Monitoring Report

CARBON OFFSET UNIT (CoU) PROJECT

Title: Tumakuru Biodiesel Production From Waste Oil, Fat And Biomass

UCR Project ID: 232

Version 1.0

MR No: 01

Date of MR: 10/03/2023

First CoU Issuance Period: 09 Years, 0 Months

Crediting Period: 01/01/2014 to 31/12/2022

Monitoring Period: 01/01/2014 to 31/12/2022

Monitoring Report (MR)
CARBON OFFSET UNIT (CoU) PROJECT

Monitoring Report	
Title of the project activity	Tumakuru Biodiesel Production From Waste Oil, Fat And Biomass
UCR Project Registration Number	232
Version	1
Completion date of the MR	10/03/2023
Monitoring period number and duration of this monitoring period	Monitoring Period Number: 1 Duration of this monitoring Period: (first and last days included (01/01/2014 to 31/12/2022)
Project participants	Project Proponent: Eco Green Fuels Pvt Ltd (EGFPL), Tumakuru, Karnataka Aggregator: Progressive Management Consultants
Host Party	India
Applied methodologies and standardized baselines	**CDM UNFCCC Methodology** Large-scale Consolidated Methodology ACM 0017: Production of biofuel, Version 04.0
Sectoral scopes	Sectoral Scope: (1) Energy industries (renewable / non renewable sources), (5) Chemical industries and (7) Transport.
Estimated amount of GHG emission reductions for this monitoring period per year	2014: 796 CoUs (796 tCO2)
	2015:1197 CoUs (1197 tCO2)
	2016: 1233 CoUs (1233 tCO2)
	2017: 2291 CoUs (2291 tCO2)
	2018: 2540 CoUs (2540 tCO2)
	2019: 1837 CoUs (1837 tCO2)
	2020: 307 CoUs (307 tCO2)
	2021: 1450 CoUs (1450 tCO2)
	2022: 470 CoUs (470 tCO2)
Total Emission Reductions in 1st crediting period	**12121 CoUs (12121 tCO_{2eq})**

SECTION A. Description of project activity

A.1. Purpose and general description of project activity >>

a) Purpose of the project activity and the measures taken for GHG emission reductions >>

The project **Tumakuru Biodiesel Production From Waste Oil, Fat And Biomass** is located at Survey No: 252, Road No. 1, 2nd Phase, Vasanthanaraspura Industrial Area, District: Tumakuru, State: Karnataka, Pin Code: 572128, Country: India.

The details of the registered project are as follows:

Purpose of the project activity:

Eco Green Fuels Pvt Ltd (EGFPL) is the project proponent (PP) for the project activity and specializes in manufacturing biodiesel using used cooking oil (UCO), waste animal fats and other biowastes (biomass) which are locally sourced to prepare biodiesel via a process called transesterification. The project activity is a biofuel production plant – which is the plant where feedstock (e.g. oil, waste oil/fat sugar, starch) is processed to biofuel.

Biodiesel, a Fatty Acid Methyl Esters (FAME) mixture, is a feasible biofuel to, at least, partially replace diesel fuel in the transport sector and stationary installations. Biodiesel is considered a renewable fuel and reduces carbon emissions when compared to conventional diesel The biodiesel production process in the project activity consists of the homogeneously catalyzed transesterification of UCO with methanol assisted by sodium or potassium hydroxide, as catalyst precursor. The alcohol used for esterification is methanol from fossil fuel origin. Volumes of biodiesel produced with alcohols other than methanol (for example, ethanol) are not included in the quantity of biodiesel for which emission reductions are claimed in this project activity.

The project activity was commissioned in 2011 and involves the construction and operation of a biofuel production plant for producing (blended) biofuel that is used as fuel in existing stationary installations (e.g. diesel generators) and in vehicles within India. The project activity is hence a renewable energy project activity that displaces more-GHG-intensive fossil fuel for combustion in vehicles and stationary installations. The UCO's chemical properties make it suitable for both

renewable diesel and biodiesel production. .

b) Brief description of the installed technology and equipment>>

EGFPL has indigenously designed and developed this biodiesel facility to suit various requirements which are designed to handle low to high free fatty acids (FFA) feedstocks. EGFPL produces international standard biodiesel with an average density of 0.866 kg/l using their **"Greenergiser- Biodiesel Processor" ™** range of biodiesel processors which has the capacity to produce upwards of five tons per day (5 TPD) of biodiesel.

The biodiesel is manufactured from biogenic sources, which means that the oils and/or fats originate from either vegetable or animal biomass, but not from mineral (fossil) sources. The gross calorific value of the biodiesel produced is 9605cal/g which is within the limits of the Indian regulation (BIS range between 9400 - 9800 cal/g). The by-product, glycerol, is sold to local cosmetic/brown soap industries in the surrounding area. EGFPL does not incinerate glycerol at the project activity site.

