CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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Jatropha bio-diesel production and power generation project in Madagascar

A.2. Description of the small-scale project activity:

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Purpose of the project activity;

The project activity includes the production of Jatropha bio-diesel fuel and the consumption of the produced bio-diesel fuel for electricity generation. The project produces bio-diesel from crude Jatropha oil that is extracted from Jatropha seeds. The produced bio-diesel is transported to JIRAMA (Jiro sy Rano Malagasy, Electricity and Water of Madagascar)'s power plants listed in Table 1 and used for electricity generation.

Table 1: JIRAMA's power plants included in the project

	Capacity (kW)	Electricity generation (kWh/yr)
TOAMASINA (fuel oil fired)	7500	38,250,000
TOAMASINA (gas oil fired)	2000	10,200,000
AMBODIATAFANA	20	22,867
ANTANAMBAO	28	62,348
BRICKAVILLE	182	614,205
FOULPOINTE	210	697,223
MAHANORO	201	682,039
MANANARA	282	917,522
MAROANTSETRA	518	1,543,976
MAROLAMBO	69	90,898
SAINTE MARIE	587	2,141,506
SOANIERAN'IVONGO	116	320,515
VAVATENINA	131	413,257
BEFOTAKA	10	12,428
BETROKA	261	685,428
IAKORA	28	31,874
IKALAMAVONY	86	165,923
IKONGO	41	40,934
IVOHIBE	40	67,732
MANANJARY	540	1,991,200
MIDONGY	29	41,472
NOSY VARIKA	56	94,858
RANOHIRA	84	179,486
VANGAINDRANO	190	563,239
VOHIPENO	113	356,423
VONDROZO	29	47,860

ANDILAMENA	235	450,436
ANJOZOROBE	78	131,139
ANOSIBE AN'ALA	97	152,556
FENOARIVO CENTRE	75	114,838
MANAKAMBAHINY	100	157,343
TSIROANOMANDIDY	600	1,826,132

The project promotes mitigation of greenhouse gas emissions through displacing grid electricity generated from electricity distribution systems that would have been supplied by fossil fuel fired generating units.

In the proposed project, local farmers plant Jatropha and the project purchases Jatropha seeds from them. However, the project will provide technical guidance to local farmers on Jatropha plantation because Jatropha cultivation technique has not been fully systematized in Madagascar yet.

Contribution of the project activity to sustainable development of Madagascar

The project will contribute to sustainable development of Madagascar in several ways;

- **Technology transfer**: The technology applied to the project, the trans-esterification technology, is new to Madagascar. The project will include the training of local employees at the bio-diesel production plant. Also, the project includes technology transfer of Jatropha cultivation technique to local farmers.
- **Energy security**: Currently, Madagascar is almost totally dependent on imports for petroleum products and soaring crude oil prices affect the Malagasy economy. Therefore it is necessary for Madagascar to develop renewable energy sources that is stable and unaffected by crude oil prices. Bio-diesel is one of promising energy sources for them because it can be produced in their country and the proposed project can contribute to the development and use of renewable energy.
- **Promotion of MAP**: Madagascar Action Plan (MAP) is a development plan for 2007-2011. It states the commitments, strategies and actions that aims to ignite rapid growth, to lead to the reduction of poverty, and to ensure that the country develops in accordance with the UN Millennium Development Goals. One of strategies written in MAP is to "promote the development and use of alternative energy resources such as bio-fuels that included palm oil, jatropha, soy and sugar cane". The project meets the strategy and it will contribute to achieve their target.
- **Job creation**: The project will hire 50 workers at the bio-diesel plant. Besides, it is expected that about 1000 local farmers will earn additional cash by selling Jatropha seeds to the project.

A.3. Project participants:

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Table 2: Project participants

Name of Party involved	Private and/or public entity(ies) project participants	Kindly indicate if the Party involved wishes to be considered as project participant
Madagascar (host)	JIRO SY RANO MALAGASY (JIRAMA)	No
Japan	Sojitz Corporation	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party(ies):

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Republic of Madagascar

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

>>

Atsinanana region

A.4.1.3. City/Town/Community etc:

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Toamasina

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

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The bio-diesel production plant will be built in the west of Toamasina city. It will be located at a new reclaimed land along Route 2. The plant will be approximately 20,000 m^2.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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Type and category of the project activity

Project types and categories of small-scale CDM project activities are listed in the table in Appendix B of the simplified modalities and procedures for small-scale CDM project activities, hereafter referred to as Appendix B.

The project activity falls under the following type and category;

Type: Type (i) – Renewable energy projects
Category: D. – Electricity generation for a system

Technology applied by the project activity

The core technology of the Project is to produce Fatty Acid Methyl Ester, based on crude Jatropha oil, as an alternative fuel to petroleum diesel. The chemical reaction during the trans-esterification process is shown in Figure 1.

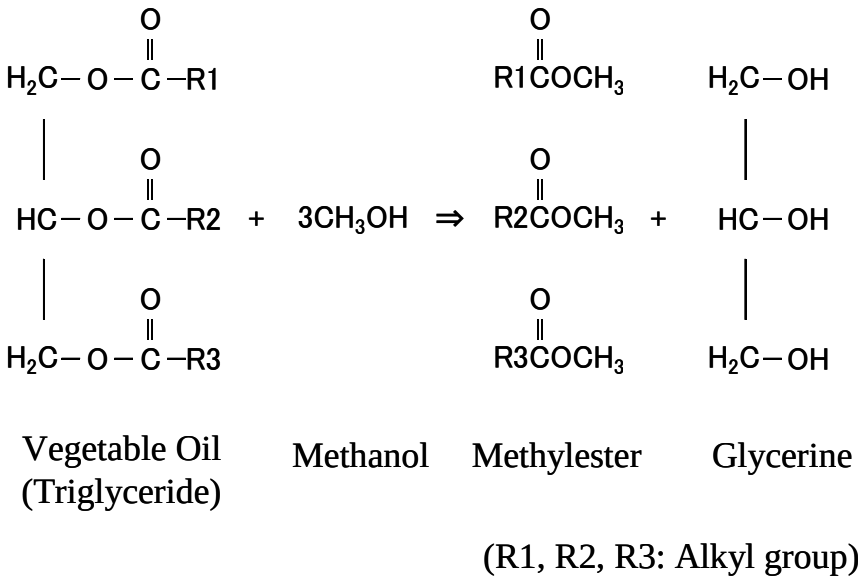

Figure 1: Chemical reaction during the trans-esterification process

The trans-esterification process consists of four principal steps;

(1) Pretreatment
Remove the components, such as free fatty acids and gummy materials, which will be detrimental to subsequent processing steps.

