PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT

Title: Agriwaste Biogas Project at APMC in Vadodara, Gujarat

Version 1.0

Date 19/09/2021

First CoU Issuance Period: 7 years, 0 months

Date: 01/01/2014 to 31/12/2020

Project Concept Note (PCN)
CARBON OFFSET UNIT (CoU) PROJECT

BASIC INFORMATION	
Title of the project activity	Agriwaste Biogas Project at APMC in Vadodara, Gujarat
Scale of the project activity Completion date of the PCN	Small Scale 18/09/21
Project participants	Aryan Associates, Vadodara, Gujarat, India
Host Party	India
Applied methodologies and standardized baselines	AMS.I.C. Thermal energy production with or without electricity UCR Protocol Standard Baseline AMS-III.AO Methane recovery through controlled anaerobic digestion
Sectoral scopes	01 Energy industries (Renewable/NonRenewable Sources) 13 Waste handling and disposal
Estimated total average GHG emission reductions	68249 CoUs (68249 tCO_{2eq})

SECTION A. Description of project activity

A.1. Purpose and general description of Carbon offset Unit (CoU) project activity >>

The project **Agriwaste Biogas Project at APMC in Vadodara, Gujarat** is located in near Ajwa Rd, NH-8, Nehru Chacha Nagar, Sayaji Park Society, City Vadodara, State Gujarat, India.

The details of the registered project are as follows:

Purpose of the project activity:
The **Agriwaste Biogas Project at APMC in Vadodara, Gujarat** is located within the wholesale market spread over 30 acres over 2 acres and is the main trading market for fresh produce and fruits in the city of Vadodara, Gujarat.
Commissioning dates of digesters:

Digester # 1 (85m3)	Digester # 2 (85m3)	Digester # 3 (85m3)
01/06/12	01/01/17	01/03/18

The purpose of the project activity is the set up 3 (three) independent biogas plants (digesters) of $85m^3$ capacity each for serving the captive electricity and energy needs at the facility using agricultural waste at the facility.

It is estimated that between 2 tons per day (TPD) (2000kgs/d) of agricutural waste is generated at the project site between the years 2014-2016 and 6 TPD (6000kg/d) daily between 2017-2020.

The APMC is an autonomous body. There are several agricultural produce market committees (APMCs) established in each state to facilitate marketing of the agricultural produce. The facility and its waste management is outside the perview of the local municipal authority and hence there is no monetary assistance provided by the state government for the waste handling at the market located on the national highway.

By using the biogas captured from the digesters the project activity generates power for captive use. The project activity is the controlled biological treatment of biomass or other organic matters through anaerobic digestion in closed reactors equipped with biogas recovery for electricity generation and a combustion/flaring system.

The sludge is then dried and wastewater is reused and recycled back into the biogas process. The dried sludge is then converted to organic fertilizer that is sold locally to farmers at low cost by the project proponents.

The APMC at Vadodara has established itself as a centre of excellence in catering to the need of farmers by promoting three market yards – Sayajipura, Hathikhana and Kewdabaug. Other features of the yard are wide approach road, private telephone exchange, 100-tonne ripening chamber for banana, mango and papaya, organic waste converter, an information system to address issues relating to farmers and soil health laboratory.

Today, an estimated one-third of all the food produced in the world goes to waste. That's equal to about 1.3 billion tons of fruits, vegetables, meat, dairy, seafood, and grains that either never leave the farm, get lost or spoiled during distribution, or are thrown away in hotels, grocery stores, restaurants, schools, or home kitchens. It could be enough calories to feed every undernourished person on the planet.

When organic waste such as fruits and vegetables in the project activity goes to waste, we also waste all the energy and water it takes to grow, harvest, transport, and package it. And when such biomass goes to the landfill and rots, it produces methane—a greenhouse gas even more potent than carbon dioxide. About 6%-8% of all human-caused greenhouse gas emissions could be reduced if we stop wasting food and such organic waste.