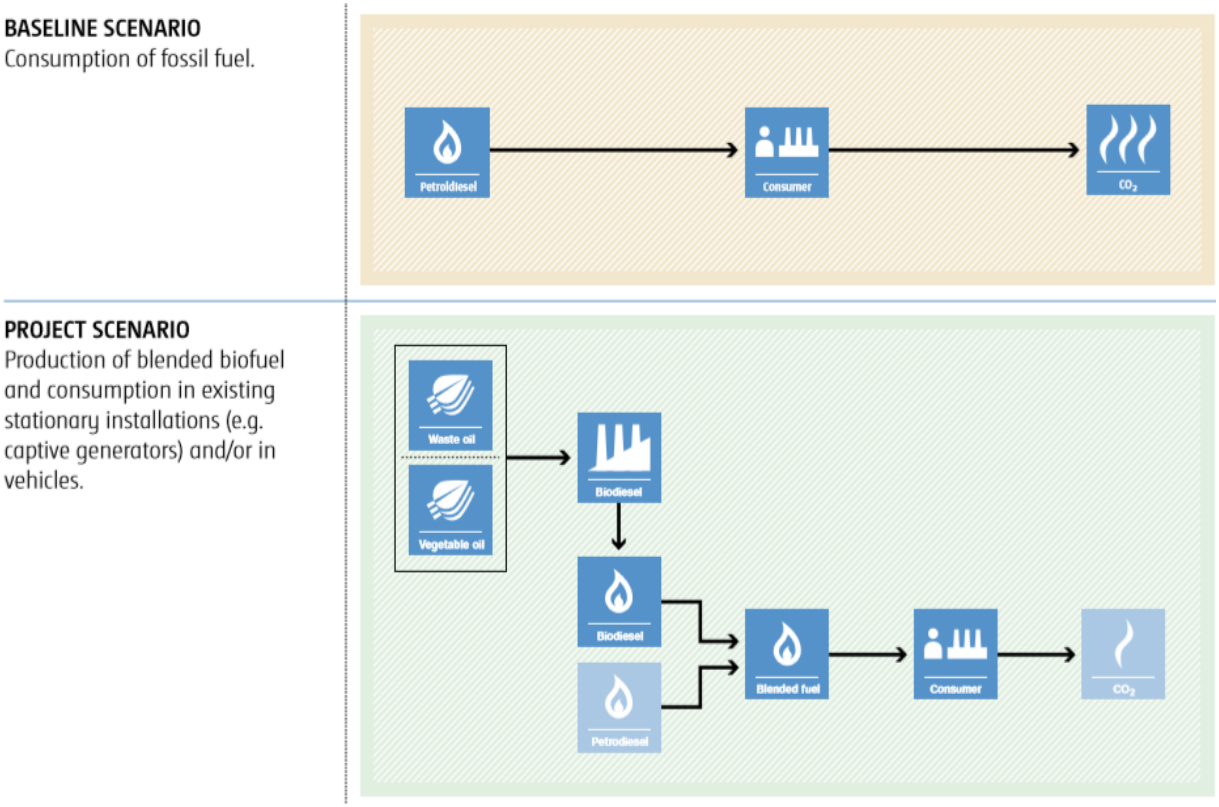
c) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.)>>

UCR Project ID: _232_
Start Date of Crediting Period: 01/01/2014
Project Commissioned Date: 2011
This is the first monitoring report for the first crediting period for the period 01/01/2014 to 31/12/2022

d) Total GHG emission reductions achieved or net anthropogenic GHG removals by sinks achieved in this monitoring period>>

The total GHG emission reductions achieved in this monitoring period is as follows:

Summary of the Project Activity and ERs Generated for the Monitoring Period	
Start date of this Monitoring Period	01/01/2014
Carbon credits claimed up to	31/12/2022
Total ERs generated (tCO_{2eq})	12121 tCO_{2eq}



The approved baseline methodology has been referred from the indicative simplified baseline and monitoring methodologies for the selected large scale UNFCCC CDM project activity in categories whose mitigation action involves:

- Renewable energy and
- Displacement of more-GHG-intensive fossil fuel for combustion in vehicles and/or stationary installations.

A.2. Location of project activity>>

Country: India
Location: Survey No: 252, Road No. 1, 2nd Phase, Vasanthanaraspura Industrial Area,
District: Tumakuru
State: Karnataka
Pin Code: 572128
Latitude: 13° 30' 27.612" N
Longitude: 77° 1' 30.324" E

A.3. Parties and project participants >>

Project activity does not involve any public funding from any Annex I Party, which leads to the diversion of official development assistance to the PP. The technology adopted by the PP is an independently developed, using in house R&D technology developed by EGFPL without international technology transfer or parties.

Party (Host)	Participants
India	Project Owner: Eco Green Fuels Pvt Ltd (EGFPL), Tumakuru, Karnataka Aggregator: Progressive Management Consultants Email: info@progressive-iso.com

A.4. References to methodologies and standardized baselines >>

SECTORAL SCOPE - 01 Energy industries (Renewable/Non-renewable sources)
- 05 Chemical industries
- 07 Transport.

TYPE I - **Renewable Energy Projects**

CATEGORY- ***ACM 0017: Large-scale Consolidated Methodology***
Production of biofuel, Version 04.0
This methodology comprises project activities involving production of biofuel that is used as fuel in existing stationary installations (e.g. diesel generators) and/or in vehicles.

APPLICABILITY- The methodology is applicable to project activities that reduce emissions through the production of blended biofuels to be used in existing stationary installations and/or in vehicles. The biofuel is produced from one or a combination of the following feedstock:
(a) Waste oil/fat;
(b) Seeds or crops that are cultivated in dedicated plantations;
(c) Biomass residues (e.g. agricultural residues, wood residues, organic wastes).

