework provided by the project proponent. As such, Scenario C2 can be eliminated.

Scenario C3: Consumption of other single alternative fuel such as CNG or LPG, etc;

The consumer faces investment and technological barriers under Scenario C3. Currently, the entire bus fleet of the consumer bus company operates on petrodiesel. Although CNG can be derived domestically, it is not a realistic move in the near future as the only existing pipeline is dedicated to exporting the gas to South Africa. Also, for the consumer to switch to other single alternative fuel such as CNG or LPG, the consumer would have to purchase a whole new bus fleet that runs on CNG or LPG incurring an extremely high-cost investment as well as familiarization with a new technology. As such, Scenario C3 can be eliminated.

Scenario C4: Consumption of a mix of above alternative fuels

Scenario C4 can be eliminated for the same reason as C3 as described above.

Scenario C5: Consumption of biodiesel from the proposed project plant.

Scenario C5 faces technological barrier and barrier due to prevailing practice. Switching the entire bus fleet to biofuel is a major challenge to the consumer. Although no major changes to the vehicles are required, the drivers as well as mechanics will need to deal with an unknown fuel that may be associated with new technological difficulties. They also need to familiarize themselves with the characteristics of the new fuel. Additionally, the consumer in the project activity is the first major bulk consumer of biofuel in Mozambique using biofuel for public transport, making the project “first of its kind”. As such, Scenario C5 can be eliminated.

As shown in the analysis above, Scenario C1, the continued use of petrodiesel is the only scenario that does not face any prohibitive barriers, therefore the baseline scenario of the project activity is use of petrodiesel, the continuation of current practice.

Step 4:Compare economic attractiveness of remaining alternatives

This step is not carried out as all alternatives but one has been eliminated in Step 3.

Baseline scenario for land use (L):

The key features of the project activity in relation to land use of the plantation site are as follows.

Table 6: Land use of plantation sites

· The applicable climate region according to the default IPCC classification, applying the guidance in Annex 3A.5 of Chapter 3, Volume 4, of the 2006 IPCC Guidelines;	Warm temperate dry
· The relevant soil type according to World Reference Base for Soil Resources (WRB) or USDA soil classifications, following the decision trees in Annex 3A.5 of Chapter 3, Volume 4, of the 2006 IPCC Guidelines;	*To be filed in later.*
· The land-use type during the last 10 years before implementation of the project activity, including any changes in the land-use during that period;	The plantation sites have been underutilized agricultural land for more than 10 years and there has been no changes in land use during that time
· The land management practice(s) during the last 10 years before implementation of the project activity, including any changes in the management practice during that period;	The land has been managed by local farmers as agricultural land for more than 10 years. There have been no changes in land management during that time.
· The vegetation type before the implementation of the project activity; and	The plantation sites are idle farmland before the project activity. Existing vegetation includes grass and shrubs.
· Land titles, GPS coordinates, or any other land description formally accepted by the host country.	Directly operated plantation: S23° 54’, E32° 39” Contract plantation: *To be filled in later.*

Step 1: Identify all realistic and credible alternatives for the land use

As per the methodology, the following alternatives are considered in relation to land use.

L1 Continuation of current land use, i.e.:

- For under-utilized land: Agricultural land continues to lie idle for several months per year. Grazing land continues to be under-utilized (extensive grazing).

L2 Conversion to plantations of the oil crop.
L3 Conversion to another plantation (annual or perennial).

Step 2:Eliminate alternatives that are not complying with applicable laws and regulations

All identified alternatives are in compliance with existing laws and regulations.

Step 3:Eliminate alternatives that face prohibitive barriers.

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity

The following barriers have been identified as the realistic and credible barriers that would prevent the implementation of the proposed project activity from being carried out, in a CDM project activity.

- Investment barriers
- Technological barriers
- Barrier due to prevailing practice

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives.

Scenario L1: Continuation of current land use (Agricultural land continues to lie idle for several months per year)

Currently, there is no national strategy in place to increase oil seed cultivation for biofuel use. As previously explained, oil seed production for biofuel use is still in its infant stage while the domestic market is almost non-existent and overseas market access has not been tested. As a result, there are no public or private incentives to change current use of land. Scenario L1 does not face any of the prohibitive barriers mentioned above.

Scenario L2 and L3 face prohibitive barriers.

Scenario L2: Conversion to plantations of the oil crop.

Scenario L2 faces investment barrier, technological barrier and barrier due to prevailing practice. The planned plantation site is an under-utilized agricultural land where crops are cultivated just part of the year by small-scale farmers who lease their land from the government. No oil crop has ever been cultivated in the vicinity of the site and without the initiatives of the CDM project bringing together a target consumer, there will be no capital or technical expertise provided to the farmers to plant and cultivate an oil crop. As such, Scenario L2 can be eliminated.

Scenario L3: Conversion to another plantation (annual or perennial)

Scenario L3 faces investment barrier, technological barrier and barrier due to prevailing practice. Currently, no commercial interests can be seen in the vicinity of the area for the development of another plantation. All the land in the area including the planned project site is government owned land leased to small-scale farmers to cultivate some cash crops or has remained vacant for a considerable amount of time. Without the initiatives of the CDM project bringing together a target consumer, there will be no capital or technical expertise provided to the farmers to develop a new plantation. As such, Scenario L3 can be eliminated.

As shown in the analysis above, Scenario L1, the continuation of current land use is the only scenario that does not face any prohibitive barriers, therefore the baseline scenario of the project activity is use of land as the underutilized agricultural land, the continuation of current practice.

Step 4:Compare economic attractiveness of remaining alternatives

This step is not carried out as all alternatives but one have been eliminated in Step 3.

The methodology indicates that the methodology, AM0047 is only applicable if Scenarios P1, C1 and L1can be demonstrated to be the baseline scenarios for projects where biofuel is produced from oil seeds. As the baseline scenario of the project activity is the combination of P1, C1 and L1, AM0047 is the applicable baseline methodology.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

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In accordance with the methodology, "Tool for the demonstration and assessment of additionality Version 05.2" which is the latest version agreed by the CDM Executive Board is applied to the project activities. According to the Tool, the following steps are carried out.

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

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

As shown in Section B.4., the following alternatives have been identified for each element of the project activity.

<u>Production of fuels (P):</u>

P1 Continuation of current practices with no investment in biodiesel production capacity;
P2 The project activity implemented without the CDM; and
P3 Investment in any other alternative fuel, such as CNG or LPG replacing partially or totally the baseline fuel.

<u>Consumption of fuel (C):</u>

C1 Continuation of petroleum diesel consumption (continuation of current practice);
C2 Consumption of biodiesel from other producers;
C3 Consumption of other single alternative fuel such as CNG or LPG, etc;
C4 Consumption of a mix of above alternative fuels;
C5 Consumption of biodiesel from the proposed project plant.

Land and use (L):

L1 Continuation of current land use, i.e.:
- For under-utilized land: Agricultural land continues to lie idle for several months per year. Grazing land continues to be under-utilized (extensive grazing).

L2 Conversion to plantations of the oil crop.
L3 Conversion to another plantation (annual or perennial).

Sub-step 1b: Consistency with mandatory laws and regulations:

All alternatives are consistent with mandatory laws and regulations.

Step 2: Investment analysis:

In accordance with the methodology and the "Tool for the demonstration and assessment of additionality (Version 05.2)", Step 2 was carried out only for the production of fuel. As the "Guideline for Completing CDM-PDDs and CDM-NM Version 07" clearly indicate that Section B.4. and Section B.5. are complementary and the same information need not be repeated, only the summary will be provided.

Sub-step 2a: Determine appropriate method

Benchmark analysis is chosen for the project activity.

Sub-step 2b: Apply benchmark analysis

The Financial Investment Rate of Return (FIRR) is calculated for Scenario P1 and Scenario P2 and compared to the benchmark. The benchmark chosen is 15.73% which is the interest rate inclusive of country-related risk premium adopted for Mozambique by Japan Bank of International Cooperation for export finance. This is a suitable benchmark as the BDF plant, the main equipment to be purchased in the project activity incurring the largest cost, will be imported from Japan. The financing will be sought from an international loaning facility, such as JBIC due to the lack of local financing of this scale. The rate of 15.73% is deemed appropriate as it falls between the official discount rate of Mozambique which is 9.95%[4] and long-term interest rate commercial banks of Mozambique standing at 20-22% and is also in line with the reference interest rate of the Central Bank's Standing Lending Facility of 14.5%. Considering the significance of the risk involved in the first-of-a-kind project, 5% is added to make the benchmark 20.73% is a conservative benchmark.

The benchmark analysis is not conducted for Scenario P3 as using investment in fuels other than biofuel is not envisaged by the project company which will be set up with a specific purpose of producing BDF made from Jatropha seeds.

Sub-step 2c: Calculation and comparison of financial indicators

[4] As of 31 December 2007

The IRR of the project activity implemented without the CDM related benefits are calculated based on the following project data.

Table 7: Initial investment costs

Item	Cost (US$)
BDF plant	32,426,550
Cultivation (Direct operation)	11,574,932
Cultivation (Contract Operation)	48,183,520
Total	48,183,520

Table 8: Annual revenue

Year	BDF price (US$/ton)[5]	BDF sales (tons)	Revenue (US$)
2011	1.034	6,600	6,825,604
2012	1.034	13,200	13,651,208
2013	1.034	19,800	20,476,813
2014	1.034	26,400	27,302,417
2015 onwards	1.034	33,000	34,128,021

Table 9: Operation and Maintenance Cost

	2010	2011	2012	2013	2014	2015 onwards
BDF plant	390,353	4,154,597	6,158,160	8,161,723	10,165,286	12,168,849
Cultivation (Direct operation)	1,636,763	1,856,500	2,076,238	2,295,976	2,515,713	2,735,451
Cultivation (Contract Operation)	1,625,248	2,299,168	2,973,088	3,647,008	4,320,928	4,994,848
Total	3,652,363	8,310,265	11,207,486	14,104,707	17,001,927	19,899,148

Using the above data, IRR over the 21-year project period is calculated as 15.33%, below the 20.73% benchmark.

Sub-step 2d: Sensitivity analysis

The methodology states that fluctuation in BDF sales price, feedstock cost and fuel cost need to be analyzed.

The results of the sensitivity analysis are as follows.

Table 10: IRR after sensitivity analysis

[5] Calculated from 0.95 (US$/liter) x 1/0.9186 (liter/ton)

	5% increase	10% increase
BDF sales price	17.35	19.26
	0.5 x baseline price	0.25 x baseline price
Feedstock cost	17.33	18.28
Fuel cost[6]	16.5	17.07

It is demonstrated that the IRR of the project activity does not reach the benchmark even when associated project costs change in favour of project profitability. Iit is, therefore, clear that the project activity will not be implemented without the support of CDM framework and revenue from sales of CERs.

Step 3:Barrier analysis

In accordance with the methodology, barrier analysis is conducted for the elements of fuel consumption and land use. As explained in Step 2, only the summaries will be provided as detailed analysis is already available in Section B.4.

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity

Identified barriers are as follows.

- Investment barriers
- Technological barriers
- Barrier due to prevailing practice

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives.

For both fuel consumption and land use, continuation of current practice is the only alternative scenario that does not face the prohibitive barriers. That is consumption of petrodiesel by bus fleet and use of land as underutilized agricultural land. As discussed in Section B.4., all other alternatives, particularly the project activity implemented outside of the CDM framework face significant investment and technological barriers as well as barrier due to prevailing practice because the project activity is a “first of a kind” activity.

Step 4:Common Practice Analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity:

Mozambique has a few BDF producing facilities using coconut oil.[7] However, they have all significantly reduced production capacity or terminated production due to price hike of coconut.