Decomposing organic material in anaerobic conditions — by microbes in the absence of oxygen — releases methane into the atmosphere. Anaerobic fermentation is common in landfill and open stockpiles such as manure piles. Global emissions from waste have almost doubled since 1970 and now produce 3% of anthropogenic (human origin) emissions (IPCC 2014). About half of these emissions come from the anaerobic fermentation of solid waste disposal on land.

A.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 contributes in improving the environmental condition in the region of by hygienic treatment of agricultural waste resulting in improvement of health standard in the city.
- The project provides employment opportunity to the local rag pickers who can collect the recyclables from the plant and ensure that only organic waste is treated.
- The project would provide both direct and indirect employment opportunity to the people of the region.
- Reduces outdoor air pollution, thus eliminating health hazards for traders in the vicinity.
- The project provides security of energy supply since it generates biogas based electricity
- It leads to better waste management thus keeping the surroundings clean and reduce some of the disease causing pathogens

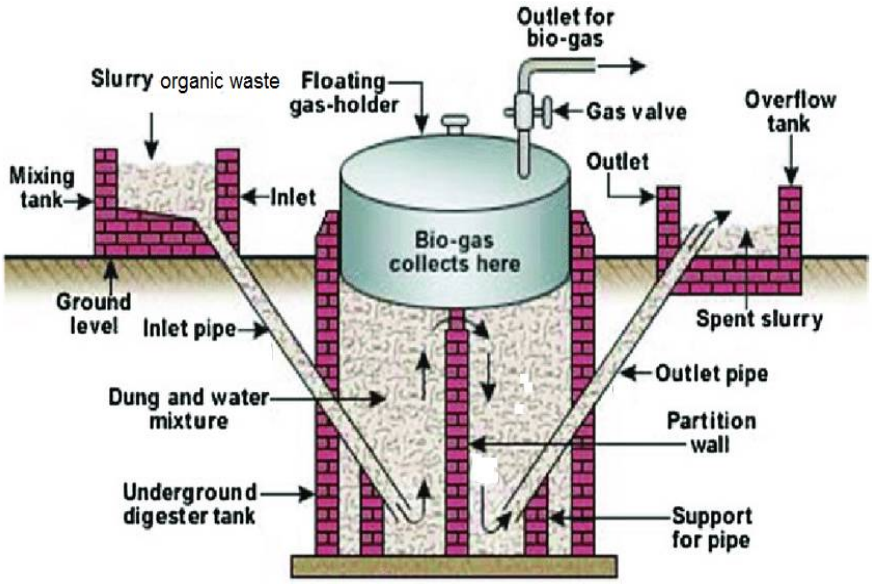
- **Environmental benefits:**
- Curbs methane emission as well as any leachate that would otherwise have been generated from the current practice of unscientific waste disposal.
- The land requirement used for a disposal site is removed as also is the area for dumping of equivalent amount of waste. This indirectly enables region towards a better way of land utilisation, like construction of housing, hospital etc.
- Further, by generating electricity through utilising the biogas, the project helps in replacing fossil fuel intensive power generation from the local grid.
- Avoids local environmental air pollution through better waste management
- Leads to soil improvement by providing high quality manure to farmers
- Reduces outdoor air pollution, and increases use of manure rather than chemical fertilizers.
- Using biogas as an energy resource contributes to clean environment.
- Agricultural waste is transformed into high-quality enriched bio-manure/fertilizer.
- Hygienic conditions are improved through reduction of pathogens by utilizing the organic wastes in the bio-digesters.
- Bio manure is a source of organic matter that stimulates biological activity

- **Economic and Technological benefits:**
- The project has a wastewater recycling facility that is powered by the biogas and reuses the water in the digester, hence conserving water.
- Provides employment to local communities through construction and maintenance of biogas units.
- The project is among the few the region than captures biogas and uses the same for the generation of electricity for captive uses at the project site.
- Agricultural waste is transformed into high-quality enriched bio-manure/fertilizer which is supplied at a lower cost than would normally be available at the retail marketplace, thus providing better soil enrichment for farmers and their crops.
- The revenue from carbon credits will showcase such efforts undertaken to make the agricultural markets environmentally sustainable by making them responsive toward the recycling of waste and maintaining the energy of ecosystem of market.