A.5. Crediting period of project activity >>

The project activity was commissioned on **2011**
Monitoring State date: 01/01/2014
Length of the crediting Period corresponding to this monitoring period: 09 years – 0 months
First CoU Crediting Period: 09 years, 0 months
Monitoring Date: 01/01/2014 to 31/12/2022

A.6. Contact information of responsible persons/entities for MR >>

Progressive Management Consultants
Email: info@progressive-iso.com
UCR Seller #110736904

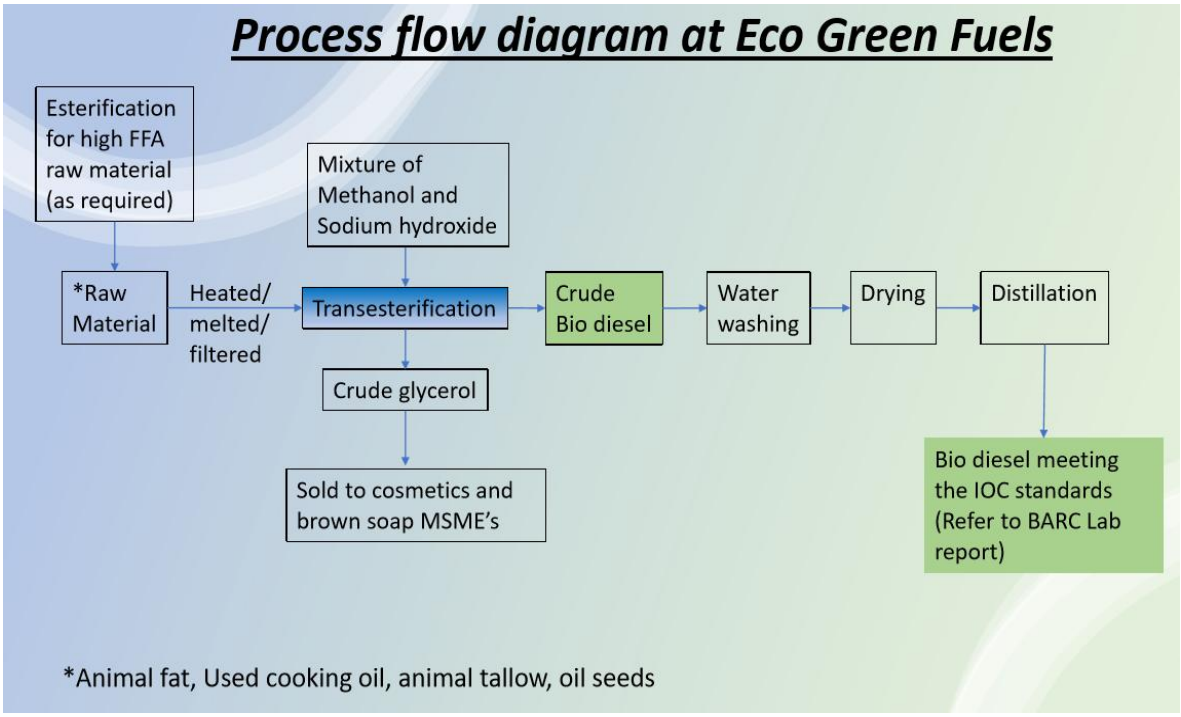
SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity >>

a) Provide information on the implementation status of the project activity during this monitoring period in accordance with UCR PCN>>

EGFPL has indigenously designed and developed this biodiesel facility in 2011, to suit various requirements of the market and is able to handle low to high ranges of free fatty acids (FFA) feedstocks. Production officially commenced in 2014. The basic process is based on a process called transesterification in which low FFA containing triglycerides, are converted to fatty acid methyl ester. This process also converts UCO to UCO Methyl Ester usually called as UCOME which is a second-generation biofuel.

b) For the description of the installed technology(ies), technical process and equipment, include diagrams, where appropriate>>



EGFPL has indigenously designed and developed this biodiesel facility to suit various requirements of the market and is able to handle low to high ranges of free fatty acids (FFA) feedstocks. The basic process is based on a process called transesterification in which low FFA containing triglycerides, are converted to fatty acid methyl ester. This process also converts UCO to UCO Methyl Ester usually called as UCOME which is a second-generation biofuel. The second generation biodiesel includes non-edible vegetable oils, waste cooking oils as well as animal fats. These are considered as promising substitute for traditional edible food crops as they neither compete with food crops nor lead to land-clearing. When fatty acids like animal fats are used it is called FAME i.e. fatty acid methyl esters, which are a type of fatty acid ester that are derived by transesterification of fats with methanol. The molecules in biodiesel are primarily FAME, are usually obtained from vegetable oils by transesterification.

Distillation Unit

When oil high in acids are used, they need to be converted to low FFA (triglycerides) using esterification process and then run through the transesterification process to reduce the same to methyl ester. 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 method, "esterification" is used to denote both esterification and transesterification for simplicity.

Reactor Unit

Methanol Storage

Methanol Cooling Unit

Bleaching Unit

Processing Unit

Processing Unit

Cooling Unit

Biodiesel is made up of monoalkyl esters of long-chain fatty acids that are made from oil with the help of an acid, base, or enzyme catalyst. The primary feed stock can be from food sources including used cooking oil, as well as nonedible sources such as jatropha, algae, and rubber seeds. Animal fats are generally formed of a mixture of triglycerides, proteins, water, and diverse minerals. Animal byproducts are created in large quantities as part of the meat and poultry production cycles. After being rendered, edible resources are processed in a range of food and feed-related enterprises.