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[6] The fuel cost includes cost of diesel fuel required for land clearing at the directly operated farm, transport by trucks, tractors used for cultivation and captive power plant.

[7] BDF plants by Ecomoz and Fabricante de Sabao have been identified.

Also, there are a number of initiatives for oil seed plantations including those of Jatropha for biofuel use in Mozambique as shown in Table 11 listing current projects. Most projects are in the very early stages of project development. There are no projects under operation in the same region as the project activity.

Table 11: The list of biofuel production initiatives

No.	Project	Crop	Location	Initial Investment Cost		Area	Status
				US$	EUR		
1	C3-Biodiesel	Jatropha	Maxixe, Inhambane	3,000,000			Approved
2	DEULCO	Jatropha	Panda, Inhambane	2,000,000			Approved
3	ELAION Africa	Jatropha	Dondo, Sofala	100,000			Approved
4	ECOMOZ	Coconut	Maputo, Sofala, Nampula	110,800,000			Approved
5	ADAMA	Jatropha	Manica				
6	JATROPHA	Jatropha	Moamba, Maputo	1,700,000			In operation
7	PROCANA	Sugarcane	Massingir, Gaza	510,042,736		30,346	Approved
8	JSE-Jatropha Sociadade de Energia	Jatropha	Maputo, Sofala, Nampula		12,000,000		Suspended
9	Grown Energy Zambeze	Jatropha	Sofala	212,000,000			In operation
10	Hende Wayela Energia	Jatropha	Homoine, Inhambane	725,000			Approved
11	D1 Oil Africa	Jatropha	Manhica, Maputo				Approved
12	Moninga Investimentos e serviços	Jatropha					
13	AVIA SPA	Jatropha			12,000,000	20,000	
14	Bioenergie Mozambique	Jatropha	Moamba, Maputo	9,690,000		9,150	In operation
15	Grown Energy	Sugarcane	Zambezia	212,129,000		162,000	In operation
16	ENERTERRA		Sofala, Nampula	172,211,550		250	
17	Grown Energy (TPY)	Sugarcane	Sofala	202,878,000		36	
18	MBFI Lda	Sugarcane	Mocuba-Zambezia	436,000			
19	Grown Energy (PTY) Ltd	Sugarcane	Sofala	202,878,000			
20	Companhia Industrial de Mozambique	Jatropha	Nampula	1,210,000		190	In operation
21	Companhia Principle Energy	Sugarcane	Manica	280,000,000		18,000	
22	Bio diesel Mozambique	Coconut	Inhambane	57,300,000			In operation

Source: Projectos de Produção de Biocomnustiveis em Moçambique, Ministério dos Recursos Minerais e Energia

Sub-step 4b: Discuss any similar Options that are occurring:

Jatropha is not conventionally grown in Mozambique. Although there are some existing initiatives of Jatropha cultivation as mentioned in the previous section, most are in early experimental stages and cultivation of Jatropha oil seeds as well as biofuel production are far from being conventional or diffused in the country. None of the projects have yet to identify customer base and the economic feasibility will not be proven for some time to come.

An essential difference between other Jatropha initiatives and the project activities is that most of the other initiatives are all contemplating to export the produced biofuel whereas the project activity has a specific domestic consumer. The fact that the biofuel produced in the project activity will be sold to a domestic customer presents an increased economic barrier as the price of the fuel will have to be kept low to make it affordable to a domestic buyer. Therefore, it can be said that the project activity is a first-of-a kind project that incorporates cultivation of Jatropha oil seeds, production of biodiesel and its consumption all domestically.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The methodology chosen for this project activity, AM0047 ver. 03 "Production of biodiesel based on waste oils and/or waste fats from biogenic origin or from oil seeds cultivated in dedicated plantations for use as fuel" is applied in the following manner in order to calculate baseline and project emissions, leakage and emission reduction.

The amount of biofuel production in the project activity will increase in several phases and will vary every year according to the following table. The calculations described below show estimations when production reaches maximum level after 2015.

Table 12: The amount of biofuel consumed during the first crediting period:

Year	Amount (tons)	
2011	6,600	20%
2012	13,200	40%
2013	19,800	60%
2014	26,400	80%
2015	33,000	100%
2016	33,000	100%
2017	33,000	100%

Baseline emissions

Baseline emissions are estimated as follows:

$$BE_y = BD_y \cdot CF_{PD} \cdot EF_{CO2,PD} \times NCV_{PD} \qquad \text{Equation 1}$$

where:

BE_y = Baseline emissions in year y (tCO_2)

BD_y = Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel by the captive consumer times blending fraction ($C_{BBD,y}*f_{PJ,y}$). Only blended biodiesel complying with the applicability conditions shall be considered and that which is consumed by identified in-country consumers to substitute petrodiesel in the year y (tonnes). Biodiesel produced and consumed at the site (self-consumption) must be discounted in the calculation of the baseline emissions.

CF_{PD} = Conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel)

$EF_{CO2,PD}$ = Carbon dioxide emissions factor for petrodiesel (tCO_2/GJ)

NCV_{PD} = Net calorific value of petrodiesel (GJ/tonne)

Determination of *BD*

For BD_y, values for production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel by the captive consumer times blending fraction ($C_{BBD,y}*f_{PJ,y}$) are compared in the following manner in order to reach the most conservative value of 33,000 tonnes per year.

Parameter	Description	Unit	Value	Source
$P_{BD,y}$	Amount of production of biodiesel	t/yr	33,000	Project data Will be monitored.
$C_{BD,y}$	Amount of consumption of biodiesel	t/yr	33,000	Project data Will be monitored.
$C_{BBD,y}*f_{PJ,y}$	Consumption of blended biodiesel by the captive consumer (33,000t/yr) times blending fraction (0.2)	t/yr	165,000	Project data Will be monitored.

Determination of CF_{PD}

CF_{PD}, a conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel) is calculated according to Equation 2 described below as provided in the methodology.

$$CF_{PD} = \frac{NCV_{BD}}{NCV_{PD}} \qquad \text{Equation 2}$$

Parameter	Description	Unit	Value	Source
CF_{PD}	Conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel)		0.937	Calculated according to Equation 2

NCV_{BD}	Net calorific value of biodiesel	GJ/tonne	40.3	Project data. Will be monitored.
NCV_{PD}	Net calorific value of petrodiesel	GJ/tonne	43	IPCC 2006

Determination of $EF_{CO2,PD}$

For $EF_{CO2,PD}$, carbon dioxide emissions factor for petrodiesel, the IPCC default value of 0.0741 tCO_2/GJ is used. The justification for the use of IPCC default value is provided in Section B.6.2.

Project emissions

Project emissions are estimated as follows:

$$PE_y = \sum_j PE_{fuel,j,y} + PE_{elec,y} + PE_{MeOH,y} + PE_{Tr,y} + PE_{W,y} + PE_{BC,y} \qquad \text{Equation 3}$$

Where:

PE_y = Project emissions during the year y (tCO_2)

$PE_{fuel,j,y}$ = Project emissions from combustion of fuels (i.e. for required steam) in biodiesel production in year y (tCO_2)

$PE_{elec,y}$ = Project emissions from electricity consumption in the biodiesel plant in year y (tCO_2)

$PE_{MeOH,y}$ = Project emissions from combustion of fossil fuel derived methanol in the biodiesel ester in year y (tCO_2)

$PE_{Tr,y}$ = Project emissions from transport of both feedstock to the project site and biodiesel to the facility where the blending takes place in year y (tCO_2)

$PE_{w,y}$ = Project emissions from waste water treatment in year y, if applicable (tCO_2e)

$PE_{BC,y}$ = Project emissions associated with the cultivation of land to produce biomass

(1) Project emissions from combustion of fossil fuel

No fossil fuel will be used in the project activity. As, boilers used in the project activity will be fired by Jatropha seed cake, carbon-neutral biomass, there will be no project emissions from combustion of fossil fuel.

(2) Project emissions from electricity consumption

Electricity will be required to operate the oil expeller and BDF plant. Electricity is also used in the composting process of the seed cake, however, the amount of electricity used in this process is extremely small, therefore, is excluded from the project emission calculation.

Although electricity required to operate the BDF plant will be mainly sourced from the grid, a part of required electricity will be generated by a captive diesel power plant during peak hours when electricity tariff is extremely high.

The emissions from electricity consumption will be calculated according to the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption[8]” as per the methodology.

Based on the abovementioned tool, the project activity falls under Scenario C .III where the implementation of the project activity affects both the quantity of electricity supplied from the grid and the quantity of electricity that is generated by the captive power plant. As per the methodology, emission factors are determined using Scenario A (electricity consumption from the grid) and Scenario B (electricity consumption from an off-grid fossil fuel fired captive power plant). The more conservative value between the emission factors is to be used for the calculation of the project emissions from the use of electricity.

The calculation is conducted as follows.

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,i,y} \times \left(1 + TDL_{j,y}\right) \qquad \text{Equation (1)}$$

Parameter	Description	Unit	Value	Source
$PE_{EC,y}$	Project emissions from electricity consumption in year y	tCO_2	23,966	Calculated in equation (1)
$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y	MWh/yr	17,612	Project data Will be monitored.
$EF_{EL,j,y}$	Emission factor for electricity generation for source j in year y	tCO_2/MWh	0.94	The more conservative value among the emissions factors of grid and captive power plant
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source j in year y		0.2	Default provided in the methodology
j	Sources of electricity consumption in the project		Mozambique grid and diesel captive power plant	

The emissions factor for electricity supplied by the grid is calculated using Option A1 of the Tool which is the combined margin approach. According to the Tool, combined margin emission factor is calculated according to the “Tool to calculate the emission factor for an

[8] Updated from “Tool to calculate project emissions from electricity consumption” at EB39.

electricity system”. The details of the calculation are provided in Annex 3. The result of the calculation is 0.0028 tCO_2/MWh.

The emissions factor for electricity generated by the captive diesel power plant is calculated using Option B1 of the Tool in the following manner. As per the methodology, Equation (4) is selected because the project activity does not involve a cogeneration plant.

$$EF_{EL,i,j,y} = \frac{\sum_{n}\sum_{i} FC_{n,i,t} \times NCV_{i,t} \times EF_{CO2,i,t}}{\sum_{n} EG_{n,t}} \qquad \text{Equation(4)}$$

Parameter	Description	Unit	Value	Source
$EF_{EL,j,y}$	Emission factor for electricity generation for source j in year y	tCO_2/MWh	0.94	Calculated in equation (4)
$FC_{n,i,t}$	Quantity of fossil fuel type i fired in the captive power plant n in the time period t	tonne	1,028	Project data Will be monitored.
$NCV_{i,t}$	Average net calorific value of fossil fuel type i used in the period t	GJ/tonne	43.3[9]	IPCC 2006
$EF_{CO2,i,t}$	Average CO_2 emission factor of fossil fuel type i used in the period t	tCO_2 / GJ	0.0748[10]	IPCC 2006
$EG_{n,t}$	Quantity of electricity generated in captive power plant n in the time period t	MWh/year	3,522	Project data Will be monitored.
i	the fossil fuel types fired in captive power plant n in the time period t		Diesel	
j	Sources of electricity consumption in the project		Diesel power plant	
n	Fossil fuel fired captive power plants installed at the site of the electricity consumption source j	unit	1	
t	Time period for which the emission factor for electricity generation is determined (see further guidance below)	yr	1	

As demonstrated in the calculation the above, the emission factor for diesel captive power plant, 0.94 tCO_2/MWh is the more conservative value leading to higher project emission and lower

[9] Upper end of the 95% confidence level

[10] Upper end of the 95% confidence level

total emission reduction compared to 0.0028 tCO_2/MWh., the emission factor of grid. Therefore, the value of 0.94 tCO_2/MWh is used to estimate project emissions from electricity consumption.