A.3. Location of project activity >>

Country: India.
District: Vadodara
Village: Vadodara
Landmark: Ajwa Rd, NH-8
State: Gujarat
Code: 390019

A.4. Technologies/measures >>



Biogas is a mixture of methane and carbon dioxide. It also has traces of hydrogen sulphide (3%),

ammonia, oxygen, hydrogen, water vapour etc., depending upon feed materials and other conditions. Biogas is generated by fermentation of cellulose rich organic matter under anaerobic conditions. In anaerobic conditions, the methane-producing bacteria become more active. Thus, the gas produced becomes rich in methane.

The optimum utilization depends upon the successful physical installations, which in turn depend upon plant design and its selection. The basic conversion principle is that when a non-ligneous biomass is kept in a closed chamber for a few days, it ferments and produces an inflammable gas. The anaerobic digestion consists of three stages: I Hydrolysis; II Acid formation and III Methane fermentation. The processes are carried out by two sets of bacteria namely acid forming bacteria and methane formers. The acidogenic phase I is the combined hydrolysis and acid formation stages in which the organic wastes are converted mainly into acetate, and phase II is the methanogenic phase in which methane and carbon dioxide are formed. The better the three stages merge with each other, the shorter the digestion process.

The technical specifications of the KVIC model bio-digesters are as follows:

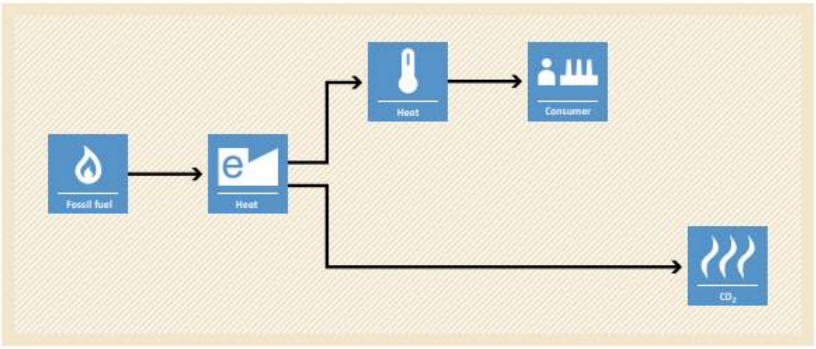
Specification	Value
Capacity per unit	85 m^3
Mixing Proportion	(Water: Waste) 1:1
Number of units (digesters)	3
Feed Material	Agricultural /Food/Vegetable/Fruit Waste
Biogas Power Engine Capacity	12 kwh
Working Days	330
Calorific Value Biogas	20 MJ/m^3

A.5. Parties and project participants >>

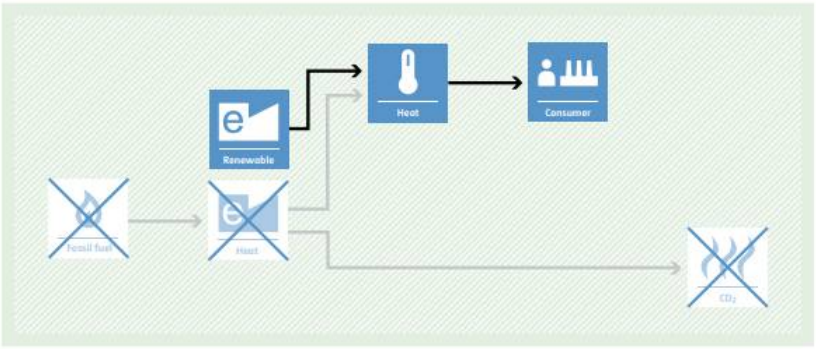
Party (Host)	Participants
India	Aryan Associates, Vadodara, Gujarat, India