Bioethanol and biodiesel in India can be produced from various sources. Depending on the raw material, a biofuel is called 1G, 2G and 3G, where 'G' stands for 'generation'. The source of 1G – the first generation of biofuels – include edible sources like molasses, sugar-containing materials like sugarcane, sugar beet and sorghum, starch-containing materials like corn, cassava and rotten potatoes, and edible oil seeds. 2G biofuels (such as the project activity) use non-edible sources like non-edible oilseeds (e.g. *Jatropha curcas*), used cooking oil (UCO), agriculture residue such as rice straw, cotton stalk, corn cobs, saw dust, bagasse, etc. 3G biofuels are drawn from industrial waste, municipal solid waste, etc. 2G and 3G biofuels are recognised as being more advanced.

Raw materials like animal fat, UCO, animal tallow, oil seeds are used in this reactor to produce bio diesel. The raw materials are heated and melted, and an initial filtration is done as required. When oil high in acids are used, they need to be converted to Low FFA (Triglycerides) using esterification process and then run the transesterification process to reduce to methyl ester. Melted and filtered raw material is pumped into the bio diesel reactor. 15% methanol and 1% Sodium Hydroxide (weight of the raw material pumped) is added in a chemical mixing tank. Methanol and Sodium Hydroxide is left to react in the chemical tank for 15 – 20 minutes which will produce sodium methoxide solution. When the reaction temperature reaches about 60^{o}C, sodium methoxide is sent to the bio diesel reactor containing the raw material (heated, melted and filtered Animal fat, Used cooking oil, animal tallow, oil seeds) and stirred for about 120 – 150 minutes. On completion of the reaction time bio diesel and glycerol are produced. This mixture is sent to the glycerol tank for settling for about 10 hours.

Glycerol settles in the selling tank and bio diesel is sent to wash. Aerators are used in the washing tank and this process takes about 3 hours. Biodiesel is further heated above 100 ^{o}C to remove any moisture and refined to meet the IOC standards. The samples are tested for density and other parameters. If it does not meet the required standards, then the necessary steps are run once again like biodiesel/glycerol separation, ester washing, ester drying. Bio diesel meeting the standard is sent to the cooling unit.

Methanol is recovered from crude glycerol (by product) produced and is sold to MSME's dealing with cosmetics and brown soap manufacturing. Recovered Methanol is used again as input to the plant. Bio diesel is washed to neutralized to remove any residual catalyst and soaps formed during the esterification and remove residual free glycerol and methanol. Ester drying helps with meeting the stringent limits of removing water present in the final bio diesel product. The final product is tested for 860 – 900 kg/m^{3}.

Biodiesel Specification	Value
Density @15 ^{o}C	875 kg/m^3 0.875 kg/l
Flashpoint	138 ^{0}C
Sulphur Content	0.09%
Carbon Residue % by mass	0.019
Sulphated Ash % by mass	0.019
Water Content mg/kg	370
GCV cal/g	9605
$NCV_{BD,y}$ Net calorific value of biodiesel produced in year y	42.652 GJ/t

B.2 Do no harm or Impact test of the project activity>>

There are social, environmental, economic and technological benefits which contribute to sustainable development.

- **Social benefits:**
- The project activity removes unhealthy oils from the food chain and converts it into clean energy and gradually replace fossil fuels with biofuels.
- By removing UCO from the food ecosystem, the project activity reduces diseases such as atherosclerosis, hypertension, liver diseases, and alzheimer's from the local population.
- In India, UCOs tend to be used repeatedly to reduce expenses. The heating of oils to their boiling points repeatedly results in the formation of free reactive oxygen (free radicals) which is responsible for oxidative stress causing elevated levels of glucose, creatinine, and cholesterol in the human body (source:studies). Hence the project activity prevents ailments associated with repeated use of UCO.
  Utilizing UCO helps reduce unscientific dumping of waste oil that would otherwise end up in an uncontrolled dump site or sewer pipes.

  Waste or Used vegetable oil is a second generation biofuels made from oil that is no longer fit for human consumption.

- **Environmental benefits:**
- UCO is converted into biodiesel by a simple chemical reaction called transesterification, which results in the production of fatty acid methyl esters with properties similar to diesel. Hence using it as a blend in fossil fuels, the project activity reduces GHG emissions.
  The growing supply of UCO, can be linked directly to an ever-increasing demand for edible oils. This is apparent in both domestic cooking and industrial food production, with vegetable- and animal-based oils and fats being increasingly used, particularly for frying food. As a waste, the inappropriate disposal of UCO can have major environmental issues when discharged into the sewerage systems, UCO can impact the operation of wastewater treatment plants. Hence this project activity has immense environmental benefits.
  Biodiesel has zero sulfur content and offers a significant reduction in carbon monoxide and hydrocarbon emissions. UCO gives better engine performance and less emissions when

tested on commercial diesel engines.

Biodiesel is an alternative to petroleum-based fuels derived from a variety of feedstocks, including vegetable oils, animal fats, and waste cooking oil.

The absence of adequate waste disposal by animal meat processing facilities and food processing/service facilities provides a great opportunity to create biodiesel from these very inexpensive raw materials and reduce landfill waste.

Transforms the waste oil/fat into useful energy resources and thus preserves limited fossil fuel resources.

Along with CO_2 reductions, the project contributes to the sustainable development by reducing other pollutants such as SO2, NOx and CO due to fossil fuel combustion.

Biofuels from used waste oil are considered as a promising substitute for traditional biofuels from edible food crops as they neither compete with food crops nor lead to land-clearing.