(3) Project emissions from fossil carbon content in methanol

Emissions from use of fossil fuel based methanol in production of BDF are estimated according to the methodology as follows.

$$PE_{MeOH,y} = MC_{MeOH,y} \times EF_{C,MeOH} \times \frac{44}{12}$$ Equation 5

Parameter	Description	Unit	Value	Source
$PE_{MeOH,y}$	Project emissions from combustion of fossil fuel derived methanol in the biodiesel ester in year *y*	tCO_2	8,168	Calculated in equation 5
$MC_{MeOH,y}$	Mass of methanol consumed in the biodiesel plant, including spills and evaporations in year *y*	tonnes	5,940[11]	Project data Will be monitored.
$EF_{C,MeOH}$	Carbon emissions factor of methanol, based on molecular weight	tC/tMeOH	12/32	Default provided in the methodology

(4) Project emissions from transport

The feedstock produced in the project plantations will be transported partly by trucks on road and partly by railway. Only the emissions from transport by trucks will be considered in the estimation of project emissions as the feedstock to be transported by rail will be a part of the consolidated cargo on existing lines and will not lead to any increase in the number of train operations. Therefore, the project emissions from transportation of feedstock on rail are negligible.

The transportation of biodiesel is omitted in accordance with the methodology as the current distribution of petrodiesel being displaced by project activity involves similar transportation of fuel to the blending facility.

The methodology allows for two options for determining project emissions from transportation involved in the project activity. Option 1 is an approach based on distance travelled and vehicle type while Option 2 is based on actual monitored vehicle fuel consumption. Option 1 is selected for the project activity as data required for Option 1 are more easily accessible.

The calculation of project emissions based on Option 1 is carried out as follows according to the methodology. As the methodology indicates, the second portion of the following equation which estimates emissions from transport of biodiesel to the blending station is ignored because the petrodiesel currently being used by the bus company involves similar transport to the blending location. These parameters will also not be monitored.

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[11] Estimated as 18% of BDF production volume. 33,000*0.18＝5,940

$$PE_{Tr,y} = \left[\frac{FS_{Tr,y}}{TL_{Tr,y}} \times AVD_{FS} \times EF_{km,tr}\right] + \left[\frac{P_{BD,y}}{TL_{BD}} \times AVD_{BD} \times EF_{km,tr}\right] \quad \text{Equation 6}$$

Parameter	Description	Unit	Value	Source
$PE_{Tr,y}$	Project emissions from transport of both feedstock to the project site and biodiesel to the facility where the blending takes place in year y	tCO_2	565	Calculated in equation 6
$FS_{Tr,y}$	Feedstock used for the production of biodiesel in year y	tonnes	128,700	Project data Will be monitored.
TL_{FS}	Average truck load for vehicles transporting feedstock	tonnes	15	Project data Will be monitored.
AVD_{FS}	Average distance travelled by vehicles transporting feedstock (km), including the transportation from the field to the crude vegetable oil production plant (if off-site) and including the return trip/s	km	60	Project data Will be monitored.
$EF_{km,tr}$	Carbon dioxide emissions factor for vehicles transporting feedstock or biodiesel	tCO_2/km	0.0011	IPCC 2006 The use of default value is justified in Section B.7.

(5) Project emissions from waste water treatment

All wastewater emitted from the BDF production process will be recycled within the plant and therefore, there will be no associated emissions from wastewater. As there will be no waste water treatment in the project activity, parameters included in calculation of emissions from waste water treatment are also excluded from the monitoring items.

(6) Project emissions associated with the cultivation of lands to produce biomass

As the project activity involves biodiesel production from oil seeds cultivated on under-utilized agricultural land and is not part of one or several registered CDM A/R project activity, emissions from cultivating Jatropha will be calculated as per the following equation provided in the methodology,

$$PE_{BC.y} = \sum_{j} PE_{Fuel,BC,j,y} + PE_{Elec,BC,y} \quad \text{Equation 10}$$

Where:

$PE_{BC,,y}$ = Project emissions from cultivating biomass in year *y* (tCO_2e/yr)

$PE_{Fuel,BC,j,y}$ = Project emissions from fossil fuel consumption for agricultural operations in year *y* (tCO_2/yr). The project emissions from fossil fuel combustion ($PE_{fuel,BC,j,y} = PE_{FC,j,y}$) will be calculated following the latest version of *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"*. For this purpose, the processes *j* in the tool corresponds to all fossil fuel combustion in the agricultural operations that are part of the project activity.

$PE_{Elec,BC,,y}$ = Project emissions from electricity consumption for agricultural operations in year y (tCO2/yr). The project emissions from electricity consumption ($PE_{Elec,BC,,y} = PE_{EC,y}$) will be calculated following the latest version of *"Tool to calculate project emissions from electricity consumption"*. In case the electricity consumption is not measured then the electricity consumption shall be estimated as follows: $= \sum_{I} {}_{PJ\,y\,BC\,i\,y} EC\ CP$ *8760 , , , , where $CP_{BC,i,y}$ is the rated capacity (in MW) of electrical equipment i used for agricultural operations.

In case there are other project emissions from agricultural process as described in Table 8, they will be added to Equation 10 above as per the methodology.

<u>Project emissions from fossil fuel consumption for agricultural operations</u>

The project activity will utilize diesel operated tractors for cultivation of Jatropha seeds. Emissions are estimated according to the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" as set out in the methodology in the following manner.

$$PE_{FC,j,y} = \sum_{i} FC_{i,j,y} \times COEF_{i,y} \qquad \text{Equation (1)}$$

Parameter	Description	Unit	Value	Source
$PE_{FC,,j,y}$ (=$PE_{fuel,BC,j,y}$)	Project emissions from fossil fuel consumption for agricultural operations in year *y*	tCO_2	74	Calculated according to Equation (1)
$FC_{i,j,y}$	quantity of fuel type *i* combusted in process *j* during the year *y*	tonnes	23	Estimated by project developer
$COEF_{i,y}$	CO_2 emission coefficient of fuel type *i* in year *y*	tCO_2/t	3.2388	Calculated by Equation (4)
i	Are the fuel types combusted in process *j* during the year *y*		Diesel	Project data

There are two options provided for the calculation of the CO2 emission coefficient $COEF_{i,y}$. Option A requires data on chemical composition of the fuel type used and is the preferred method. However, since such data are not available for the project activity, Option B where calculation is conducted using net calorific value and CO2 emission factor of the fuel type used is selected for the purpose of estimating project emissions from fossil fuel use.

$COEF_{i,y}$ using Option B is carried out as follows.

$$COEF_{i,y} = NCV_{i.y} \times EF_{CO2,i,y} \qquad \text{Equation (4)}$$

Parameter	Description	Unit	Value	Source
$COEF_{i,y}$	CO2 emission coefficient of fuel type i in year *y*	tCO_2/mass or volume unit	3.2388	Calculated in Equation (2)
$NCV_{i,y}$	weighted average net calorific value of the fuel type *i* in year *y*	GJ/tonne	43.3	IPCC 2006 Justification is provided in Section B.7.
$EF_{CO2,i,y}$	weighted average CO2 emission factor of fuel type *i* in year *y*	tCO_2/GJ	0.0748	IPCC 2006 Justification is provided in Section B.7.
i	fuel types combusted in process *j* during the year *y*		Diesel	Project data

Project emissions from electricity consumption for agricultural operations

The project activity will utilize grid electricity for pumping water from a well as well as for office operation. As per the methodology, the emissions from such electricity use are calculated according to the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

According to the abovementioned tool, calculation is carried out in the following manner. The project activity falls under Scenario A where electricity is purchased solely from the grid and no captive power plant is installed at the site of electricity consumption. For Scenario A, the calculation of project emissions is carried out as follows.

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,i,y} \times \left(1 + TDL_{j,y}\right) \qquad \text{Equation (1)}$$

Parameter	Description	Unit	Value	Source
$PE_{EC,y}$ ($=PE_{Elec,BC,,y}$)	Project emissions from electricity consumption in year y	tCO_2	1	Calculated in equation (1)
$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y	MWh/yr	19	Project data Will be monitored.
$EF_{EL,j,y}$	Emission factor for electricity generation for source j in year y	tCO_2/MWh	0.0028	Calculated as combined margin
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source j in year y		0.2	Default value. Will be monitored.
j	Sources of electricity consumption in the project		Mozambique grid	

The tool provides several options for grid emission factor. Option A1, combined margin approach is chosen for the project activity. According to the tool, combined margin emission factor is calculated according to the "Tool to calculate the emission factor for an electricity system". The details of the calculation are provided in Annex 3. As the combined margin emission factor is calculated ex-ante, monitoring is not conducted during the crediting period.

Table 13 of the methodology provides for additional emissions to be considered if the project activity entails cultivation of biomass to produce oil seeds. The emissions considered are described in the following.

Table 13: Other project emission sources from the agricultural process

Emission Sources	Cases in which the emission sources should be considered	Applicability to the project activity
N_2O emissions from the application of fertilizers.	Should be estimated if **synthetic fertilizers or organic fertilizers** (e.g., animal manure, compost, sewage sludge, rendering waste) are applied at the plantation. CO_2 emissions from urea application. 4 Should be estimated if **urea** is applied as a nitrogen	The project activity will utilize organic fertilizers, therefore, resulting N_2O emissions will be considered.
CO_2 emissions from urea application.	Should be estimated if **urea** is applied as a nitrogen source at the plantation.	No urea will be applied at the project plantations.
CO_2 emissions from application of limestone and dolomite.	Should be estimated if **limestone or dolomite** is applied to the plantation to reduce soil acidity and improve plant growth.	No limestone or dolomite will be applied to the project plantations.
Emissions from clearance of land prior to the establishment of the biomass plantation.	Should be estimated if the biodiesel is produced from oil seeds cultivated in dedicated plantations on under-utilized agricultural land. If it can be demonstrated that at maturity of the acreage, the total stock in above ground and below ground biomass is higher in the project case than in the baseline these emissions do not need to be estimated. For this, the project proponents should: · Estimate the above and below ground biomass in the baseline; · Estimate the above and below ground biomass with the project when the acreage reaches maturity. This should be done using specific data for the project activity.	Project plantations will be established on under-utilized agricultural land, however, as the total stock in above ground and below ground biomass is higher in the project case than in the baseline scenario, estimations are not carried out. Estimations on above and below ground biomass in the baseline and the project activity are described in Annex 3.
CO_2 emissions resulting from changes in soil carbon stocks following land use changes or changes in the land management practices.	Should be estimated if land use change or change in land management practices is introduced with the cultivation of biomass under the project activity. If it can be demonstrated that at maturity of the acreage, the total stock in above ground and below ground biomass is higher in the project case than in the baseline this	As the total stock in above ground and below ground biomass is higher at the maturity of the acreage than in the baseline case, the emissions will not be estimated. The baseline and project above and below

	emissions don't need to be estimated. For this, the same procedure as above should be used.	ground biomass stock is estimated in Annex 3.
CH_4 and N_2O emissions from the field burning of biomass	Should be estimated if biomass from the plantation is to be burnt regularly during the crediting period (e.g. after harvest).	Biomass at the project plantations will not be burnt.
Direct N_2O emissions from land management at the plantation	Should be estimated when relevant, for example, drainage/management of organic soils is only applicable in the case of organic soils.	No land management or drainage leading to N_2O emissions will take place.
Emissions from the production of synthetic fertilizer that is used at the plantations	Should be estimated if synthetic fertilizers are applied at the plantation.	Emissions from production of synthetic fertilizers will be considered.