A.6. Baseline Emissions>>

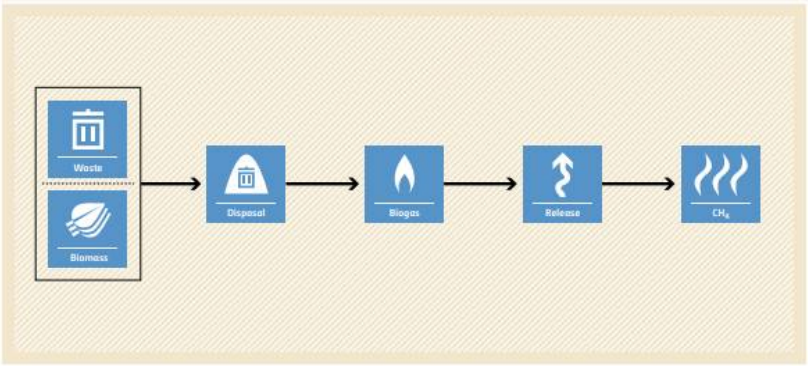
BASELINE SCENARIO
Energy generation (thermal heat and / or electricity) by more-carbon-intensive technologies based on fossil fuel. In case of retrofits or capacity addition, operation of existing renewable power units without retrofit and capacity addition.



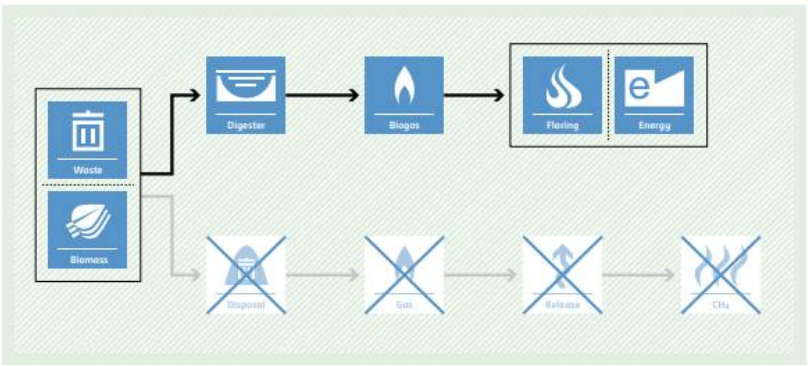
PROJECT SCENARIO
Energy generation by installation of new renewable energy generation units, by retrofitting or replacement of existing renewable energy generation units as well as by switch from fossil fuel to biomass in modified existing facilities.



BASELINE SCENARIO
Biomass or other organic matter would have otherwise been left to decay anaerobically.



PROJECT SCENARIO
Biological treatment of biomass or other organic matters through anaerobic digestion in closed reactors equipped with biogas recovery and a combustion/flaring system.



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

- the situation where, in the absence of the project activity, biomass and other organic matter (including manure where applicable) are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter.

- the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. Hence the baseline scenario is also electricity imported from a grid in the absence of the project activity.

A.7. Debundling>>

This micro scale project is not a debundled component of a larger project activity.

SECTION B. Application of methodologies and standardized baselines

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

SECTORAL SCOPE - 01 Energy industries (Renewable/Non-renewable sources)
13 Waste handling and disposal

TYPE I - Renewable Energy Projects

CATEGORY- ***AMS-I.C.: Thermal energy production with or without electricity***

This methodology comprises renewable energy technologies that supply users i.e. residential, industrial or commercial facilities with thermal energy that displaces fossil fuel use. These units include technologies such as energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.

AMS III.AO. Methane recovery through controlled anaerobic digestion

This methodology comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS), or in an animal waste management system (AWMS), or in a wastewater treatment system (WWTS). In the project activity, controlled biological treatment of biomass or other organic matters is introduced through anaerobic digestion in closed reactors equipped with biogas recovery and combustion/flaring system.