(2) Trans-esterification
The pretreated triglycerides are reacted with methanol to form the raw methyl esters and glycerine. The catalysts used in the trans-esterification process are sodium hydroxide and sodium methylate. There are two basic steps: the reaction process followed by separation of the methyl ester and glycerine. The reaction is pushed closer to completion by using an excess of methanol. Processes are designed to a high level of conversion, and methyl ester purity (>98%).

(3) Methyl ester purification
Remove the excess methanol, catalyst and glycerol carried from the trans-esterification process. Methanol removed is recycled to the trans-esterification process.

(4) Glycerol purification
Remove methanol for recycling to the trans-esterification process. Further impurities, such as catalyst and methyl ester, are carried in the glycerol and removed to produce a higher grade of glycerine.

The process flow is shown in Figure 2.

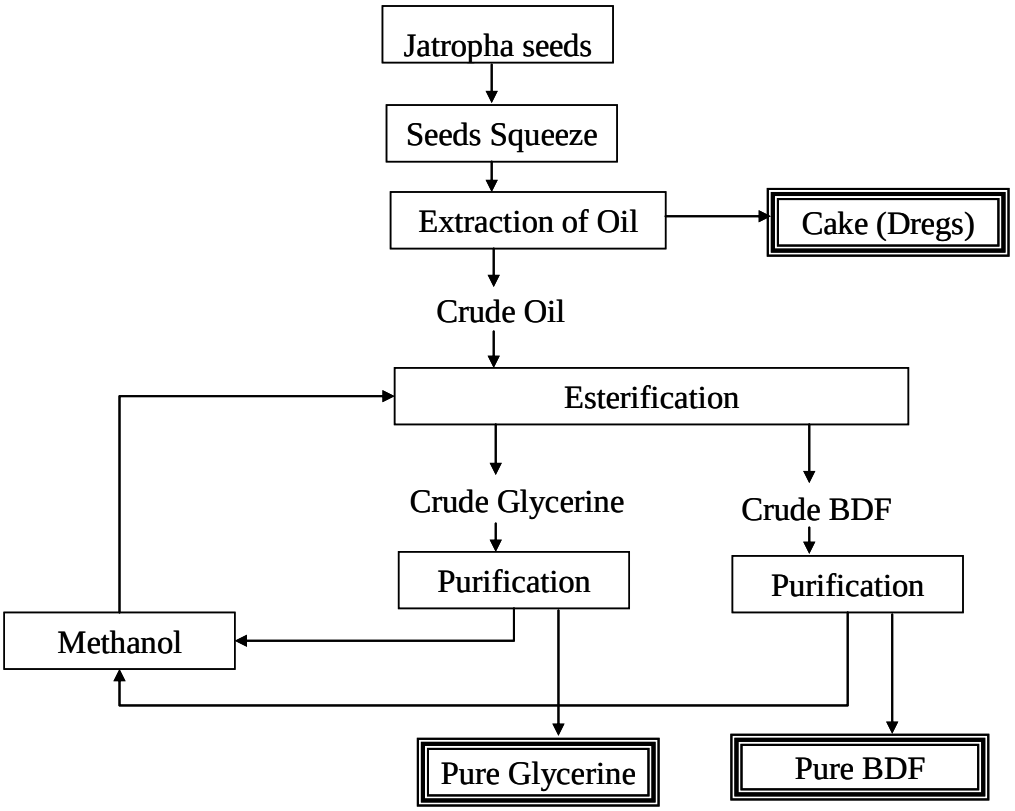

Figure 2: Process flow diagram

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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Table 3 shows the estimated amount of emission reductions over the crediting period.

Table 3: Estimated amount of emissions reduction

Year	Estimation of annual emission reductions in tonnes of CO_2e
1	16,825
2	16,825
3	16,825
4	16,825
5	16,825
6	16,825
7	16,825
8	16,825
9	16,825
10	16,825
Total estimated reductions (tonnes of CO_2e)	168,250
Total number of crediting years	10 years

Annual average of the estimated reductions over the first crediting period (tonnes of CO_2e)	16,825

A.4.4. Public funding of the small-scale project activity:

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No public funding is used in the project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

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As stated in Appendix C of the simplified modalities and procedures for small-scale CDM project activities, which is Annex 7 of EB07 report, a proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

As there is no registered small-scale CDM project activity at the site, the project is not a debundled component of a larger project activity.

SECTION B. Application of a baseline and monitoring methodology

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

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Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories are provided as a part of the Appendix B as mentioned in A.4.2 above. The proposed project activity uses the following approved methodology;

AMS-I.D. - Grid connected renewable electricity generation, Version 13 dated 14th December 2007 (hereafter referred to as AMS-I.D.).

B.2 Justification of the choice of the project category:

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The definitions for small-scale clean development mechanism project activities are stated in Decision -/CMP.2. According to the decision, "Type I project activities shall remain the same, such that renewable energy project activities shall have a maximum output capacity of 15 MW (or an appropriate equivalent)."

According to AMS-I.D., "Renewable energy technologies that supply electricity to a grid fall into category I.D.". The methodology also says "This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.".