Based on the assessment above, estimation of project emission is carried out for emissions from the application of synthetic and organic fertilizer as well as emissions from the production of synthetic fertilizer are in the following manner.

Determination of N_2O emissions from the application of synthetic and organic fertilizer

Equations 1 and 2 provided in Annex 1 of the methodology are used in the following manner to estimate N_2O emissions from the application of the fertilizer.

$$PE_{N2o-N,Fer.y} = F_{N,y} \times EF_{N2o-N.dir} \times GWP_{N2o} \times \frac{44}{28} \qquad \text{Equation 1}$$

Parameter	Description	Unit	Value	Source
$PE_{N2O-N,Fer,y}$	Direct N_2O-N emissions from land management at the plantation in year *y*	tCO_2e/yr	706	Calculated in equation 1
$F_{N,y}$	Amount of synthetic fertilizer nitrogen and organic fertilizer nitrogen from animal manure, sewage, compost or other organic amendments applied at the plantation in year *y*	t N/yr	144.8	$F_{N,y} = F_{ON,y} + F_{SN,y}$ (refer also to Equation 3)
$EF_{N2O-N,dir}$	Emission factor for direct nitrous oxide emissions from N inputs	tN_2O-N/t N	0.01	Default provided in the methodology
GWP_{N2o}	Global warming potential of N_2O		310	IPCC2006

The amount of organic fertilizer N applied at the plantation ($F_{ON,y}$) is calculated based on the quantity of organic fertilizer applied and the N content in the organic fertilizer in the following manner.

Only the synthetic fertilizer will be used for the project activity, therefore, project emissions from the use of organic fertilizer are not estimated.

The amount of synthetic fertilizer N applied at the plantation ($F_{SN,y}$) is calculated based on the quantity of synthetic fertilizer applied and the N content in the organic fertilizer in the following manner.

$$F_{SN,y} = \sum_q M_{SF,y} \times W_{N,q,y}$$ Equation 3

Parameter	Description	Unit	Value	Source
$F_{SN,y}$	Amount of synthetic fertilizer nitrogen applied at the plantation in year *y*	t N/yr	144.8	Calculated in equation 3
$M_{SF,q,y}$	Amount of synthetic fertilizer *p* applied at the plantation in year *y*	t N/yr	1,448	Project data Will be monitored.
$w_{N,q,y}$	Weight fraction of nitrogen in synthetic fertilizer type	t N / t	0.1	IPCC 2006 Will be monitored replaced by actual project data.
q	Synthetic fertilizer types applied at the plantation in year *y*	urea		

<u>Project emissions from the production of synthetic fertilizer that is used at the plantation *($PE_{FP,y}$)*</u>

$$PE_{FP,y} = \sum_f EF_{CO2e,FP,f} \cdot M_{SF,q,y}$$ Equation 19

Parameter	Description	Unit	Value	Source
$PE_{FP,y}$	Project emissions related to the production of synthetic fertilizer that is used at the dedicated plantations in year *y*	(tCO_2e/yr)	247	Calculated in equation 3
$EF_{CO2e,FP,f}$	Emission factor for GHG emissions associated with the production of fertilizer type *f*	tCO_2e/kg fertilizer	1.7	Default provided in table
$M_{SF,p,y}$	Amount of synthetic fertilizer *p* applied at the plantation in year *y*	t N/yr	144.8	Project data Will be monitored.

<u>Leakage</u>

The methodology requires consideration of three categories of leakage as described in the following equation.

$$LE_y = LE_{MeOH,y} + LE_{WOF,y} - LE_{PD,y}$$ Equation 11

Where:

LE_y = Leakage emissions in year *y* (tCO_2)

$LE_{MeOH,y}$ = Leakage emissions associated with production of methanol used in biodiesel production in year *y* (tCO_2)
$LE_{WOF,y}$ = Leakage emissions from displacement of existing utilization of waste oil/fat in year *y* (tCO_2). These emissions will only be estimated if the biodiesel is produced from waste oil/fat
$LE_{PD,y}$ = Leakage related to the avoided production and transportation of petrodiesel (tCO_2/yr)

As the project activity does not involve utilization of waste oil or fat, only leakage from production of methanol and leakage associated with avoided production and transportation of petrodiesel will be considered.

(1) Leakage from methanol production

Emissions from production of methanol that are used in the trans-esterification process of BDF production are calculated in the following manner in accordance with the methodology.

$$LE_{MeOH,y} = MC_{MeOH,y} \cdot EF_{MeOH,PC} \qquad \text{Equation 12}$$

Parameter	Description	Unit	Value	Source
$LE_{MeOH,y}$	Leakage emissions associated with production of methanol used in biodiesel production in year *y*	tCO_2	11,583	Calculated in equation 12
$MC_{MeOH,y}$	Mass of methanol consumed in the biodiesel plant, including spills and evaporation on site, in year *y*	tonnes	5,940	Project data Will be monitored.
$EF_{MeOH,PC}$	Pre-combustion (i.e. upstream) emissions factor for methanol production	tCO_2/t MeOH	1.95	Default provided by the methodology

(2) Leakage related to the avoided production and transportation of petrodiesel

Four aspects of emissions associated with the reduced production of petrodiesel due to the project activity need to be considered as per the methodology in the following manner.

$$LE_{PD,y} = LE_{EXT,y} + LE_{LDTR,y} + LE_{EREF,y} + LE_{RDTR,y} \qquad \text{Equation 16}$$

Where:
$LE_{PD,y}$ = Leakage related to the avoided production and transportation of petrodiesel (tCO_2/yr)
$LE_{EXT,y}$ = Leakage related to extraction of crude oil (tCO_2/yr)
$LE_{LDTR,y}$ = Leakage related to long-distance transport of crude oil to the refinery (tCO_2/yr)
$LE_{REF,y}$ = Leakage related to oil refinery (tCO_2/yr)
$LE_{RDTR,y}$ = Leakage related to regional distribution: transport from refinery to local distributor(tCO_2/yr)

The use of reliable local emission factors from a pee-reviewed publication or a comparable source is recommended if available, however, default factors will be used due to the unavailability of preferred data in Mozambique.

Leakage related to extraction of crude oil ($LE_{EXT,y}$)

$$LE_{EXT,y} = BD_y \cdot CF_{PD} \cdot EF_{EXT}$$ Equation 17

Parameter	Description	Unit	Value	Source
$LE_{EXT,y}$	Leakage related to extraction of crude oil	tCO_2/yr	7,361	Calculated in equation 17
BD_y	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}*f_{\%}$)	t/yr	33,000	Project data Will be monitored.
CF_{PD}	Conversion factor from biodiesel to petrodiesel	tonnes petrodiesel/tonnes biodiesel	0.937	Calculated
EF_{EXT}	Emission factor for extraction of crude oil	tCO_2e/tpetrodiesel	0.238	Table 3 of the methodology

Leakage related to long-distance transport of crude oil to the refinery ($LE_{LDTR,y}$)

$$LE_{LDTR,y} = BD_y \cdot CF_{PD} \cdot EF_{LDTR}$$ Equation 18

Parameter	Description	Unit	Value	Source
$LE_{LDTR,y}$	Leakage related to long-distance transport of crude oil to the refinery	tCO_2/yr	3,526	Calculated in equation 18
BD_y	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}*f_{\%}$)	t/yr	33,000	Project data Will be monitored.
CF_{PD}	Conversion factor from biodiesel to petrodiesel	tonnes petrodiesel/tonnes biodiesel	0.937	Calculated
EF_{LDTR}	Emission factor for long-distance transport of crude oil to the refinery	tCO_2e/tpetrodiesel	0.114	Table 3 of the methodology

Leakage related to oil refinery ($LE_{REF,y}$)

$$LE_{REF,y} = BD_y \cdot CF_{PD} \cdot EF_{REF}$$ Equation 19

Parameter	Description	Unit	Value	Source
$LE_{REF,y}$	Leakage related to oil refinery	tCO_2/yr	2,165	Calculated in equation 19
BD_y	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}$*$f_{\%}$)	t/yr	33,000	Project data Will be monitored.
CF_{PD}	Conversion factor from biodiesel to petrodiesel	tonnes petrodiesel/tonnes biodiesel	0.937	Calculated
EF_{REF}	Emission factor related to oil refinery	tCO_2e/tpetrodiesel	0.070	Table 3 of the methodology

<u>Leakage related to regional distribution transport from refinery to local distributor ($LE_{RDTR,y}$)</u>

$$LE_{RDTR,y} = BD_y \cdot CF_{PD} \cdot EF_{RDTR} \quad \text{Equation 20}$$

Where:

BD_y = Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}$*$f_{\%}$) (t/yr)

CF_{PD} = Conversion factor from biodiesel to petrodiesel (tonnes petrodiesel/tonnes biodiesel)

EF_{RDTR} = Emission factor for regional distribution transport from refinery to local distributor as per table 3 (tCO_2e/tpetrodiesel)

Parameter	Description	Unit	Value	Source
$LE_{RDTR,y}$	Leakage related to regional distribution: transport from refinery to local distributor	tCO_2/yr	2,165	Calculated in equation 20
BD_y	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}$*$f_{\%}$)	t/yr	33,000	Project data Will be monitored.
CF_{PD}	Conversion factor from biodiesel to petrodiesel	tonnes petrodiesel/tonnes biodiesel	0.937	Calculated
EF_{RDTR}	Emission factor for regional distribution transport from refinery to local distributor	tCO_2e/tpetrodiesel	0.070	Table 3 of the methodology

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	NCV_{PD}
Data unit:	GJ/tonne
Description:	Net calorific value of petrodiesel
Source of data used:	IPCC 2006
Value applied:	43 (baseline), 43.3 (project)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Accurate reliable local or national data that are recommended for use in the methodology are not available. The second option, IPCC default values (no country-specific data are available) are used as they are deemed to reasonably represent local circumstances.
Any comment:	

Data / Parameter:	$EF_{CO2,PD}$
Data unit:	tCO_2/GJ
Description:	Carbon dioxide emissions factor for petrodiesel
Source of data used:	IPCC 2006
Value applied:	0.0741 (baseline), 0.0748 (project)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Accurate reliable local or national data that are recommended for use in the methodology are not available. The second option, IPCC default values (no country-specific data are available) are used as they are deemed to reasonably represent local circumstances.
Any comment:	

Data / Parameter:	$EF_{EL,j,y}$ $(=EF_{grid,CM,y})$
Data unit:	tCO_2/MWh
Description:	Combined margin emission factor for Mozambique grid
Source of data used:	Calculation based on national publications
Value applied:	0.0028
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the "Tool to calculate the emission factor for an electricity system"
Any comment:	As the *ex-ante* approach has been selected for both operating and build margin, no monitoring during the credit period will be conducted.