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

This project activity comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS).
In the project activity, controlled biological treatment of biomass or other organic matters is introduced through anaerobic digestion in closed reactors equipped with biogas recovery and combustion/flaring system. Co-digestion of multiple sources of biomass substrates, e.g. Fruit and vegetable waste, where those organic matters would otherwise have been treated in an anaerobic treatment system without biogas recovery.
Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually under AMS III. AO.
All three biogas units are of $85m^3$ capacity and distinct from each other.
Biogas is used for renewable power generation for captive use.
The total installed electrical energy generation capacity of the project equipment does not exceed 15 MW
The annual average temperature of the biogas site is located is higher than 5°C
Residual waste from the digestion is handled aerobically and submitted to local farmers for soil application.
The storage time of the agricultural waste does not exceed 45 days before being fed into the digesters.
The outflow from the digestion is recycled and reused within the biogas digester.
The project activity does not recover or combust landfill gas from the disposal site, does not undertake controlled combustion of the waste that is not treated biologically in a first step and does not recover biogas from wastewater treatment.
This is a small scale project with total electricity capacity of 0.012 MW which is not greater than small scale thresholds defined by the applied methodology I.C. under Type I – renewable energy project activity, i.e. the total installed electrical energy generation capacity of the project equipment does not not exceed 15 MW.

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

Each of the biogas unit is constructed within the market facility. Each biogas unit has a unique ID,

which is visible on the biogas unit. The Monitoring Report has the details of the end user's name and the location i.e. District, Mandal, village in which it is constructed along with the Unique ID.

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

The project boundary includes the physical, geographical site(s) of:

- (a) All plants generating electricity and/or thermal energy located at the project site,
- (b) Industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment affected by the project activity;
- (c) Where the treatment of biomass or other organic matters through anaerobic digestion takes place;

	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from biomass decay	CO_2	Included	Major source of emission
		CH_4	Included	Major source of emission
	Emissions from electricity generated using fossil fuels	N_2O	Excluded	Excluded for simplification. This is conservative
	Emissions from on-site electricity use	CO_2	Excluded	Electricity is generated from collected biogas, hence these emissions are not accounted for. CO2 emissions from the decomposition of organic waste are not accounted
	Emissions from residue from anaerobic digester composting	CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative

Project Activity

The project activity recovers and utilizes biogas for producing electricity and applies this methodology in addition to using a Type III component of a SSC methodology, hence any incremental emissions occurring due to the implementation of the project activity is neglected.

B.5. Establishment and description of baseline scenario (UCR Protocol) >>

The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass and other organic matter. The yearly baseline emissions are the amount of methane that would have been emitted from the decay of the cumulative quantity of the waste diverted or removed from the disposal site, to date, by the project activity, calculated as the methane generation potential using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site."

For renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the

project activity, times an emission factor for the fossil fuel displaced. Hence the baseline scenario is also electricity is imported from a grid.

The project proponent was not bound to incur this investment as it was not mandatory by national and sectoral policies. Thus, the continued operation of the project activity would continue to replace fossil fuel derived grid electricity.

Estimated Annual Emission Reductions: $BE_y = BE_{y1} + BE_{grid}$

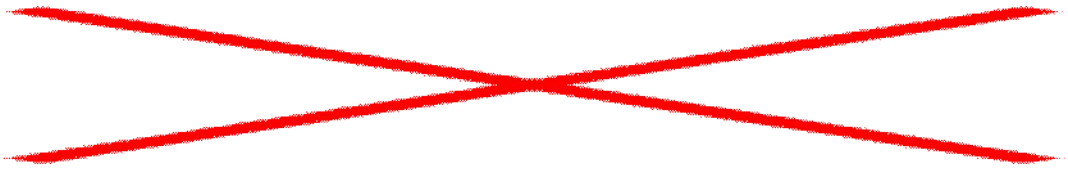
BE_y = Total Baseline Emissions in a year.