The production of UCOME in the project activity reduces the amounts of waste sent to landfills – benefitting the UCO generator economically – while also resulting in a feedstock that can be used within the transport sector, reducing its associated GHG emissions

- **Economic benefits:**
- Currently, the post pandemic recovery and increasing oil prices are posing a challenge in scaling up such biodiesel production activities, hence, earning revenue from the sale of carbon credits for the period 2014-2021, will help offset the losses for such facilities and also enable continued operation of such project activities. Unlike in Europe, where UCO derived biodiesel producers receive and trade renewable transport fuel certificates that help support and promote development of such technologies ahead of other crop-derived fuels, there is no such system in India, hence carbon credits revenue (as the UCR incentive program) can help achieve the same technology dispersion in India.

  EGFPL works with Hasiru Dala, a Bangalore based NGO that works with over 7000 waste pickers, to collect Used Cooking Oil from corporates including Infosys, Wipro , industrial houses, hotels, restaurants and caterers. Hence this project activity promotes the local economic development and improves the livelihoods of waste oil collectors by providing potential job opportunities in waste delivery to the facility.
- The project activity helps in conservation of fast depleting natural resources like diesel oil thereby contributing to the economic well being of country as a whole.

B.3. Baseline Emissions>>

Petroleum diesel is widely used as fuel in the transport sector in India, so the scenario existing prior to the start of the project is the equivalent fuel demand from existing stationary installations and vehicles is satisfied by the project activity which would have been satisfied by petroleum diesel. For the material level, large amounts of waste oil/fat is generated every day in the local area, and most are discharged into the municipal sewage system without recovery. The baseline scenario identified at the MR stage of the project activity is hence:

- *continuation of petroleum diesel consumption*

B.4. Debundling>>

This project activity is not a debundled component of a larger carbon project activity.

SECTION C Application of methodologies and standardized baselines

C.1. References to methodologies and standardized baselines >>

SECTORAL SCOPE - 01 Energy industries (Renewable/Non-renewable sources)
- 05 Chemical industries
- 07 Transport.

TYPE I - **Renewable Energy Projects**

CATEGORY- ***ACM 0017: Large-scale Consolidated Methodology***
Production of biofuel, Version 04.0
This methodology comprises project activities involving production of biofuel that is used as fuel in existing stationary installations (diesel generators) and/or in vehicles.

APPLICABILITY- The methodology is applicable to project activities that reduce emissions through the production of blended biofuels to be used in existing stationary installations and/or in vehicles. The biofuel is produced from one or a combination of the following feedstock:
(a) Waste oil/fat;
(b) Seeds or crops that are cultivated in dedicated plantations;
(c) Biomass residues (e.g. agricultural residues, wood residues, organic wastes).

C.2. Applicability of methodologies and standardized baselines >>

The biofuels and blended biofuels comply with national regulations and with suitable international standards.
Biofuel is produced from waste oil/fat and biomass residues as feedstocks.
The project activity involves the construction and operation of a biofuel production plant.
The by-product (glycerol) is not disposed of or left to decay within the project boundary. It is used as a raw material for industrial consumption and sold. Methanol from fossil fuel origin is used for the esterification of vegetable oil and waste oil/fats.
The (blended) biofuel is used by consumers within India in existing stationary installations (e.g. captive generators) and/or in vehicles. No modifications in the consumer stationary installations or in the vehicles engines are necessary to consume/combust the (blended) biofuel
The target consumer group (e.g. captive fleet of vehicles, gas stations, bulk consumers) and distribution system of the biofuel is identified and reported.
For (blended) biofuels consumed in stationary facilities, the consumer and EGFPL are bound by a contract that allows EGFPL to monitor the consumption of (blended) biofuel and the consumer shall not claim UCR carbon offset units (CoUs) resulting from its consumption.
In case of stationary installations, biofuels are blended in fractions of between 0 and 100%. In case of vehicles, the blending proportion is appropriate to ensure that the technical performance characteristics of the blended biofuels do not differ significantly from those of fossil fuels.

Only methanol from fossil origin is included because the methodology does not provide procedures for estimating emissions associated with the use of other alcohols than methanol from fossil origin.
Waste oil/fat - is defined as a residue or waste stream of biogenic origin from restaurants, agro and food industry, slaughterhouses or related commercial sectors
The biofuel is not produced from seeds or crops that are cultivated in dedicated plantations
Biofuels used at the project activity site of the biodiesel production plant for fuel combustion (e.g. for heat or electricity generation is from the same biodiesel generated in the project activity production plant.
No modifications in the consumer stationary installations or in the vehicles engines are necessary to consume/combust the (blended) biodiesel. In case of stationary installations, biodiesel or blended biodiesel with any blending fraction between 0 and 100% can be used. In case of vehicles, only blended biodiesel can be used and 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 petrodiesel. This condition is assumed to be met since the blending proportion is upto 20% by volume (B20).

C.3. Applicability of double counting emission reductions >>

The project activity has not applied for carbon credits under any other GHG programs.