Data / Parameter:	$EF_{MeOH,PC}$
Data unit:	tCO_2/t MeOH

Description:	Pre-combustion emissions factor for methanol production
Source of data used:	Apple 1998: http://edj.net/sinor/SFR4-99art7.html and 2006 IPCC Guidelines.
Value applied:	1.95
Justification of the choice of data or description of measurement methods and procedures actually applied :	Project specific data and local or nation data are not available. The default value is provided in the methodology.
Any comment:	

Data / Parameter:	$EF_{N2O\text{-}N, dir}$
Data unit:	Kg N2O-N/kg N input
Description:	Emission factor for direct N2O emission from N inputs
Source of data used:	IPCC 2006, Vol.4, Ch.11, Table 11.1
Value applied:	0.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	Project specific data and local or nation data are not available. The default value is provided in the methodology.
Any comment:	

Data / Parameter:	$EF_{CO2e,FP,f}$
Data unit:	tCO_2e/tfertilizer
Description:	Emissions factor for GHG emissions associated with the production of fertilizer type *f*
Source of data used:	Default value for urea provided in the methodology
Value applied:	1.7
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Source: Calculated based on Wood and Cowie (2004) and Swaminathan (2004)

Data / Parameter:	EF_{EXT}
Data unit:	tCO_2e/tpetrodiesel
Description:	Emission factor for extraction of crude oil
Source of data used:	Table 3 of the methodology (Source: Swiss Ecoinventory of Energy Systems 1995, Vol1, p.245)
Value applied:	0.238
Justification of the choice of data or description of	Reliable local emission factors from a peer-reviewed publication or a comparable source, if available, are recommended for use by the methodology. Due to their unavailability, default values provided in the methodology are

measurement methods and procedures actually applied :	used.
Any comment:	

Data / Parameter:	EF_{LDTR}
Data unit:	tCO_2e/tpetrodiesel
Description:	Emission factor for long-distance transport of crude oil to the refinery
Source of data used:	Table 3 of the methodology (Source: Swiss Ecoinventory of Energy Systems 1995, Vol1, p.245)
Value applied:	0.114
Justification of the choice of data or description of measurement methods and procedures actually applied :	Reliable local emission factors from a peer-reviewed publication or a comparable source, if available, are recommended for use by the methodology. Due to their unavailability, default values provided in the methodology are used.
Any comment:	

Data / Parameter:	EF_{REF}
Data unit:	tCO_2e/tpetrodiesel
Description:	Emission factor related to oil refinery
Source of data used:	Table 3 of the methodology (Source: Swiss Ecoinventory of Energy Systems 1995, Vol1, p.245)
Value applied:	0.114
Justification of the choice of data or description of measurement methods and procedures actually applied :	Reliable local emission factors from a peer-reviewed publication or a comparable source, if available, are recommended for use by the methodology. Due to their unavailability, default values provided in the methodology are used.
Any comment:	

Data / Parameter:	EF_{RDTR}
Data unit:	tCO_2e/tpetrodiesel
Description:	Emission factor for regional distribution transport from refinery to local distributor
Source of data used:	Table 3 of the methodology (Source: Swiss Ecoinventory of Energy Systems 1995, Vol1, p.245)
Value applied:	0.114
Justification of the choice of data or description of measurement methods and procedures actually applied :	Reliable local emission factors from a peer-reviewed publication or a comparable source, if available, are recommended for use by the methodology. Due to their unavailability, default values provided in the methodology are used.
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

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Baseline emissions

Using Equation 1 and values provided in Section B.6.1, BE_y has been calculated as 98,546CO_2/yr.

Project emissions

Using equations and values described in Section B.6.1, project emissions have been calculated as follows.

(1) Project emissions from fossil fuel consumption, $PE_{fuel,j,y}$, = 0 tCO_2/yr
(2) Project emissions from electricity consumption, $PE_{elec,y}$, = 23,966 tCO_2/yr
(3) Project emissions from fossil carbon content in methanol, $PE_{MeOH,y}$, = 8,168 tCO_2/yr
(4) Project emissions from transport, $PE_{Tr,y}$, = 565 tCO_2/yr
(5) Project emissions from waste water treatment, $PE_{w,y}$, = 0
(6) Project emissions associated with the cultivation lands to produce biomass, $PE_{BC,y}$, =1,029 tCO_2/yr

Total project emissions are estimated as 33,728 tCO_2/yr.

Leakage

Using equations and values described in Section B.6.1, leakage have been calculated as follows.

(1) Leakage from methanol production, $LE_{MeOH,y}$, =11,583 tCO_2/yr
(2) Leakage related to the avoided production and transportation of petrodiesel, $LE_{PD,y}$, =15,217tCO_2/yr
- Leakage related to extraction of crude oil, $LE_{EXT,y}$, =7,361tCO_2/yr
- Leakage related to long-distance transport of crude oil to the refinery, $LE_{LDTR,y}$ =3,526 tCO_2/yr
- Leakage related to oil refinery, $LE_{REF,y}$, =2,165 tCO_2/yr
- Leakage related to regional distribution transport from refinery to local distributor, $LE_{RDTR,y}$, = 2,165 tCO_2/yr

Total leakage is estimated as - 3,463tCO_2/yr.

Emissions Reduction

In the methodology, it is noted that when leakage emissions from production of petrodiesel adjusted for emissions from production of methanol and displacement of waste oil/fat, exceed the emissions from cultivation of biomass for biodiesel production, leakage and project emissions from production of biomass can be ignored. It is expressed in the equation below.

If $(-LE_y) > PE_{BC,y}$, then:

$$ER_y = \left(BE_y - \left(PE_y - PE_{BC,y}\right)\right) \cdot q_{reg,y} \qquad \text{Equation 22}$$

Where:

ER_y	= Emission reductions in year *y* (tCO_2/yr)
BE_y	= Baseline emissions in year *y* (tCO_2/yr)
PE_y	= Project emissions in year *y* (tCO_2/yr)
LE_y	= Leakage emissions in year *y* (tCO_2/yr)
$q_{reg,y}$	= Fraction of biodiesel that is additional to regulatory requirements (%)

($-LE_y$) of the project activity is + 3,463 tCO_2/y which is greater than $PE_{BC,y}$ estimated at 1,029 tCO_2/yr, therefore, Equation 22 described above is applicable to the project activity.

<u>Determination of $q_{reg,y}$</u>

As all the biodiesel from the project activity is consumed with the same blending ratio of 20%, $q_{reg,y}$ is determined according to the following equation as per the methodology. Prior to the project, as in the baseline scenario for the project activity, there are no regulatory requirements for utilization of biodiesel fuel in Mozambique. There are no current public or private programmes to use biodiesel in transport vehicles.

$$q_{reg,y} = \left(1 - \frac{f_{BL,y}}{f_{PJ,y}}\right) \qquad \text{Equation 23}$$

Where:

$f_{BL,y}$	= Fraction of biodiesel in the blended diesel in the baseline scenario in year y (%), determined in accordance with Table 4
$f_{PJ,y}$	= Fraction of biodiesel in the blended diesel in the project scenario in year y (%)

Parameter	Description	Unit	Value	Source
$q_{reg,y}$	Fraction of biodiesel that is additional to regulatory requirements		1	Calculated in equation 23
$f_{BL,y}$	Fraction of biodiesel in the blended diesel in the baseline scenario in year		0	Project data
$f_{PJ,y}$	Fraction of biodiesel in the blended diesel in the project scenario in year		0.2	Project data

Emissions reduction is estimated as follows.

$$ER_y = \left(BE_y - \left(PE_y - PE_{BC,y}\right)\right) \cdot q_{reg,y}$$

= (98,546tCO_2/yr – (33,728 tCO_2/yr – 1,029 tCO_2/yr))* 1
= 65,847 tCO_2/yr

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

	Estimation of	Estimation of	Estimation of project	Estimation of

	baseline emissions (tonnes of CO2e)	project emissions (tonnes of CO2e)	emissions associated with cultivation of biomass (tonnes of CO2e)	overall emission reductions (tonnes of CO2e)
2011	19,709	7,569	1,029	12,867
2012	39,418	14,109	1,029	26,338
2013	59,127	20,649	1,029	39,507
2014	78,836	27,189	1,029	52,676
2015	98,546	33,728	1,029	65,847
2016	98,546	33,728	1,029	65,847
2017	98,546	33,728	1,029	65,847
Total (tonnes of CO_2e)	**492,728**	**170,700**	**7,203**	**328,929**

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Applicability Conditions

Data / Parameter:	$f_{PJ,y}$ and $f_{PJ,i,y}$
Data unit:	%
Description:	Fraction of biodiesel in the blended diesel in the project scenario in year y and fraction of biodiesel in the blended diesel from the project activity, with blending ratio i, in year y
Source of data to be used:	Records from blending operations.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	20
Description of measurement methods and procedures to be applied:	Recording volumes or flows with calibrated meters for every produced blend.
QA/QC procedures to be applied:	During the process of creating the blended biodiesel at the blending station, the blending operation will be monitored to assure adequate mixing of the products in the correct proportions. This includes measuring and recording the volumes and blend levels as verified through bills of lading, meter printouts or other auditable records of both the biodiesel and diesel fuel, which comprise the blend.
Any comment:	See “BQ-9000 Quality Assurance Program Requirements for the Biodiesel

	industry" for further information.

Data / Parameter:	$f_{reg,y}$
Data unit:	%
Description:	Fraction of biodiesel in the blended diesel bound by regulation in year y.
Source of data to be used:	Regulations in the Host Country
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	This will be monitored annually.
QA/QC procedures to be applied:	
Any comment:	There are no existing regulations requiring biofuel blend.

Data / Parameter:	Various parameters; Compliance of biodiesel produced with national regulations
Data unit:	Various data units
Description:	Compliance of produced biodiesel with national regulation, biofuel properties
Source of data to be used:	Various measurements based on national or international standards
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Annual checks will be condected according to national regulation. Various methods of measurement and uncertainty analysis.
QA/QC procedures to be applied:	According to national or international standards.
Any comment:	

Data / Parameter:	$MP_{Glyc,y}$
Data unit:	Tonnes (t)
Description:	Amount of byproduct glycerol produced during plant operation
Source of data to be used:	Measured (volumetric or weighed) values.
Value of data applied for the purpose of calculating expected emission reductions in	6,600 tonnes per year (20 t/d * 330 operating days/year). The parameter is not required for estimation of emissions reduction.

section B.5	
Description of measurement methods and procedures to be applied:	All quantity of produced glycerol will be monitored by volumetric flow meter including a volume integrator or load cell to measure the weight of produced glycerol.
QA/QC procedures to be applied:	Volumetric flow meter and integrator will be calibrated periodically. Load cell will also be calibrated periodically. Measured amounts will be crosschecked against mass balance of the biodiesel production unit.
Any comment:	

Data / Parameter:	$N_{a,p,y}$
Data unit:	
Description:	Number of animals of type a observed on sampled land parcel p
Source of data to be used:	Measured
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The parameter is not required for estimation of emissions reduction.
Description of measurement methods and procedures to be applied:	Animals will be counted annually. Monitoring frequency will be increased in case of significant intra-annual fluctuations.
QA/QC procedures to be applied:	Cross-check with farmers' livestock inventory data
Any comment:	

Data / Parameter:	$d_{a,p,y}$
Data unit:	d/yr
Description:	Number of days during which the animals of type a are present on sampled land parcel p
Source of data to be used:	Measured / counted
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The parameter is not required for estimation of emissions reduction.
Description of measurement methods and procedures to be applied:	The number of days will be counted daily and aggregated annually. Monitoring frequency will be increased in case of significant intra-annual fluctuations.
QA/QC procedures to be applied:	Cross-check with farmers livestock inventory data.
Any comment:	

Baseline Emissions

Data / Parameter:	BD_y
Data unit:	Tonnes
Description:	Most conservative value among production of biodiesel ($P_{BD,y}$), consumption of biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}$*$f_{pj,y}$). The biodiesel from waste oil/fat alone or from crops cultivated on dedicated plantations which comply with the applicability conditions, and that consumed by identified in-country consumers to substitute petrodiesel in the year *y* (tonnes) shall be considered for claiming CERs. Volumes of biodiesel produced with alcohols other than methanol (for example, ethanol) are not included in the quantity of biofuel claiming emissions reduction. Further, volumes of biodiesel produced from non-fossil fuel methanol are not included in the quantity of biofuel claiming emissions reduction.
Source of data to be used:	Metering system at production site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	33,000
Description of measurement methods and procedures to be applied:	All produced biodiesel will be metered using calibrated measurement equipment that is maintained regularly and checked for proper functioning.
QA/QC procedures to be applied:	Cross check production and consumption data with sales records.
Any comment:	Measured for reference purposes to ensure consumption of biodiesel does not exceed production of biodiesel.