$BE_{grid} = EG_{y,grid} \times EF_{y,grid}$

BE_{grid}	=	Baseline emissions for the grid electricity displaced by the project in year y (t CO2e)
$EG_{y,grid}$	=	Amount of grid electricity displaced by project in year y (MWh)
$EF_{y,grid}$	=	Emission factor of the grid (t CO2e/MWh) = 0.9 (UCR Standard)

$BE_{y1} = BE_{swds,y} + BE_{manure,y} + BE_{WW,y} - MD_{reg,,y} \times GWP_{CH4}$

BE_{y1}	=	Baseline emissions from biomass and other organic matter left to decay within the project boundary and methane is emitted to the atmosphere
$BE_{swds,y}$	=	Baseline emission determination of digested waste that would otherwise have been disposed in stockpiles shall follow relevant procedures in AMS-III.E. This is equal to the yearly methane generation potential of the SWDS at the year y, considering all the wastes deposited in it since its beginning of operation, and without considering any removal of wastes by the project activity.
$BE_{manure,y}$	=	Baseline emissions from the manure co-digested by the project activities = 0
$BE_{WW,y}$	=	Baseline emissions from the wastewater co-digested = 0
$MD_{reg,,y}$	=	Amount of methane that would have to be captured and combusted in the year y to comply with the prevailing regulations (tonne) = 0
GWP_{CH4}	=	21 is the default IPCC value of CH_4 applicable to the crediting period ($tCO_{2e}/t\ CH_4$)



Estimated total baseline emission reductions (*BE*) = 68249 CoUs (68249 tCO_{2eq})

B.6. Prior History>>

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

B.7. Changes to start date of crediting period >>

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

B.8. 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

B.9. Monitoring period number and duration>>

First Issuance Period: 7 years, 0 months – 01/01/2014 to 31/12/2020

B.8. Monitoring plan>>

Data/Parameter	Date of commissioning of biogas units
Data unit	Date.
Description	Actual date of commissioning of the project device
Source of data Value(s) applied	Monitoring Report As and when commissioned
Measurement methods and procedures	The construction processes are maintained from its initiation to completion dates for the biogas unit. Thus the start date of each of the unit installed is recorded in the monitoring report.
Monitoring frequency	As and when commissioned and fixed and recorded in the monitoring report
Purpose of data	To estimate baseline emissions

Data / Parameter:	Q_{waste}
Data unit:	tons
Description:	Quantity of solid waste or residual waste
Source of data:	Measured
Measurement procedures (if any):	On-site data sheets recorded monthly using weigh bridge
Monitoring frequency:	Monthly-
QA/QC procedures:	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier)
Any comment:	-

Data / Parameter:	**N_y**
Data unit:	Number of operational days in a year
Description:	Measured
Source of data:	-
Measurement procedures (if any): Monitoring frequency:	Records kept in the log book. Annually, based on monthly records
QA/QC procedures: Any comment:	- -

Data / Parameter:	**$EG_{y,grid}$**
Data unit:	kwh
Description:	Number of days animal is alive in the farm in the year *y*
Source of data:	-
Measurement procedures (if any):	Records of sales, records of food purchases in log book.
Monitoring frequency:	Annually, based on monthly records
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$EG_{grid,y}$
Data unit:	MWh
Description:	Quantity of electricity generated
Source of data	Plant records
Measurement procedures (if any): Monitoring frequency:	Measured using calibrated meters. Calibration shall be as per the relevant methodologies. Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedure	-
Any comment:	The parameter need to be monitored for project activities which displaces grid electricity

Data / Parameter:	$EF_{grid,y}$
Data unit:	t CO_2e/MWh
Description: Source of data	CO_2 emission factor for the grid electricity in year *y* -
Measurement procedures (if any): Monitoring frequency:	As described in UCR Standard Annual
QA/QC procedure	-
Any comment:	The parameter need to be monitored for project activities which displaces grid electricity