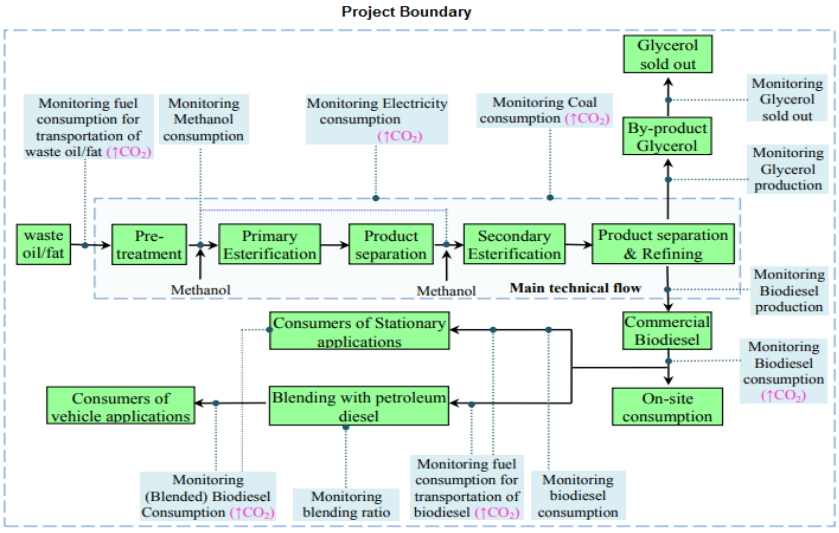
C.4. Project boundary, sources and greenhouse gases (GHGs)>>

The spatial extent of the project boundary encompasses:

(a) where applicable, transportation of:

- Raw materials (e.g. seeds and/or biomass residues) to the project plant(s);
- Feedstock (e.g. vegetable oil and/or waste oil/fats) to the biofuel production plant; and
- The biofuels to the site where it is blended with fossil fuels or used in stationary installations;

(b) the biofuel production plant at the project site, comprising the processing unit(s) (e.g. esterification, fermentation, hydrolysis) plus other installations on the site (e.g. storage, refining, blending, etc.);



Leakage Emissions is not applicable as the project activity does not use technology or equipment transferred from another activity.

There is no registered or an application to register another similar carbon project activity with the same project participants in the same project category within 1 km of the project boundary, hence the project activity is not a debundled component of a large scale project.

	Source	GHG	Included?	Justification/Explanation
Baseline Emissions	Vehicles and stationary combustion installations consuming petrodiesel	CO_2	**Included**	Major source of GHG emissions
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	On-site energy consumption at biodiesel production plant Combustion of fossil fuel derived methanol in the biodiesel ester Transportation of oil seeds, vegetable oils and or oil/fat wastes Transportation of biodiesel to blending facility	CO_2	**Included**	Major source of GHG emissions from transesterification with methanol of fossil origin
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative

C.5. **Establishment and description of baseline scenario (UCR Standard Protocol) >>**

The baseline scenario identified at the MR stage of the project activity is:

- *Continuation of petroleum diesel consumption*

Emission Reductions (ER_y) The emission reduction due to the project activity is calculated as the difference between the baseline emissions and the sum of the project emissions and the leakage:

$ERy = BE_y - (PE_y + LE_y)$

BE_y= Baseline emissions in year y (t CO_{2e})

$BEy = BD_y \times NCV_{BD,y} \times EF_{CO2,PD,y}$

$$BD_y = \left[min\left\{ \left(P_{BD,y} - P_{BD,on-site,y} \right); \left(\sum_i f_{PJ,i,y} \cdot C_{BBD,i,y} \right) \right\} - P_{BD,other,y} \right] \cdot \left(\frac{\sum_i C_{BBD,i,y} \cdot \left(\frac{f_{PJ,i,y} - f_{reg,y}}{f_{PJ,i,y}} \right)}{\sum_i C_{BBD,i,y}} \right)$$

EF_{CO2} = The CO_2 emission factor for petrodiesel in (tCO2/TJ), obtained from reliable local or national data if available, otherwise,IPCC default emission factors are used.

BDy = Quantity of biodiesel eligible for crediting in year y (t)

$P_{BD,y}$ = Quantity of biodiesel produced in the project plant in year y (t)

$P_{BD,on-site,y}$ = Quantity of biodiesel consumed at the project biodiesel production plant and/or the oil production plant(s) in year y = 0 (t)

$f_{PJ,B20,y}$ = Fraction of biodiesel in the blended biodiesel type in year y (100%)

$C_{BBD,B,y}$ = Quantity of blended biodiesel type consumed by the final consumer(s) (stationary installation in hotels/industries) in year y (t)

$f_{PJ,B,y}$ = Fraction of biodiesel in the blended biodiesel type in year y (100%)

$sC_{BBD,B,y}$ = Quantity of blended biodiesel type consumed by the captive consumer(s) in year y (t)

$P_{BD,other,y}$ = Quantity of biodiesel that is either produced with alcohols other than methanol from fossil origin or produced using oil seeds or waste oil(s)/fat(s) other than those eligible under this methodology according to the applicability conditions in year y = 0 t

$EF_{CO2,EL,y}$ = CO_2 emissions factor for electricity consumed in year y for biodiesel production = 0

The project activity consumes biodiesel at the biodiesel production plant, and the biodiesel is produced with methanol from fossil origin, so

$P_{BD,on-site,y}$ =0, and

$P_{BD,other,y}$ =0.

Project emissions on account of transportation of waste oil/UCO/methanol is negligible

since they are sourced from industries within a 50 km radius of the project activity.