Data / Parameter:	$P_{BD,y}$
Data unit:	Tonnes
Description:	Quantity of produced biodiesel from the feedstock from dedicated plantations that is used by TPM's bus fleet to substitute for petrodiesel.biodiesel ($C_{BD,y}$) and consumption of blended biodiesel times blending fraction ($C_{BBD,y}$*$f_{pj,y}$). The biodiesel from jatroha cultivated on dedicated plantations which comply with the applicability conditions, and that consumed by TPM's bus fleet to substitute petrodiesel in the year *y* (tonnes) shall be considered for claiming CERs. Volumes of biodiesel produced with alcohols other than methanol (for example, ethanol) are not included in the quantity of biofuel claiming emissions reduction. Further, volumes of biodiesel produced from non-fossil fuel methanol are not included in the quantity of biofuel claiming emissions reduction.
Source of data to be used:	Metering system at production site
Value of data applied for the purpose of	33,000

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	All produced biodiesel will be metered using calibrated measurement equipment that is maintained regularly and checked for proper functioning.
QA/QC procedures to be applied:	Cross check production and consumption data with sales records.
Any comment:	Measured for reference purposes to ensure consumption of biodiesel does not exceed production of biodiesel.

Data / Parameter:	$C_{BD,y}$
Data unit:	Tonnes
Description:	Quantity of biodiesel from feedstock from dedicated plantations consumed by the TPM to substitute for petrodiesel.
Source of data to be used:	Metering system at consumer site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	33,000
Description of measurement methods and procedures to be applied:	Continuous recording of filling buses. Use calibrated measurement equipment that is maintained regularly and checked for proper functioning.
QA/QC procedures to be applied:	Cross check production and consumption data with sales records.
Any comment:	Consumption of biodiesel will be determined as the consumption of blended biodiesel times the blending fraction of the respective blend.

Data / Parameter:	$C_{BBD,y}$
Data unit:	Tonnes
Description:	Quantity of blended biodiesel from feedstock from dedicated plantations consumed by host country consumers to substitute for petrodiesel.
Source of data to be used:	Metering system at fuelling stations.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	165,000
Description of measurement methods and procedures to be	Fuelling of buses will be recorded continuously. The meter will be calibrated and maintained regularly and checked for proper functioning.

applied:	
QA/QC procedures to be applied:	Cross check production and consumption data with sales records.
Any comment:	

Data / Parameter:	NCV_{BD}
Data unit:	GJ/tonne
Description:	Net calorific value of biodiesel.
Source of data to be used:	Laboratory analysis.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	40.3
Description of measurement methods and procedures to be applied:	Laboratory analysis will be conducted annually. Measured according to relevant national or international standards regulating determination of NCV by calibrated equipment.
QA/QC procedures to be applied:	Consistency of measurements and local / national data with default values by the IPCC will be checked. If the values differ significantly from IPCC default values, additional information will be collected or conduct measurements.
Any comment:	Analysis has to be carried out by accredited laboratory. A sample is representative if uncertainty of the NCV does not exceed ±5% at 95% confidence level.

Project emissions

Data / Parameter:	$PE_{Elec,y}$
Data unit:	tCO_2
Description:	Emissions from consumption of electricity at the biofuel production site in the project case in year y.
Source of data to be used:	Calculated as per the “Tool to calculate project emissions from electricity consumption”. When using the tool $PE_{Elec,y} = PE_{EC,y}$.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	23,966
Description of measurement methods and procedures to be applied:	As per the “Tool to calculate project emissions from electricity consumption”
QA/QC procedures to be applied:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Any comment:	

Data / Parameter:	**$EC_{PJ,j,y}$**
Data unit:	MWh/yr
Description:	Quantity of electricity consumed at the biofuel production site by the project electricity consumption source j in year y
Source of data to be used:	Onsite measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	17,612
Description of measurement methods and procedures to be applied:	Measured continuously by an electricity meter.
QA/QC procedures to be applied:	Calibrated to manufacturer's standard regularly.
Any comment:	

Data / Parameter:	$TDL_{j,y}$
Data unit:	MWh/yr
Description:	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data to be used:	Choose one of the following options: · Use recent, accurate and reliable data available within the host country; · Use as default values of 20% for
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.2
Description of measurement methods and procedures to be applied:	Monitored annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years. For estimation using recent, accurate and reliable data available in host country, $TDL_{j,y}$ should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$FC_{,n,i,t}$
Data unit:	Tonnes/year
Description:	Quantity of diesel fuel fired in the captive power plant in the time period t
Source of data to be used:	Annual data during the crediting period: Onsite measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,028
Description of measurement methods and procedures to be applied:	Monitored continuously by using weight or volume meters.
QA/QC procedures to be applied:	The consistency of metered fuel consumption quantities should be cross-checked with an annual energy balance that is based on purchased quantities and stock changes.
Any comment:	Applicable where Option B1 is used

Data / Parameter:	$EG_{,n,t}$
Data unit:	MWh /year
Description:	Quantity of electricity generated in captive power plant n in the time period t
Source of data to be used:	Onsite measurements.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3,522
Description of measurement methods and procedures to be applied:	Monitored continuously using electricity meters and aggregated annually.
QA/QC procedures to be applied:	Cross check measurement results with records for sold electricity where relevant
Any comment:	Applicable where Option B1 is used

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ per mass or volume unit (e.g. GJ/m³, GJ/ton)
Description:	Weighted average net calorific value of fuel type *i* in year *y*
Source of data to be	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC

used:	Guidelines on National GHG Inventories will be used as the preferred option of values provided by the fuel supplier in invoices are not available. The option of measurements by the project participant is not possible due to lack of resources and technology. Another option of regional or nation default values are also not available in Mozambique.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	43.3
Description of measurement methods and procedures to be applied:	Future revision of the IPCC Guidelines will be monitored.
QA/QC procedures to be applied:	
Any comment:	Applicable where Option B1 is used

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of fuel type *i* in year *y*
Source of data to be used:	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories as the preferred option of values provided by the fuel supplier in invoices are not available. The option of measurements by the project participant is not possible due to lack of resources and technology. Another option of regional or nation default values are also not available in Mozambique.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0748
Description of measurement methods and procedures to be applied:	Future revision of the IPCC Guidelines will be monitored.
QA/QC procedures to be applied:	
Any comment:	Applicable where option B1 is used.

Data / Parameter:	$MC_{MeOH,y}$
Data unit:	Tonnes
Description:	Mass of methanol consumed in the biodiesel plant.
Source of data to be used:	Mass meters.

Value of data applied for the purpose of calculating expected emission reductions in section B.5	5,940
Description of measurement methods and procedures to be applied:	Measured continuously. Calibrated measurement equipment that is maintained regularly and checked for proper functioning will be used.
QA/QC procedures to be applied:	Crosscheck against methanol purchase receipts and calculated stochiometric requirements.
Any comment:	Adjust for stock changes when comparing purchase data with consumption data; Also used for leakage calculations. Use most conservative values. Any spills onsite and evaporation are accounted as consumption. Please note that data should also report the source of methanol - from fossil fuel or non-fossil fuel sources. As per the applicability only Biofuel produced using fossil fuel based methanol can be credited.

Data / Parameter:	$FS_{tr,y}$
Data unit:	Tonnes
Description:	Feedstock used for the production of biodiesel
Source of data to be used:	Plant record, Records of truck operators
Value of data applied for the purpose of calculating expected emission reductions in section B.5	128,700
Description of measurement methods and procedures to be applied:	Every feedstock will be monitored by Mass or volumetric (including quantity integrator) meters (e.g. load cell).
QA/QC procedures to be applied:	Crosscheck data provided by trucks delivering the feedstock with measured feedstock inputs at plant. Use most conservative values.
Any comment:	

Data / Parameter:	AVD_{FS}
Data unit:	Km
Description:	Average distance travelled by vehicles transporting feedstock (km), including the transportation from the field to the crude vegetable oil production plant (if off-site) and including the return trip/s
Source of data to be used:	Records of truck operator
Value of data applied for the purpose of calculating expected emission reductions in	60

section B.5	
Description of measurement methods and procedures to be applied:	Monitored annually by using vehicle odometer
QA/QC procedures to be applied:	Check consistency of distance records provided by the truck operators by comparing recorded distances with other information from other sources (e.g. maps).
Any comment:	If feedstock is supplied from different sites, this parameter should correspond to the mean value of km travelled by trucks that supply the biodiesel plant

Data / Parameter:	TL_{FS}
Data unit:	Tonnes
Description:	Average truck load for vehicles transporting feedstock
Source of data to be used:	Records of truck operator; plant records, vehicle manufacturer information
Value of data applied for the purpose of calculating expected emission reductions in section B.5	15
Description of measurement methods and procedures to be applied:	Monitored annually.
QA/QC procedures to be applied:	Cross check against vehicle manufacturer's capacity rating
Any comment:	

Data / Parameter:	$EF_{km,tr}$
Data unit:	tCO_2 /km
Description:	Carbon dioxide emission factor for vehicles transporting feedstock and biodiesel
Source of data to be used:	Default values from IPCC 1996 are used as measurements are not possible due to lack of resources and technology. Local / national data are also not available.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0011
Description of measurement methods and procedures to be applied:	Monitored annually.
QA/QC procedures to be applied:	Check consistency of measurements and local / national data with default values from IPCC. If the values differ significantly from IPCC default values, possibly

	collect additional information or conduct measurements.
Any comment:	Default values from the IPCC will be used in a conservative manner. The value for uncontrolled US heavy duty diesel vehicle with assumed fuel economy of 2.2 km/litre is used. The vehicles in Mozambique are in much worse conditions and generally have higher emissions.

Project emissions associated with the cultivation of lands to produce biomass

Data / Parameter:	$PE_{Fuel,BC,j,y}$
Data unit:	tCO_{2e}
Description:	Project emissions from fossil fuel consumption for agricultural operations in year *y*.
Source of data to be used:	Calculated as per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”. When using the tool $PE_{Fuel,BC,j,y} = PE_{FC,j,y}$.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	74
Description of measurement methods and procedures to be applied:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
QA/QC procedures to be applied:	As per the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”
Any comment:	

Data / Parameter:	$FC_{i,j,y}$
Data unit:	tonnes/year
Description:	Quantity of fuel type *i* combusted used in the agricultural operation in process *j* during the year *y*
Source of data to be used:	Onsite measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	23
Description of measurement methods and procedures to be applied:	Monitored continuously by either mass or volume flow-meter. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); · Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable

	maintenance; · In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
QA/QC procedures to be applied:	The consistency of metered fuel consumption quantities will be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Any comment:	

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ per mass or volume unit (e.g. GJ/m³, GJ/ton)
Description:	Weighted average net calorific value of fuel type *i* in year *y*
Source of data to be used:	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories will be used as the preferred option of values provided by the fuel supplier in invoices are not available. The option of measurements by the project participant is not possible due to lack of resources and technology. Another option of regional or nation default values are also not available in Mozambique.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	43.3
Description of measurement methods and procedures to be applied:	Future revision of the IPCC Guidelines will be monitored.
QA/QC procedures to be applied:	
Any comment:	Applicable where Option B is used

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of fuel type *i* in year *y*
Source of data to be used:	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories as the preferred option of values provided by the fuel supplier in invoices are not available. The option of measurements by the project participant is not possible due to lack of resources and technology. Another option of regional or nation default values are also not available in Mozambique.
Value of data applied for the purpose of calculating expected emission reductions in	0.0748

section B.5	
Description of measurement methods and procedures to be applied:	Future revision of the IPCC Guidelines will be monitored.
QA/QC procedures to be applied:	
Any comment:	Applicable where option B is used.