The project produces Jatropha bio-diesel, which is biomass-derived fuel. The produced bio-diesel fuel is transported to existing diesel power plants and used for electricity generation. All the power plants included in the project activity are operated by JIRAMA, which is a national water and electricity company in Madagascar, and provide electricity to grids. Total capacity of the power plants in the project is shown in Table 1. The capacity is 14.536MW and it is lower than 15 MW. Therefore, the project activity is a small-scale CDM project activity of Type I and it falls into category I.D.

B.3. Description of the project boundary:

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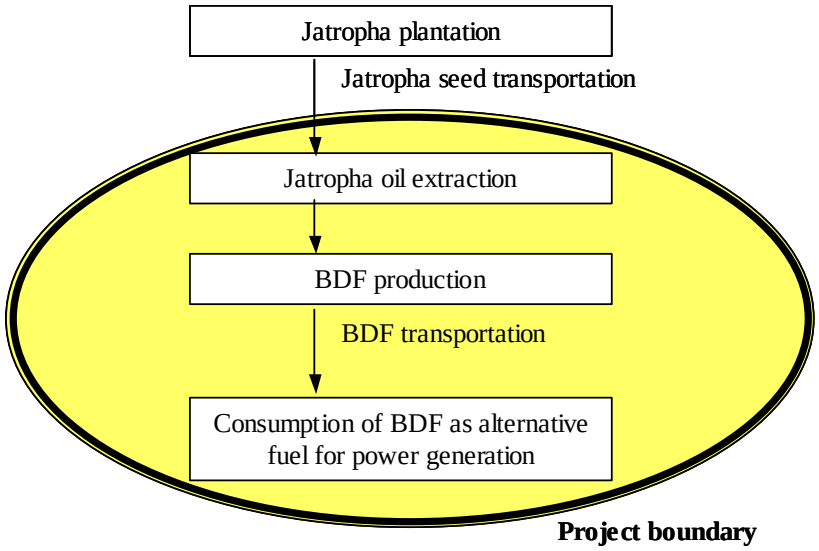
According to AMS-I.D., the project boundary encompasses the physical, geographical site of the renewable generation source. In the project activity, the power plants are to be included in the project boundary.

The project activity includes the production of Jatropha bio-diesel as well as the consumption of bio-diesel at the power plants. Therefore, the bio-diesel production plant should be included in the project boundary as well. At the plant, crude oil is extracted from Jatropha seeds and the Jatropha oil turn into bio-diesel, and hence both activities are included in the project boundary. Furthermore, transportation of bio-diesel to each power plant is a part of the project and it should be included in the project boundary.

The project purchases Jatropha seeds from local farmers, in other words, farmers plant Jatropha, harvest its seed and sell them to the project. Jatropha plantation is not under the control of the project participants, and hence it cannot be included in the project boundary.

Activities included in the project boundary are shown in Figure 3.



CDM – Executive Board

Figure 3: Project boundary

B.4. Description of baseline and its development:

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AMS-I.D. provides two baseline options, as follows;

8. For a system where all generators use exclusively fuel oil and/or diesel fuel, the baseline is the annual kWh generated by the renewable unit times an emission coefficient for a modern diesel generating unit of the relevant capacity operating at optimal load.

9. For all other systems, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/kWh) calculated in a transparent and conservative manner as;

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'.

OR

(b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Madagascar has three interconnected electric systems in Antananarivo, Fianarantsoa and Toamasina and a large number of independent micro grids composed of distributed diesel generators (usually one power plant for a grid) across the country. Regarding the power plants listed in Table 1, Toamasina fuel oil fired power plant and Toamasina fuel oil fired power plant belong to an interconnected electric system in Toamasina, while each of the rest belongs to a different micro grid.

For power plants in Toamasina interconnected electric system, Paragraph 9 is applied to calculate the baseline emissions since the system consists of two thermal power plants and one hydroelectric power plant. An emission coefficient is calculated as the weighted average emissions of the current generation mix.

For other power plants, Paragraph 8 is applied since each micro grid has one power plant with diesel generators. Emission factors for diesel generator systems are provided in Table I.D.1, AMS-I.D, and an appropriate emission factor for each power plant should be chosen to calculate the baseline emissions.

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 small-scale CDM project activity:

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According to Attachment A to Appendix B, additionality of the small-scale project activity is demonstrated by an explanation to show that the project activity would not have occurred anyway due to at least one of the barriers such as (a) investment barrier, (b) technological barrier, (c) barrier due to prevailing practice or (d) other barriers.

A barrier identified in the project activity

Technology of Jatropha plantation;

One of strategies written in MAP is to promote the development and use of alternative energy resources such as bio-fuels that included palm oil, jatropha, soy and sugar cane, and Madagascar has encouraged

growing Jatropha. However Jatropha cultivation technique has not been fully systematized in Madagascar yet. The proposed small-scale CDM project activity will provide technical guidance to local farmers on Jatropha plantation to ensure the stable supply of Jatropha seed. In the absence of the project activity, it is difficult to secure enough Jatropha seeds on a commercial scale and this kind of project cannot be occurred.

Technology of bio-diesel production;
Bio-diesel is produced by the chemical reaction during the trans-esterification process. The project will be the first of its kind in Madagascar and the technology applied to the project activity, the trans-esterification technology, is not available in the country. Therefore a technological barrier is identified for the project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The emission reductions of the project activity are calculated pursuant to AMS-I.D.