Project Emissions are only from CO2 emissions from combustion of fossil carbon contained in methanol that is chemically bound in the biodiesel during the esterification process, and released upon combustion.

$$PE_y = AF_{1,y} \times (PE_{BPF,y} + PE_{MeOH,y} + PE_{Tr,y} + AF_{2,y} \times PE_{BC,y})$$

Where,

$$PE_{BPF,y} = \sum_j PE_{FC,j,y} + PE_{EC,y} + PE_{W,y}$$
$$= FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y} + EC_y \times EF_{CO2,EL,y} \times (1+TDL_y) + PE_{W,y}$$

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

$$PE_{tr,y} = \sum_m \sum_i (FC_{m,i,y} \times NCV_i \times EF_{CO2,i})$$

$$LE_y = LE_{MeOH,y} + LE_{WOF,y} - LE_{PD,y}$$
$$LE_{MeOH,y} = MC_{MeOH,y} \cdot EF_{MeOH,PC}$$
$$LE_{WOF,y} = 0$$
$$LE_{PD,y} = LE_{PROD,y} + LE_{REF,y} + LE_{LDT,y}$$
$$= BD_y \cdot \frac{NCV_{BD,y}}{NCV_{PD,y}} \cdot (EF_{PROD} + EF_{REF} + EF_{LDT})$$

$PE_{EW,y}$ = Project emissions from anaerobic treatment of waste water in year y = 0
$AF_{2,y}$ = Allocation factor for the oil seeds cultivation in year y = 0
$PE_{BC,y}$ = Project emissions associated with the cultivation of land to produce oil seeds in year y = 0

Project emissions from fossil carbon in the biodiesel due to the use of methanol from fossil origin in the transesterification process **($PE_{MeOH,y}$)**

These emissions are estimated as follows:

$PE_{MeOH,y}$ □ $MC_{MeOH,y}$ EF_{CMeOH} 44/12

Year	% of glycerol	Methonol consumed	Methanol Tonnes (Bdy)
2014	26532	32428	25.682976
2015	39888	48752	38.611584
2016	41088.42	50219.18	39.77359056
2017	76314.69	93273.51	73.87261992
2018	84571.848	103365.592	81.86554886
2019	61154.73	74744.67	59.19777864

2020	10238.13	12513.27	9.91050984
2021	48295.26	59027.54	46.74981168
2022	15665.31	19146.49	15.16402008

Where,

$PE_{MeOH,y}$ = Project emissions from fossil carbon in the biodiesel due to transesterification with methanol of fossil origin in year y (tCO_2)

$MC_{MeOH,y}$ = Quantity of methanol consumed in the biodiesel plant, including spills and evaporations on-site in year y (tMeOH)

$EF_{C,MeOH}$ = Carbon emissions factor of methanol, based on molecular weight (tC/tMeOH)
44/12 = Molecular weight ratio to convert t of carbon into t of CO2 (tCO2/tC)

There is a surplus of waste oil/fat in the region of the project activity and the project activity does not result in increased fossil fuel consumption elsewhere. Thus, the leakage emissions from displacement of existing utilization of waste oil/fat is zero, hence

$LE_{WOF,y}$ =0.

NCV_{PD}	=	42.652 GJ/t Net calorific value of petrodiesel as per 2006 IPCC Guidelines for GHG Inventories
EF_{CO2}	=	0.0741 tCO2/TJ IPCC 2006 guidelines for National Greenhouse Gas inventories got stationary combustion (petrodiesel)
EF_{MeOH}	=	0.375 tCO2/tMeOH is the default emissions factor for methanol based on molecular weight
MeOH conversion factor (1ltr)	=	0.791 KG
$f_{PJ,B100,y}$	=	Fraction of biodiesel in the blended biodiesel type B100 in year y 100% ratio

Year	Quantity of Biodiesel Produced (litres)
2014	294800
2015	443200
2016	456538
2017	847941
2018	939687.2
2019	679497
2020	113757
2021	536614
2022	174059

Year	BE y (tCo2eq)
2014	815
2015	1225
2016	1262
2017	2344
2018	2598
2019	1879
2020	314
2021	1483
2022	481

Year	PEmeoh,y (tCO2eq)
2014	18.10979077
2015	27.22611693
2016	28.04548053
2017	52.0896679
2018	57.72570754
2019	41.7420234
2020	6.988180016
2021	32.9646108
2022	10.69257826

Year	Emission Reductions (tCO2)
2014	796
2015	1197
2016	1233
2017	2291
2018	2540
2019	1837
2020	307
2021	1450
2022	470
Total	12121

(Ex-Post) Calculated ER_y = 12121 CoUs (12121 tCO2eq)

C.6. Prior History>>

The project activity has not applied to any other GHG program for generation or issuance of carbon offsets or credits.

C.7. Monitoring period number and duration>>

MR No: 01
There is no change in the start date of crediting period.
Monitoring Start Date: 01/01/2014 to 31/12/2022

C.8. Changes to start date of crediting period >>

There is no change in the start date of crediting period.

C.9. Permanent changes from PCN monitoring plan, applied methodology or applied standardized baseline >>

There are no permanent changes from registered PCN monitoring plan and applied methodology

C.10. Monitoring plan>>

The Monitoring Plan includes the inputs and outputs required for calculating leakage, baseline and project emissions which shall be based on a complete documented mass balance, adjusted for stock changes, covering:
(a) Amounts of waste oil/fat or biomass residues purchased and processed;
(b) Amounts of catalysts purchased, processed and recovered;
(c) Amounts of methanol purchased and processed;
(d) Amounts of glycerol or other by-products produced and incinerated and/or sold for utilization;
(e) Amounts of blended biofuel consumed, sold or blended