Data / Parameter:	$PE_{Elec,BC,,y}$
Data unit:	tCO_2
Description:	Project emissions from electricity consumption for agricultural operations in year y
Source of data to be used:	Calculated as per the “Tool to calculate project emissions from electricity consumption”. When using the tool $PE_{Elec,BC,y} = PE_{EC,y}$.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1
Description of measurement methods and procedures to be applied:	As per the “Tool to calculate project emissions from electricity consumption”
QA/QC procedures to be applied:	As per the “Tool to calculate project emissions from electricity consumption”
Any comment:	

Data / Parameter:	$EC_{PJ,j,y}$
Data unit:	MWh/yr
Description:	Quantity of electricity consumed in agricultural operation by the project electricity consumption source j in year y
Source of data to be used:	Onsite measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	19
Description of measurement methods and procedures to be applied:	Measured continuously by an electricity meter.
QA/QC procedures to be applied:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. Crosscheck with

	invoice from electricity company.
Any comment:	

Data / Parameter:	$TDL_{j,y}$
Data unit:	MWh/yr
Description:	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data to be used:	Choose one of the following options: · Use recent, accurate and reliable data available within the host country; · Use as default values of 20% for
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.2
Description of measurement methods and procedures to be applied:	Monitored annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years. For estimation using recent, accurate and reliable data available in host country, $TDL_{j,y}$ should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$M_{SF,q,y}$
Data unit:	tonnes of synthetic fertilizer / year
Description:	Amount of synthetic fertilizer *q* applied at the plantation in year *y* where *q* are the synthetic fertilizer types applied at the plantation in year *y*
Source of data to be used:	On-site records by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	144.8
Description of measurement methods and procedures to be applied:	Measured continuously. Cross-check records of applied quantities with purchase receipts
QA/QC procedures to	

be applied:	
Any comment:	

Data / Parameter:	$W_{N,q,y}$
Data unit:	tN/t synthetic fertilizer
Description:	Weight fraction of nitrogen in synthetic fertilizer type *q* where *q* are the synthetic fertilizer types applied at the plantation in year *y*
Source of data to be used:	Specifications by the fertilizer manufacturer For the purpose of estimation of project emissions, the default value provided in IPCC 2006 Vol.4, Table 11.3 is used.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1
Description of measurement methods and procedures to be applied:	Measured continuously.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$W_{N,q,y}$
Data unit:	tN/t synthetic fertilizer
Description:	Weight fraction of nitrogen in synthetic fertilizer type *q* where *q* are the synthetic fertilizer types applied at the plantation in year *y*
Source of data to be used:	Specifications by the fertilizer manufacturer For the purpose of estimation of project emissions, the default value provided in IPCC 2006 Vol.4, Table 11.3 is used.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1
Description of measurement methods and procedures to be applied:	Measured continuously.
QA/QC procedures to be applied:	
Any comment:	

Leakage

In accordance with the methodology, as the project activity does not involve usage of waste oil and/or waste fats, monitoring of leakage is not required.

B.7.2. Description of the monitoring plan:

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All monitoring equipment will be installed by experts and regularly calibrated to the highest standards by the project proponent. Technical and operation expertise required as well as training of monitoring staff will be provided by the technology provider.

The project proponent will establish a monitoring framework to conduct monitoring of required parameters including maintenance of monitoring equipments. Each part of the project activity, agricultural production, BDF production and BDF consumption will have a manager who is responsible for overseeing the recording of the monitoring data and their maintenance. There will be two managers for agricultural production; one for direct farming plantation and another for contract farming plantation. These managers report to the monitoring supervisor of Biomoc. The monitoring supervisor is responsible for ensuring the quality of monitoring, data archives and preparation of the monitoring report. The monitoring supervisor reports to the General Manager who is responsible for the entire monitoring operation. The organizational structure is described in the following diagram.

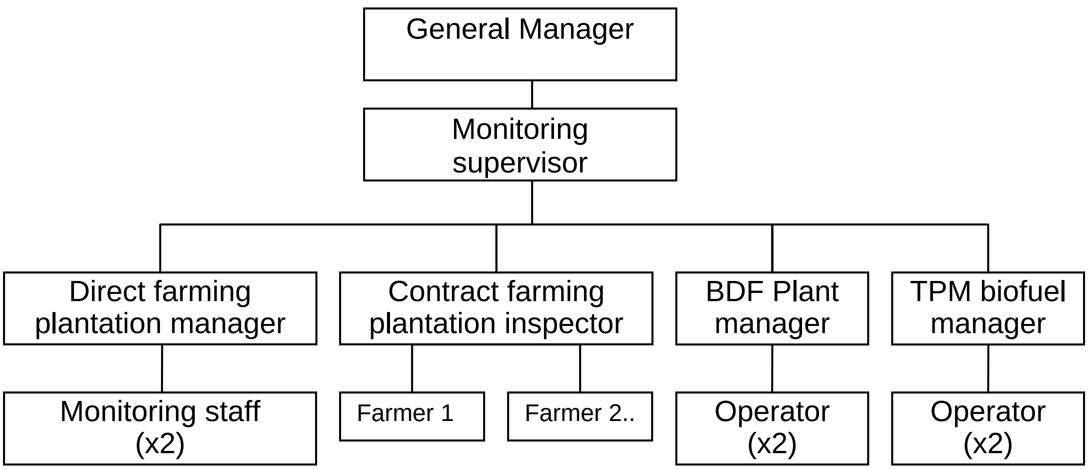

Figure 4: Monitoring structure

Operational and monitoring teams for Jatropha cultivation, biofuel production and biofuel consumption will comprise the following structures.

Jatropha cultivation

For project plantations established on under-utilized agricultural land, a database specifying the locations of the dedicated plantations will be created and periodically updated. The location Jatropha origins will be identified for all amounts of Jatropha seeds processed by the biodiesel plant.

At the direct farming plantation, there will be two staff members responsible for recording and archiving the monitoring data. They report to the plantation manager who oversees the monitoring activity at the plantation and report to the monitoring supervisor of Biomoc.

For contract farming plantations, Biomoc will designate a plantation inspector who oversees the operation and monitoring activities at contract farmer. The inspector will archive and report the data collected by the owners of each farm. The inspector is also responsible for providing proper training and instructions to contract farmers.

Biofuel production

At the BDF plant, there will be two operators responsible for recording and archiving the monitoring data. They report to the plant manager who oversees the monitoring activity and report to the monitoring supervisor of Biomoc.

Biofuel consumption

TPM, the bus operator will designate a biofuel manager responsible for reporting the monitoring results to the monitoring supervisor of Biomoc. The two operators reporting to the biofuel manager will be in charge of recording and archiving of the data.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

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The current version of the PDD is completed in December 2008 by:

Clean Energy Finance Committee
Mitsubishi UFJ Securities Co., Ltd. (MUS)

MUS is a CDM advisor to the project (not a project participant).

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

01/01/2010

C.1.2. Expected operational lifetime of the project activity:

>>

21 years

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

>>
01July 2011

C.2.1.2. Length of the first crediting period:

>>
7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
Intentionally left blank

C.2.2.2. Length:

>>
Intentionally left blank

SECTION D. Environmental impacts

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D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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Avaliacao do Impacto Ambiental, Decreto n° 45/2004 de 29 de Setembro was enacted in 2004 setting the requirements for environmental impact assessment (EIA) in Mozamnbique. The project activity, with its dedicated plantation for Jatropha cultivation encompassing 10,000 ha, falls under Category A for which a full-scale EIA is required. A public hearing is also required as part of the EIA.

The EIA process will need to be carried out as follows.

(1) Prepare Terms of Reference (TOR) for EIA.
(2) Obtain approval of TOR from the Ministry of Environment
(3) Commission EIA to a domestic consultant registered with the Ministry of Environment. Carry out EIA.
(4) Obtain approval of EIA from the Ministry of Environment
(5) After project approval, pay tax (0.2% of the project cost)

The approval process of the EIA takes about 90 days. EIA is reviewed by the Steering Commitete consisting of Ministry of Agriculture, Ministry of Minerals and Resources, Ministry of Science and Technology, Universities, NGOs and etc.

As described in Section A.2., the overall impact of the project activity on environment is positive, however, all potential impacts especially in relation to cultivation of Jatropha on large-scale plantations will be examined and mitigation measures as well as management plans will be drawn up in order to ensure that impacts including transboundary effects will be minimized.

As pre-assessement of environmental impacts prior to the implementation of full-scale EIA, the following table lists the main issues to be addressed and counter-measures to be taken.

Table 14: Major environmental impacts, mitigation measures and management plan

Category	Issue	Expected environmental impact	Examples of mitigation measures and management plan
Agriculture	Afforestation	Large-scale cultivation of single crop	Biodiversity will be secured through mixing cashew nuts, legumes and vanilla in cultivation.
	Soil	Deprivation of soil nutrients from farms with little N content.	Maintain suitable level of N by applying mixed or urea fertilizer. If available, bio-fertilizer containing nitrogen fixation microbes will be used. Also, N content will be supplied to the soil through mix cultivation of legumes (soy, pigeon pea, etc.). Simplified soil test will be conducted regularly to monitor nutrient condition of soil.
	Social environment	Impact on living environment of workers for securing large number of seasonal workers during peak periods, such as harvests.	Drill wells for the living quarter. Build temporary housing for seasonal works and secure toilets and drainage.
	Local economy	Impact on local economy, changes in employment	Positive impacts will be brought through increase in employment opportunity and income. Set purchase price of Jatropha that competes with market price of other agricultural products in such a way that it does not interfere with existing agriculture.
	Gender	Increase labor burden on women	Build up a system where women's labor burden will be reduced through prioritizing the hiring of men who currently work in South Africa as seasonal workers.
BDF plant	Wastewater	Contamination of water by discharging the wastewater from BDF cleansing process. The wastewater contains alkali (KOH) and high level of fatty acid (approx 50,000ppm)	BDF cleansing wastewater will be fully applied to the compost. During the aerobic digestion process of compost, potassium will be used as nutrients while fatty acid will be broken down into CO_2 and water.
	Waste	Glycerin is produced as by-product of BDF containing high level lf alkali and water	It will be used with wastewater as a source of nitrogen and potassium for aerobic digestion of compost.

		(over 60.%).	
	Exhaust gas	Exhaust gas from boilers for oil expeller and BDF producing equipment	CO_2 emissions will be mitigated by using carbon-neutral seed cake of Jatropha as fuel instead of heavy oil. Sulfur content of the seed cake is believed to be 1/10 of heavy oil, thereby reducing the emission of sulf oxide.
	Land	Impact on soil and river by utilization of the land for BDF plant.	By using existing land already used by Petromoc, the impact on land is significantly mitigated compared to constructing a brand new plant.

For BDF production, only a simplified EIA to be inserted as an addendum to the EIA of the existing facility is required as the production plant will be installed within the existing oil related facility of Petromoc.

EIA is not required for the usage of biofuel by public buses.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>
Based on the analysis of impacts and mitigation measures put in place, there will be no significant negative impact on the environment.

SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

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Comments were sought from relevant government departments, agencies, regional government bodies, lcocal government bodies, etc. through meetings. A stakeholder meeting was also held at the initiative of the Ministry of Science and Technology on 27 November 2008.

E.2. Summary of the comments received:

>>
Comments that have been received are summarized in the following table.