Project emissions

No equation is provided to quantify project emissions related to the project activity in AMS-I.D, however project participants shall use the following equation to calculate the project emissions of the project in year y;

$$PE_y = PE_{elec,y} + PE_{fuel,on-site,y} + PE_{t,y} \quad (1)$$

Where:

PE_y	is the project emissions during the year y (tCO_2e)
$PE_{elec,y}$	is the emissions from electricity consumption due to the project activity in year y (tCO_2e)
$PE_{fuel, on-site,y}$	is the emissions due to fuel on-site consumption in year y (tCO_2e)
$PE_{t,y}$	is the emissions from transport of bio-diesel in year y (tCO2e)

Emissions from electricity consumption ($PE_{elec,y}$)

The emissions from electricity consumption in year y shall be estimated from the following equation:

$$PE_{elec,y} = EG_{PJ,FF,y} * CEF_{elec} \quad (2)$$

Where:

$EG_{PJ,FF,y}$	is the amount of electricity consumed from the grid for the project activity (MWh)
CEF_{elec}	is the carbon emission factor for electricity generation in the project activity (tCO_2/MWh)

Emissions from fuel consumption ($PE_{fuel, on-site,y}$)

The emissions from fuel consumption in year y shall be estimated from the following equation:

$$PE_{fuel,on-site,y} = F_{cons,y} * NCV_{c,fuel} * EF_{c,fuel} \quad (3)$$

Where:

$F_{cons,y}$	is the fuel consumption related to the project activity in year y (tonne)
$NCV_{c,fuel}$	is the net caloric value of the fuel (MJ/t)
$EF_{c,fuel}$	is the CO_2 emission factor of the fuel (tCO_2/MJ)

Emissions from increased transport ($PE_{t,y}$)

The project activity substitute fossil fuel based power generation with bio-diesel based power generation and fossil fuel is substituted with bio-diesel of the same calorific value. Since bio-diesel has lower calorific value than fuel oil, gas oil and diesel oil, the amount (in mass and weight) of fuel required for the power generation will be in creased, and hence the number of transport of fuel will be increased in the project activity.

The emissions from increased transport in year y shall be estimated from the following equation:

$$PE_{t,y} = NO_{vehicles,y} * DT_y * VF_{cons} * NCV_{t.fuel} * D_{fuel} * EF_{t.fuel} \quad (4)$$

Where:

$NO_{vehicles,y}$	is the number of additional vehicles for transport
DT_y	is the average distance travelled for additional bio-diesel transport in year y (km)
VF_{cons}	is the vehicle fuel consumption in litres per kilometre (l/km)
$NCV_{t,fuel}$	is the Calorific value of the fuel (MJ/Kg or other unit)
D_{fuel}	is the fuel density (kg/l), if necessary
$EF_{t,fuel}$	is the Emission factor of the fuel (tCO_2/MJ)

Baseline emissions

As stated in AMS-.D., the baseline is calculated as the annual kWh generated by the renewable unit times an appropriate emission coefficient of each electricity system. To calculate the baseline emissions of the project activity, project participants shall use the following equation:

$$BE_y = BE_{T,y} + BE_{m,y} \quad (5)$$

Where:

$BE_{T,y}$	is the baseline emissions from electricity generation displaced by the project activity in Toamasina interconnected electric system in year y (tCO_2e)
$BE_{m,y}$	is the total baseline emissions from electricity generation displaced by the project activity in micro grids in year y (tCO_2e)

Emissions from Toamasina grid ($BE_{T,y}$)

Baseline emissions from electricity generation displaced by the project activity in Toamasina interconnected electric system shall be estimated from the following equation:

$$BE_{T,y} = EG_{T,y} * CEF_T * 10^{-3} \quad (6)$$

Where:

$EG_{T,y}$	is the total amount of electricity generated at power plants in Toamasina grid using bio-diesel fuel in the project activity during the year y (kWh)
CEF_T	is the carbon emission factor for Toamasina grid in the project scenario ($kgCO_2e/kWh$)

As per AMS-I.D., CEF_T is calculated as the weighted average emissions of the current generation mix.

Emissions from micro grids ($BE_{m,y}$)

Baseline emissions from electricity generation displaced by the project activity in Toamasina interconnected electric system shall be estimated from the following equation:

$$BE_{m,y} = \sum_{m} EG_{m,y} * CEF_m * 10^{-3} \quad (7)$$

Where:

$EG_{m,y}$	is the amount of electricity generated at power plant *m* in micro grid using bio-diesel fuel in the project activity during the year y (kWh)
CEF_m	is the carbon emission factor for diesel generating unit of power plant *m* ($kgCO_2e/kWh$)
m	is all power plants in micro grids generating electricity from bio-diesel in the project activity

As per AMS-I.D., each CEF_m is chosen from among emission factors for diesel generator systems for three different levels of load factors given in Table I.D.1

Leakage

Leakage is calculated according to Attachment C to Appendix B, "General guidance on leakage in biomass project activities" hereafter referred to as the leakage guideline.

Emission sources of a project activity shall be identified as per the table given in the leakage guidance. Relevant emission source of the project activity is emissions from biomass generation / cultivation since the biomass type used in the project activity is "Biomass from croplands or grasslands (woody or non-woody)" and the activity in the absence of the project is "the land would be abandoned".

Regarding emissions from the production of the renewable biomass, the leakage guideline identifies potentially significant emission sources, such as;

(a) Emissions from application of fertilizer; and
(b) Project emissions from clearance of lands.

Emissions from application of fertilizer

Emissions from application of fertilizer are calculated as per A/R Methodological tool "Estimation of direct nitrous oxide emission from nitrogen fertilization" (Version 01), which is Annex 16 of EB13 report.