The following procedure shall be used to verify the actual amount of biofuel from waste oil/fat or biomass residues that is consumed by the end user for displacement of fossil fuel and its correspondence with the produced amount of biofuel from waste oil/fat or biomass residues:
(a) the produced amount of biofuel from waste oil/fat or biomass residues is recorded by a periodically calibrated metering system;
(b) The amount of biofuel produced from waste oil/fat or biomass residues transported to the storage of the blender is recorded by a calibrated metering system at the point of filling the (road) tankers and at the point of delivery at the blender site;
(c) During the process of creating the biofuel blend at the blending station, the blending operation shall be monitored to assure adequate mixing of the products in the specified 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 biofuel and fossil fuel, which comprise the blended biofuel;

- Contractually, EGFPL has to monitor consumption by its consumers as follows:
  - The receiving amount of blended biofuel in the gas station or final distributor is recorded by a calibrated metering system and the storage fill level is recorded by a calibrated filling level indicator;
  - For stationary installations, the amount of the blended biofuel filled into the installation where combustion takes place is recorded by a calibrated metering system;
  - If blending is done by a third party, contractual arrangement are in place, that the receiving amount of biofuel at the blending facility is to be recorded by a calibrated metering system and the storage fill level is recorded by a calibrated filling level indicator.

The monitoring and recording of the required parameters is carried out by trained personnel who are managed by the Project Manager. All measurements will use calibrated measurement equipment that are maintained regularly and checked for its functioning which will meet the minimum requirement of the methodology. All indicators of importance for controlling and reporting of projects performance have been incorporated in the monitoring plan (Monitoring Report during verification) as well as indicated in the planned formal set of monitoring protocol and work instructions.

Data/Parameter	$Q_{waste\ oil/fat/biomass}$
Data unit	ton/yr
Description	Waste oil/fat/biomass purchased in year y

Source of data Value(s) applied	Weigh scales/bridges/Purchase Records/Invoices Log Sheet/Receipts are maintained electronically and provided to the verifier for cross checking purposes.
Measurement methods and procedures	Weighbridge
Monitoring frequency	Every purchased waste oil/fat is monitored daily/monthly. Data records have been provided to the verifier.
Purpose of data	To estimate baseline emissions

Data/Parameter	$\mathbf{MU_{Glyc,y}}$
Data unit	MT
Description	Amount of by-product (e.g. glycerol) incinerated or sold or used
Source of data Value(s) applied	Plant records and log books receipts
Measurement methods and procedures	Data type: Measured Responsibility: PP
Monitoring frequency	Daily
QA/QC	All produced by-product must be tracked via sales data or internal records.
Purpose of Data	This monitored parameter is used to meet the applicability condition “The by-product (e.g. glycerol) is not disposed of or left to decay. It should be either incinerated or used as raw material for industrial consumption or sold”

Data/Parameter	$P_{BF,y}$
Data unit	litres
Description	Quantity of biofuel produced in the project plant in year y

Year	Quantity of Biodiesel Produced (litres)
2014	294800
2015	443200
2016	456538
2017	847941
2018	939687.2
2019	679497
2020	113757
2021	536614
2022	174059

Source	On-site measurements by the PP
Measurement methods and procedures	All produced biofuel must be metered Monitoring: Log book Data type: Monitored
Monitoring frequency	Daily/Hourly
QA/QC	Cross check production and consumption data with sales records

Data/Parameter	$NCV_{BF,y}$
Data unit	*42.652* GJ/t
Description	Net calorific value of biofuel produced in year y
Source of data Value(s) applied	Laboratory analysis
Measurement methods and procedures	Measured according to relevant national or international standards regulating determination of NCV by calibrated equipment
Monitoring frequency	Annually

QA/QC	Analysis is carried out by accredited laboratory. A sample is representative if uncertainty of the NCV does not exceed ±5% at 95% confidence level. Lab Report is provided to the verifier during the audit.

Data/Parameter	**$MC_{MeOH,y}$**
Data unit	tMeOH
Description	Quantity of methanol consumed in the biofuel plant, including spills and evaporations on-site in year y

Methanol Tonnes (Bdy)
25.682976
38.611584
39.77359056
73.87261992
81.86554886
59.19777864
9.91050984
46.74981168
15.16402008

Source of data Value(s) applied	Mass meters
Measurement methods and procedures	The methanol consumption should be net of any water content. Methanol spilled and evaporated on the project site should be considered as consumption for estimating the emissions
Monitoring frequency	Continuously
QA/QC	Crosscheck against methanol purchase receipts and calculated stochiometric requirements

Data/Parameter	**NCV_{PD}**
Data unit	GJ/t
Value	42.65
Description	Net calorific value of petrodiesel
Source of data Value(s) applied	Default

Measurement methods and procedures	2006 IPCC Guidelines for GHG Inventories Value(s) applied
Monitoring frequency	NA
QA/QC	IPCC default value
Purpose	For baseline emissions calculation

Data/Parameter	**$EF_{CO2,PD}$**
Data unit	TCO2/GJ
Value	0.0741
Description	Net calorific value of petrodiesel
Source of data Value(s) applied	Default
Measurement methods and procedures	2006 IPCC Guidelines for GHG Inventories Value(s) applied
Monitoring frequency	NA
QA/QC	IPCC default value
Purpose	For baseline emissions calculation

Data/Parameter	**$EF_{C\ MeOH}$**
Data unit	tC/tMeOH
Value	0.3750
Description	Carbon emission factor of methanol, based on molecular weight
Source of data Value(s) applied	Default
Measurement methods and procedures	(12/32)
Monitoring frequency	NA
QA/QC	Calculated
Purpose	For project emissions calculation