Table 15: Stakeholder comments

Stakeholder	Comments
Ministry of Mines, Resources and Energy	• Highly interested in the Project, Welcome the Project. • Welcome biofuel production project as a business initiative as the government body responsible for energy. Want to approve it as the government. • Government's top priority is tackling food shortage. The next priority is energy

Stakeholder	Comments
	crop. ● Want to support using Jatropha for rural electrification.
Ministry of Environment	● Welcome the investment. Our policy objectives are sustainable development and poverty reduction. Would like the project proceed upon consensus with other ministries. Poverty reduction is a major challenge and welcome the project that contributes to it. Greening, rural electrification and building local schools are important. Want the project to contribute to the society by listening well to the desires of local communities.
Ministry of Agriculture, Agriculture Promotion Center	● Large scale cultivation is under way by private investment. Want to support the project. Bio energy promotion is one of the strategies of the government. However, food shortage and escalating food prices are the top priority. Bioenergy is second priority. ● It is a good idea to mix Jatropha cultivation with coconuts and others. ● Ministry of Agriculture has yet to support the supply chain. Currently looking for a private company to do so. The absence of an off-taker of agricultural products is a problem. Will support it within the project. ● Choosing Gaza region as the plantation site is a good judgment. ● 33,000 tons of BDF is large considering the demand size of Mozambique. Requires further consideration on whether consumption is possible.
Ministry of Agriculture, Gaza regional branch	● Want the Jatropha cultivation where there is no competition with food. Food is the top priority and investor wanting to produce food should always be able to find land. Land owned by community should be used respecting the community. Mixing the Jatropha with food and contracting the cultivation out to the community are good ideas. ● Not well aware of what Jatropha is like.
Ministry of Development and Planning	● Welcome the Project. ● Competition with food exists but co-existence is possible. BDF crops do no require good soil and water, so different categories of land can be used. ● Industrialization is a key in this country. Agro-industry should especially be considered. Wish the Project to contribute to industrialization. ● Welcome the private investment. Jatropha project requires road, telecommunication, water and energy. Development of infrastructure should be considered in the Project. Need to have the community development viewpoint.
Ministry of Science and Technology	● Can coordinate between Japanese company, Petromoc and university. Can support securing of the land. ● Want the Japanese side to conduct human resources development.
UEM (National University)	● Introduction of BDF complies with government strategy. It contributes to regional development.
Investment Agency	● Gaza State is a good place to cultivate energy crop.
Ministry of Transport	● Welcome introduction of BDF. Want clean fuel. The lower the price, the better. Should carefully consider the impact on citizens. ● BDF can also be used for rail.
Governor of Gaza	● Welcome the Project in Gaza. The biggest interest is whether the price of BDF can be contained. The interest in Jatropha in the region is high. ● Food is top priority. Malabane is a suitable place as not much food is being produced there.

Stakeholder	Comments
	• Teaching farmers the cultivation technique is important.
Mabalane County government	• Have high hopes for the Project. Want to contribute to environmental protection and mitigation of pollution. • Mabalane is a good place for Jatropha cultivation. There are lots of vacant land and there is no conflict. Transport and personnel cost can be mitigated due to availability of railway.
Farmers in Chibuto	• Know about BDF. Everybody knows Jatrohpa.
Fabricante de Sabao & Oleos (oil miller and producer of soap)	• Know little about Jatropha. • There are cases where BDF production is halted due to the price hike of vegetable oil. Important to follow the price trend of oil. • Can cooperate in the Project by providing the milling facility.
World Bank	• Support the BDF development as long as it is sustainable and ensures social safeguard. • Mozambique has suitable soil, land, climate and human resources for BDF production. Mozambique can be next Brazil in 10-20 years. Can look at larger region as market. • The biggest supporter of BDF project is the President of Mozambique making the BDF production in Mozambique that much more promising.
JICA	• If developed properly, Mozambique can be a model country in the region in agriculture.

E.3. Report on how due account was taken of any comments received:

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As described above, all comments are in favour of the implementation of the project activity. Concerns and suggestions raised will be taken into account in the process of project implementation.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project involves no ODA or public funding from Parties that are Annex I signatories to the Kyoto Protocol.

Annex 3

BASELINE INFORMATION

Calculation of emission factor of Mozambique grid

The grid emission factor has been calculated following the guideline "Tool to calculate the emission factor for an electricity system".

The following step by step approach has been followed to estimate the grid emission factor.

STEP 1. Identify the relevant electric power system.
STEP 2. Select an operating margin (OM) method.
STEP 3. Calculate the operating margin emission factor according to the selected method.
STEP 4. Identify the cohort of power units to be included in the build margin (BM).
STEP 5. Calculate the build margin emission factor.
STEP 6. Calculate the combined margin (CM) emissions factor.

Step 1: Identify the relevant electric power system:

The relevant electric power system is the Mozambique grid, the only grid in the country.

Step 2: Select an operating margin (OM) method

There are following four options for calculating OM.

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

The simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. Because more than 50% of total grid generation in Mozambique is produced by hydro power which is one of the low-cost/must-run resources, Simple OM cannot be used for the project activity. Due to the lack of available data to calculate either Simple adjusted OM or Dispatch data analysis OM, Average OM is selected for calculating OM for Mozambique grid.

STEP 3. Calculate the operating margin emission factor according to the selected method.

The average OM emission factor is calculated as the 3-year generation-weighted average CO_2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system. The data used are chosen using one of the following methods.

- **Option A:** Based on data on fuel consumption and net electricity generation of each power plant / units
- **Option B:** Based on data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit
- **Option C:** Based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system

Option C is selected. The following assumptions are made.

Item	Value	Unit	Source
Conversion efficiency	20%		assumed
Operation time	8760	hours/year	
Capacity factor	80%		assumed
Natural gas emission factor	15.3	tc/TJ	IPCC
Molecular weight of carbon	3.66667		IPCC
Specific consumption of diesel	0.3	liters/kWh	ANEEL
Specific mass of diesel	0.00084	ton/l	BEN
Diesel calorific value	43	GJ/t	IPCC
Diesel emission factor	0.074	tCO_2/GJ	IPCC

The details of the calculations are as follows.[12]

		2000		2001		2002	
		Power generated (MWh)	CO_2 emission (tCO_2)	Power generated (MWh)	CO_2 emission (tCO_2)	Power generated (MWh)	CO_2 emission (tCO_2)
Hydro	HCB	9,397,700	0	11,583,500	0	12,411,400	0
	EdM	254,567	0	257,788	0	262,576	0
Thermal	Diesel	41,599	33,357	42,210	33,847	33,854	27,146
	Natural Gas	1,500	1,893	2,000	2,525	3,686	4,653
Total Energy Produced		9,697,366	35,250	11,887,499	36,371	12,713,518	31,799
CO_2 emission factor			0.00363502		0.00305962		0.002501
Average		0.0028					

		2003		2004		2005	
		Power generated (MWh)	CO_2 emission (tCO_2)	Power generated (MWh)	CO_2 emission (tCO_2)	Power generated (MWh)	CO_2 emission (tCO_2)
Hydro	HCB	10,626,600	0	11,559,400	0	13,105,022	0
	EdM	243,100	0	108,824	0	158,670	0

[12] Mozambique Biofuel Assessment, World Bank, Page F.10

Thermal	Diesel	33,500	26,862	38,594	30,947	14,000	11,226
	Natural Gas	3,328	4,201	6,752	8,523	7,218	9,111
Total Energy Produced		10,908,531	31,063	11,715,574	39,470	13,286,915	20,337
CO_2 emission factor			0.00284761		0.00336901		0.001531

Based on the above table the OM emission factor as 3-year average between 2000-2005 is **0.0028t CO_2/MWh**

STEP 4. Identify the cohort of power units to be included in the build margin (BM)

The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently has been considered as the representative number of power plants in the build margin. The total of these power plants is larger than the generation of the five most recently built power plants in the grid.

The plants included in the build margin and their generation details are given below.

To be filled in later

STEP 5: Calculate the BM emission factor:

The BM emission factor from the above mentioned data has been estimated as tonnes of CO_2/MWh.

To be filled in later

STEP 6. Calculate the combined margin (CM) emissions factor

The combined margin emission factor has been estimated as a weighted average of the OM and BM.

$$EF_y = w_{OM,y} \cdot EF_{OM,y} + w_{BM,y} \cdot EF_{BM,y}$$

To be filled in later

The combined margin emission factor has been estimated as tonnes of CO_2/MWh of electricity generation.

Calculation of above-ground and below-ground biomass stock for baseline and project scenarios

Above-ground and below-ground biomass stock for baseline and project scenarios are estimated according to IPCC Good Practice Guidance for LULUCF as well as Volume 4 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories using Tier 1 methodology due to the limited availability of data.

Above-ground and below-ground biomass stock in the baseline scenario

In the baseline scenario which is the scenario prior to the start of the project activity, the plantation sites are idle agricultural land occupied by only grass and shrubs. Therefore, the land can be considered grassland for the purpose of estimating biomass stock.

According to the Tier 1 method for estimating biomass accumulation in grassland, it is assumed that no changes take place in living biomass carbon stocks.[13] Therefore, biomass stock at the proposed plantation sites in the baseline scenario is estimated as zero.

Above-ground and below-ground biomass stock in the project scenario at the maturity of the acreage

Jatropha is a perennial crop that grows to be approximately 5 m tall. IPCC Guidelines state that "perennial crops can include trees and shrubs, in combination with herbaceous crops (e.g. agroforestry) or as orchards, vineyards and plantations such as cocoa, coffee, tea, oil palm, coconut, rubber trees, and bananas except where these lands meet the criteria for categorisation as forest land"[14]. As Jatropha is similar to the crops mentioned here, it can be assumed that Jatropha plantations are cropland.

According to IPCC Guidelines, changes in belowground biomass cannot be estimated for cropland because limited data are available.[15] The estimation of changes in aboveground biomass using the Tier 1 or the default method is carried out as follows.

$$\Delta C_B = \left(\Delta C_G - \Delta C_L\right) \qquad \text{Equation 2.7 (IPCC 2006)}$$

Where:

ΔC_B = annual change in carbon stocks in biomass for each land sub-category, considering the total area, tonnes C yr-1

ΔC_G = annual increase in carbon stocks due to biomass growth for each land sub-category, considering the total area, tonnes C yr-1

ΔC_L = annual decrease in carbon stocks due to biomass loss for each land sub-category, considering the total area, tonnes C yr-1

The default or Tier 1 method indicates that above-ground biomass stock is estimated by multiplying the area of perennial woody cropland by a net estimate of biomass accumulation from growth using a default value and subtract losses associated with harvest or gathering or disturbance. [16]

Since the only the seeds, not trees will be harvested during the project activity, the loss of biomass is assumed to be zero.

The increase in biomass stock is calculated as follows.

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[13] 2006 IPCC Guidelines for National Greenhouse Gas Inventories , Vol.4, Chap.6, p.6.6

[14] 2006 IPCC Guidelines for National Greenhouse Gas Inventories , Vol.4, Chap.5, p.5.6

[15] 2006 IPCC Guidelines for National Greenhouse Gas Inventories , Vol.4, Chap.5, p.5.1

[16] 2006 IPCC Guidelines for National Greenhouse Gas Inventories , Vol.4, Chap.5, p.5.7

$$\Delta C_G = A \times G = 29{,}000 \times 2.1 = 60{,}900$$

Where:

A = Area of plantation (hectar)
G = Biomass accumulation rate (tonnes C ha-1 yr-1)

Because the loss of biomass stock is zero, the annual change in carbon stock is equal to its increase. The total carbon removal by sink in CO_2 equivalent is 223,300 tCO_2 per year[17].

As demonstrated in the calculations above, the amount of biomass stock is greater after the project implementation compared to the baseline case.

[17] 60,900*44/12＝223,300

Annex 4

MONITORING INFORMATION

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