Direct N_2O emissions as a result of nitrogen application are calculated using the following equations;

$$N2O_{direct-N,t} = (F_{SN,t} + F_{ON,t}) * EF_1 * MW_{N2O} * GWP_{N2O} \quad (8)$$

$$F_{SN,t} = \sum_{i}^{I} M_{SFi,t} * NC_{SFi} * (1 - Frac_{GASF}) \quad (9)$$

$$F_{ON,t} = \sum_{j}^{J} M_{OFi,t} * NC_{OFi} * (1 - Frac_{GASM}) \quad (10)$$

Where:

$N2O_{direct-N,t}$	Direct N_2O emission as a result of nitrogen application within the project boundary in year *t* (tCO_2e)
$F_{SN,t}$	Mass of synthetic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_X in year *t* (t-N/yr)
$F_{ON,t}$	Mass of organic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_X in year *t* (t-N/yr)
EF_1	Emission Factor for emissions from N inputs (t-N_2O-N /t-N input)
MW_{N2O}	Ratio of molecular weights of N_2O and N (44/28) (t-N_2O /t-N)
GWP_{N2O}	Global Warming Potential for N_2O (kg-CO_2-e /kg-N_2O) (IPCC default =310, valid for the first commitment period)
$M_{SFi,t}$	Mass of synthetic fertilizer type *i* applied in year *t* (tonne)
NC_{SFi}	Nitrogen content of synthetic fertilizer type *i* applied (g-N/100 g fertilizer)
$Frac_{GASF}$	Fraction that volatilises as NH_3 and NO_X for synthetic fertilizers (dimensionless)
$M_{OFi,t}$	Mass of organic fertilizer type *j* applied in year *t* (tonne)
NC_{OFi}	Nitrogen content of organic fertilizer type *j* applied (g-N/100 g fertilizer)
$Frac_{GASM}$	Fraction that volatilises as NH_3 and NO_X for organic fertilizers (dimensionless)
I	Number of synthetic fertilizer types
J	Number of organic fertilizer types

Emissions from clearance of lands

Project emissions from clearance of lands can be significant in cases where an area is deforested to produce the biomass. In the project case, the land would be abandoned in the absence of the project activity. In that case, the land area can regenerate in the absence of production of the biomass resulting in increasing carbon stocks in carbon pools, but it is suggested to neglect as a simplification according to the leakage guideline. Hence, emissions from clearance of land in the project activity can be neglected.

Emission reductions

To calculate the emission reductions the project participant shall apply the following equation:

$$ER_y = BE_y - PE_y - L_y \quad (11)$$

Where:

ER_y	is the emissions reductions in year y (t CO_2e)
BE_y	is the emissions in the baseline scenario in year y (t CO_2e)
PE_y	is the emissions in the project scenario in year y (t CO_2e)
L_y	is the leakage in year y (t CO_2e)

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

(Copy this table for each data and parameter)

Data / Parameter:	**$NCV_{c,fuel}$**
Data unit:	MJ/t
Description:	Net caloric value of fuel consumed by the project activity
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 2: Energy, 1 Introduction, TABLE 1.2)
Value applied:	40.4
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**$EF_{c,fuel}$**
Data unit:	tCO_2/MJ
Description:	Emission factor for fuel consumed by the project activity
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 2: Energy, 2 Stationary Combustion, TABLE 2.2)
Value applied:	0.0774
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**EF_1**
Data unit:	$t\text{-}N_2O\text{-}N$ /t-N input
Description:	Emission factor for emissions from N inputs
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 4: Agriculture, Forestry and Other Land Use, TABLE 11.1)
Value applied:	0.01
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	MW_{N2O}
Data unit:	t-N_2O /t-N
Description:	Ratio of molecular weights of N_2O and N
Source of data used:	
Value applied:	44/28
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	GWP_{N2O}
Data unit:	kg-CO_2-e /kg-N_2O
Description:	Global Warming Potential (GWP) of N_2O, valid for the relevant commitment period
Source of data used:	Decisions under UNFCCC and the Kyoto Protocol
Value applied:	310
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$Frac_{GASF}$
Data unit:	dimensionless
Description:	The fraction that volatilises as NH_3 and NO_X for synthetic fertilizers
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 4: Agriculture, Forestry and Other Land Use, TABLE 11.3)
Value applied:	0.10
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$Frac_{GASM}$
Data unit:	dimensionless
Description:	The fraction that volatilises as NH_3 and NO_X for organic fertilizers
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 4: Agriculture, Forestry and Other Land Use, TABLE 11.3)
Value applied:	0.20

Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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Project emissions

Emissions from electricity consumption ($PE_{elec,y}$)

Emissions from electricity consumption on-site are calculated using Equation 2. The values used for calculation and the calculation result are shown in Table 4

Table 4: Calculation data of $PE_{elec,y}$

Parameter	Value	Remarks
$EG_{PJ,FF,y}$	3,500 MWh	Estimation by experts
CEF_{elec}	0 tCO_2/MWh	Estimation
$PE_{elec,y}$	0 tCO_2/yr	Calculated using Equation 2

The bio-diesel production plant will be built in Toamasina and it will consume electricity from Toamasina grid. In the project scenario, bio-diesel will substitute fossil fuel at power generating units in Toamasina grid and an emission coefficient of the grid is assumed to be zero.

Emissions from fuel consumption ($PE_{fuel, on-site,y}$)

Emissions from fossil fuel consumption are calculated using Equation 3. The values used for calculation and the calculation result are shown in Table 5

Table 5: Calculation data of $PE_{fuel, on-site,y}$

Parameter	Value	Remarks
$F_{cons,y}$	1,800 tonne	Estimation by experts
$NCV_{c,fuel}$	40.4 MJ/t	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 2: Energy, 1 Introduction, TABLE 1.2)
$EF_{c,fuel}$	0.0774 tCO_2/MJ	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 2: Energy, 2 Stationary Combustion, TABLE 2.2)
$PE_{fuel, on-site,y}$	5,629 tCO_2/yr	Calculated using Equation 3

Emissions from increased transport ($PE_{t,y}$)

It is difficult to confirm transportation distance from the bio-diesel production plant to each power plant, and hence $PE_{t,y}$ cannot be estimated ex-ante. However, it should be monitored and calculated regardless.

Total project emissions (PE_y)
Estimated amount of the project emissions over the crediting period is shown in Table 6.

Table 6: Total project emissions

Year	$PE_{elec,y}$ (tCO_2e)	$PE_{fuel, on\text{-}site,y}$ (tCO_2e)	**PE_y (tCO_2e)**
1	0	5,629	**5,629**
2	0	5,629	**5,629**
3	0	5,629	**5,629**
4	0	5,629	**5,629**
5	0	5,629	**5,629**
6	0	5,629	**5,629**
7	0	5,629	**5,629**
8	0	5,629	**5,629**
9	0	5,629	**5,629**
10	0	5,629	**5,629**
Total for the crediting period	**0**	**56,290**	**56,290**

Baseline emissions

Emissions from Toamasina grid ($BE_{T,y}$)
Emissions from electricity generation displaced by the project activity in Toamasina interconnected electric system are calculated using Equation 6. The values used for calculation and the calculation result are shown in Table 7.

Table 7: Calculation data of $BE_{T,y}$

Parameter	Value	Remarks
$EG_{T,y}$	48,450,000 kWh/yr	Estimation based on the hearings with JIRAMA
CEF_T	0.261 $kgCO_2$/kWh	Calculated in Annex3
$BE_{T,y}$	12,645 tCO_2/yr	Calculated using Equation 6

Emissions from micro grids ($BE_{m,y}$)
An appropriate carbon emission factor for each power plant *m* is adapted from AMS-I.D. by its capacity. The values used for calculation are shown in Table 8.

Table 8: Calculation data of $BE_{m,y}$

m	Capacity (kW)	$EG_{m,y}$ (kWh)	CEF_m ($kgCO_2e$/kWh)
AMBODIATAFANA	20	22,867	1.9
ANTANAMBAO	28	62,348	1.9

BRICKAVILLE	182	614,205	0.9
FOULPOINTE	210	697,223	0.8
MAHANORO	201	682,039	0.8
MANANARA	282	917,522	0.8
MAROANTSETRA	518	1,543,976	0.8
MAROLAMBO	69	90,898	1.3
SAINTE MARIE	587	2,141,506	0.8
SOANIERAN'IVONGO	116	320,515	1.3
VAVATENINA	131	413,257	1.3
BEFOTAKA	10	12,428	2.4
BETROKA	261	685,428	0.8
IAKORA	28	31,874	1.9
IKALAMAVONY	86	165,923	1.3
IKONGO	41	40,934	1.3
IVOHIBE	40	67,732	1.3
MANANJARY	540	1,991,200	0.8
MIDONGY	29	41,472	1.9
NOSY VARIKA	56	94,858	1.3
RANOHIRA	84	179,486	1.3
VANGAINDRANO	190	563,239	0.9
VOHIPENO	113	356,423	1.3
VONDROZO	29	47,860	1.9
ANDILAMENA	235	450,436	0.8
ANJOZOROBE	78	131,139	1.3
ANOSIBE AN'ALA	97	152,556	1.3
FENOARIVO CENTRE	75	114,838	1.3
MANAKAMBAHINY	100	157,343	1.3
TSIROANOMANDIDY	600	1,826,132	0.8

Using Equation 7, $BE_{m,y}$ is calculated to be 13,201 tCO_2 per year .

Total baseline emissions (BE_y)

Estimated amount of the baseline emissions over the crediting period is shown in Table 9.

Table 9: Total baseline emissions

Year	$BE_{T,y}$ (tCO_2e)	$BE_{m,y}$ (tCO_2e)	**BE_y (tCO_2e)**
1	12,645	13,201	**25,846**
2	12,645	13,201	**25,846**
3	12,645	13,201	**25,846**
4	12,645	13,201	**25,846**
5	12,645	13,201	**25,846**
6	12,645	13,201	**25,846**
7	12,645	13,201	**25,846**
8	12,645	13,201	**25,846**

9	12,645	13,201	**25,846**
10	12,645	13,201	**25,846**
Total for the crediting period	**126,450**	**132,010**	**258,460**

Leakage

Emissions from application of fertilizer

No reliable country data regarding nitrogen content of fertilizer per unit is found in Madagascar. Therefore, data of nitrogen content of fertilizer applied per hectare is used for ex-ante calculation.

When the data is adopted, Equation 9 and Equation 10 are condensed as follows;

$$F_{SN,t} = \sum_{i}^{I} N_{SN,i,t} * A * (1 - Frac_{GASF}) \quad (9')$$

$$F_{ON,t} = \sum_{j}^{J} N_{ON,j,t} * A * (1 - Frac_{GASM}) \quad (10')$$

Where:

$N_{SN,t}$	Nitrogen content of synthetic fertilizer applied per hectare (t-N/yr/ha)
$N_{ON,t}$	Nitrogen content of organic fertilizer applied per hectare (t-N/yr/ha)
A	Area of Jatropha plantation, which fertilizer is applied (ha)

The values used for calculation and the calculation result are shown in Table 10.

Table 10: Calculation data of $N2O_{direct-N,t}$

Parameter	Value	Remarks
EF_1	0.01 t-N_2O-N /t-N input	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 4: Agriculture, Forestry and Other Land Use, TABLE 11.1)
MW_{N2O}	44/28	
GWP_{N2O}	310	Decisions under UNFCCC and the Kyoto Protocol
$N_{SN,t}$	0.0375 t-N/yr/ha	Philippines Forest Corp.
A	20,626 ha	Estimation by experts
$Frac_{GASF}$	0.10	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 4: Agriculture, Forestry and Other Land Use, TABLE 11.3)
$N_{ON,t}$	0 t-N/yr/ha	Philippines Forest Corp.
$Frac_{GASM}$	0.20	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Volume 4: Agriculture, Forestry and Other Land Use, TABLE 11.3)
$N2O_{direct-N,t}$	3,392 tCO_2/yr	Calculated using Equation 8

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

>>

Table 11 shows the ex-ante estimation of emission reduction for the crediting period.

Table 11: Total estimated emission reductions

Years	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	**Estimation of overall emission reductions (tCO_2e)**
Year 1	5,629	25,846	3,392	**16,825**
Year 2	5,629	25,846	3,392	**16,825**
Year 3	5,629	25,846	3,392	**16,825**
Year 4	5,629	25,846	3,392	**16,825**
Year 5	5,629	25,846	3,392	**16,825**
Year 6	5,629	25,846	3,392	**16,825**
Year 7	5,629	25,846	3,392	**16,825**
Year 8	5,629	25,846	3,392	**16,825**
Year 9	5,629	25,846	3,392	**16,825**
Year 10	5,629	25,846	3,392	**16,825**
Total (tonnes of CO_2e)	**56,290**	**258,460**	**33,920**	**168,250**

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

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Data / Parameter:	**$EG_{PJ,FF,y}$**
Data unit:	MWh
Description:	Amount of electricity consumed from the grid as a result of the project activity
Source of data to be used:	Electricity meter
Value of data	
Description of measurement methods and procedures to be applied:	
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. The readings will be double checked by the electricity distribution company.
Any comment:	To be monitored continuously

Data / Parameter:	**CEF_{elec}**

Data unit:	tCO_2/MWh
Description:	Emission factor for electricity consumption in the project activity
Source of data to be used:	Official utility documents
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	Calculated in a transparent and conservative manner at start of crediting period.
Any comment:	To be monitored annually

Data / Parameter:	$\mathbf{F_{cons,y}}$
Data unit:	tonne
Description:	Fuel consumption related to the project activity in year *y*.
Source of data to be used:	Purchase invoices and/or metering.
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	The amount of fuel will be derived from the paid fuel invoices (administrative obligation).
Any comment:	To be monitored annually

Data / Parameter:	$\mathbf{NO_{vehicles,y}}$
Data unit:	number
Description:	Number of additional vehicles for transport compared to baseline per year
Source of data to be used:	Record of a transportation company
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	Monitoring frequency is annually

Data / Parameter:	$\mathbf{DT_y}$
Data unit:	km
Description:	Average distance travelled for additional bio-diesel transport
Source of data to be used:	Expert estimate based on the record of a transportation company

Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	Monitoring frequency is annually

Data / Parameter:	**VF_{cons}**
Data unit:	l/km
Description:	Vehicle fuel consumption in litres per kilometre
Source of data to be used:	Fuel consumption record of a transportation company
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	Monitoring frequency is annually

Data / Parameter:	**$NCV_{t,fuel}$**
Data unit:	MJ/Kg or other unit
Description:	Net caloric value of transport fuel
Source of data to be used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	To be checked annually

Data / Parameter:	**D_{fuel}**
Data unit:	kg/l
Description:	Density of fuel
Source of data to be used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value of data	
Description of measurement methods and procedures to be applied:	

QA/QC procedures to be applied:	
Any comment:	To be checked ex-ante Not necessary if $NCV_{t,fuel}$ is demonstrated on a per litre basis

Data / Parameter:	**$EF_{t,fuel}$**
Data unit:	tCO_2/MJ
Description:	Emission factor of the transport fuel
Source of data to be used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	To be checked annually

Data / Parameter:	**$EG_{T,y}$**
Data unit:	kWh
Description:	Total amount of electricity generated at power plants in Toamasina grid using bio-diesel fuel in the project activity during the year y
Source of data to be used:	Electricity production statistics of JIRAMA
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	To be monitored continuously, aggregated annually

Data / Parameter:	**CEF_T**
Data unit:	$kgCO_2e/kWh$
Description:	Emission factor of Toamasina grid in the project scenario
Source of data to be used:	Calculation based on JIRAMA's electricity production statistics
Value of data	
Description of measurement methods and procedures to be applied:	Calculated as the weighted average emissions of the current generation mix, as per AMS-I.D.
QA/QC procedures to be applied:	
Any comment:	To be calculated annually

Data / Parameter:	**$EG_{m,y}$**
Data unit:	kWh
Description:	Amount of electricity generated at power plant *m* in micro grid using bio-diesel fuel in the project activity during the year y
Source of data to be used:	Electricity production statistics of JIRAMA
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	To be monitored continuously, aggregated annually

Data / Parameter:	**CEF_m**
Data unit:	$kgCO_2e/kWh$
Description:	Emission factor for diesel generating unit of power plant *m*
Source of data to be used:	AMS-I.D. (adapted from Table I.D.1)
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	To be checked annually

Data / Parameter:	**$M_{SFi,t}$**
Data unit:	tonne
Description:	Mass of synthetic fertilizer type *i* applied in year *t*
Source of data to be used:	Record of synthetic fertilizer purchased and used
Value of data	
Description of measurement methods and procedures to be applied:	Keep record of quantities purchased and used
QA/QC procedures to be applied:	Cross check with synthetic fertilizer purchased and quantity used and total area applied at project level.
Any comment:	Annually

Data / Parameter:	**$M_{OFi,}$**
Data unit:	tonne
Description:	Mass of organic fertilizer type *j* applied in year *t*

Source of data to be used:	Record of organic fertilizer purchased and/or used
Value of data	
Description of measurement methods and procedures to be applied:	Keep record of quantities purchased and/or used
QA/QC procedures to be applied:	Cross check with organic fertilizer purchased and quantity used and total area applied at project level.
Any comment:	Annually

Data / Parameter:	**NC_{SFi}**
Data unit:	g-N/100 g fertilizer
Description:	Nitrogen content of synthetic fertilizer type *i* applied
Source of data to be used:	Producers of synthetic fertilizer purchased and used
Value of data	
Description of measurement methods and procedures to be applied:	Keep record of nitrogen content from producers
QA/QC procedures to be applied:	
Any comment:	If producers do not provide data of nitrogen content, the nitrogen content should be determined by qualified lab. Before the project start

Data / Parameter:	**NC_{OFi}**
Data unit:	g-N/100 g fertilizer
Description:	Nitrogen content of organic fertilizer type *j* applied
Source of data to be used:	Organic fertilizer manufacturer, or determination in lab
Value of data	
Description of measurement methods and procedures to be applied:	Standard lab procedures
QA/QC procedures to be applied:	
Any comment:	Before the project start

Data / Parameter:	**Volume of bio-diesel input**
Data unit:	tonne
Description:	Amount of bio-diesel input for power generation
Source of data to be used:	Electricity production statistics of JIRAMA
Value of data	

Description of measurement methods and procedures to be applied:	Flow meter
QA/QC procedures to be applied:	
Any comment:	To be monitored continuously, aggregated annually.

Data / Parameter:	**Specific fuel consumption of bio-diesel**
Data unit:	kg/kWh
Description:	Fuel consumption per unit of electricity generated
Source of data to be used:	Determination in lab
Value of data	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	Standard lab procedures
Any comment:	Ex-ante

B.7.2 Description of the monitoring plan:

>>

The project boundary physically includes the bio-diesel production plant and power plants where bio-diesel is used for electricity generation. The required data regarding bio-diesel plant is collected by operators and reported to a project manager. The required data regarding power generation is collected by workers of JIRAMA's power plants and reported to a manager of JIRAMA in Antananarivo then sent to a project manager. The manager computerizes the data and stores it to present to a DOE.

Monitoring plan should meet the following conditions as per AMS-I.D.;

13. *Monitoring shall consist of metering the electricity generated by the renewable technology.*
14. *For projects where only biomass or biomass and fossil fuel are used the amount of biomass and fossil fuel input shall be monitored.*
15. *For projects consuming biomass a specific fuel consumption of each type of fuel (biomass or fossil) to be used should be specified ex-ante. The consumption of each type of fuel shall be monitored.*
16. *If fossil fuel is used the electricity generation metered should be adjusted to deduct electricity generation from fossil fuels using the specific fuel consumption and the quantity of fossil fuel consumed.*
17. *If more than one type of biomass fuel is consumed each shall be monitored separately.*
18. *The amount of electricity generated using biomass fuels calculated as per paragraph 16 shall be compared with the amount of electricity generated calculated using specific fuel consumption and amount of each type of biomass fuel used. The lower of the two values should be used to calculate emission reductions.*

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

>>

Date of completion; 31/01/2008

Name of the responsible entity determining the baseline;

Sojitz Research Institute, Ltd.
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E-mail: nishinomiya.akiko@sea.sojitz.com

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:

>>

xx/xx/2011

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

>>

25 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:

>>

N.A.

C.2.1.2. Length of the first crediting period:

>>

N.A.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

xx/xx/2014

C.2.2.2. Length:

>>
10 years

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>
According to National Office for Environment, which is in charge of EIA in Madagascar, the project activity is required to implement EIA on Jatropha plantation and bio-diesel production, even though Jatropha is cultivated by local farmers not by the project participants. EIA on power plants should have been done by JIRAMA and it is not required for the project.

The following environmental impacts are expected from the proposed project activity;

- impact on water quality from effluent discharged from the bio-diesel plant
- impact of noise,
- impact of vibration,
- impact on soil

More detailed information of environmental impact of the project activity will be identified in EIA.

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:

>>
The project activity will be designed in consideration of environmental impact and mitigation measures will be proposed in EIA when the project activity does not meet any relevant environmental standards in Madagascar.

SECTION E. Stakeholders' comments

>>

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

>>
Comments were received through the meetings with stakeholders. The following stakeholders were identified for the project activity;

- Ministry of Energy
- Ministry of Environment, water and forest
- BAMEX
- ATSINANANA region office
- DIREF (Direction Inter-Régionale des Eaux et Forêts, Inter-regional Direction of Water and Forests) in Toamasina

E.2.	Summary of the comments received:

>>

Ministry of Energy;

- is a department managing energy projects and providing relevant information.
- is interested in the project activity in terms of reducing oil import and thinks the project is beneficial.
- acknowledges that they have to achieve the target of growing Jatropha by 2011 because it is written in MAP to promote the development and use of alternative energy resources such as bio-fuel that included Jatropha. Hence Ministry of Energy, as well as Madagascar, will support the project.

Ministry of Environment, water and forest, Minister;

- expects the project contributing to the development of Madagascar in terms of forest protection and revitalization of local community, and the Ministry will support the project.
- will contact relevant organizations to assist the project as soon as technical information is submitted.
- regards the project is different from other project ideas submitted to them because it plans to consume produced bio-diesel within the country.

BAMEX;

- is an organization which support USAID program activities including Jatropha projects
- can provide information regarding field of Jatropha and its value chain to support the development of the project.

ATSINANANA region office, General Secretary;

- welcomes the project since it will be a big opportunity to ATSINANANA region.
- is not concerned about land competition between the project and Oji paper's A/R CDM project because the project is tied to Oji paper project.
- has received other Jatropha project ideas in the region however none of them has been implemented before.

DIREF in Toamasina;

- will support the project because the proposed project seems helpful for Madagascar in terms of development.
- suggests the project developer that mutual understanding with local people is important to implement the project.

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

>>

No negative comments have been received and it is not required to modify the proposed project.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Sojitz Research Institute, Ltd.
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Represented by:	
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Salutation:	
Last Name:	
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First Name:	
Department:	
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Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is used in the project activity.

Annex 3

BASELINE INFORMATION

Calculation of CEF_T

Type of fuel	Electricity Generation (kWh)	Fuel Consumption (liters)	Density (g/ml)	Fuel Consumption (g)	Fuel Consumption (Gg)	Net Calorific Value (TJ/Gg)
Hydropower	41,469,800.00					
Diesel oil	19,725,880.00	5,708,030	0.88	5,023,066,400	5.02	43.0
Total	61,195,680.00					

	2006 IPCC Guidelines				
Type of fuel	heat value (TJ)	CO2 Emission Factor (kgCO2/TJ)	carbon oxidation factor	CO2 Emissions (kgCO2)	CO2 Emission Factor (kgCO2/kWh)
Hydropower					
Diesel oil	215.86	74,100	1.00	15,995,226	
Total				15,995,226	**0.261**

Annex 4

MONITORING INFORMATION

Please refer to Section D.

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