PROJECT CONCEPT NOTE

CARBON OFFSET UNIT (CoU) PROJECT

Title: Micro Scale Biogas Project in Nepal

Version 1.0

Date 27/09/2021

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	Micro Scale Biogas Project at Nepal
Scale of the project activity	Small Scale
Completion date of the PCN	27/09/21
Project participants	Nepal Urja Bikash Company Pvt. Ltd., Chaoubishkoti-10, Bharatpur, Chitwan, Nepal
Host Party	Nepal
Applied methodologies and standardized baselines	AMS.I.E. Switch from non-renewable biomass for thermal applications by the user. UCR Protocol Standard Baseline
Sectoral scopes	01 Energy industries (Renewable/NonRenewable Sources)
Estimated amount of annual average GHG emission reductions	22 CoUs /year (22 tCO_{2eq}/yr)
Estimated total amount of GHG emission reductions during the crediting period	154 CoUs

SECTION A. Description of project activity

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

The project **Micro Scale Biogas Project in Nepal** is located in Region Terai, District: Tanahu Village: AnbuKhaireni, Area: Gandaki, Nepal.

The details of the registered project are as follows:

Purpose of the project activity:
The Micro Scale Biogas Project is located in Nepal and the purpose of the project activity is the set up 1 (one) independent biogas plant (digester) of $20m^3$ capacity for serving three (3) households using polutry litter and food waste. Co-digestion, as is the case in this project activity, leads to enhanced biogas production potential, system stability due to synergetic effects, and resolving the problem of waste management in the vicinity in a holistic approach. The food waste, generated by the households, is mixed with the poultry litter and in this way replaces Non-Renewable Biomass with biogas for cooking and heating water. The replacement of firewood that is non renewable biomass (NRB) is counted as emission reductions or carbon offset units (CoUs) under the UCR Standard using pre-determined emission factors based on digester capacity.

This project contributes strongly to sustainable development of the rural households involved in the project. The promotion of biogas in Nepal has resulted in significant social and financial benefits. The technical adaptation of biogas systems, designed specifically for Nepalese conditions, has made remarkable progress during the past decade, and the outlook is excellent for continued improvements and expanded use. Biogas is making an increasing contribution in meeting the cooking and lighting energy needs of the rural population as well as enhancing agricultural output as a result of using the slurry from the biogas digester as fertiliser. The widespread adoption of biogas technology in Nepal is due to its modular and easy to construct design.

The project activity is a voluntary action by the project proponents since:
- The implementation of digesters is a voluntary action by the households.
- The targets formulated by the Government of Nepal for the implementation of digesters are not mandatory
- The approach of the biogas installation is demand driven. Every household makes a substantial part of the investment itself.

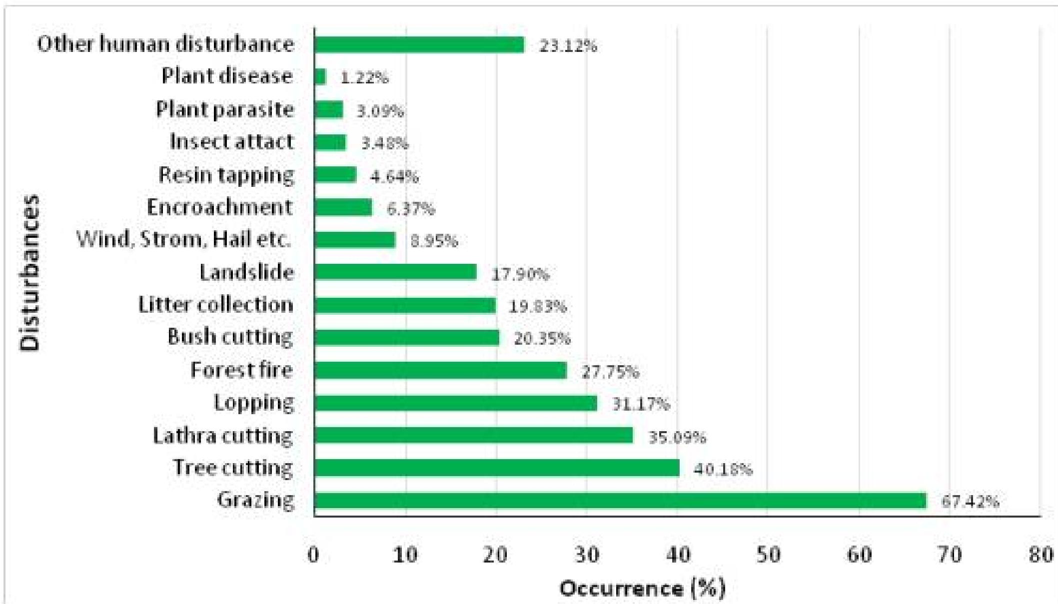
Many such biogas systems rely on government subsidy and foreign donations for their implementation, hence earning carbon revenues from the mining of carbon credits on the voluntary market, especially for ex-post emission reductions during the 2014-2020 vintage period, will help pay for future capacity expansion of the biogas systems, operation and maintenance costs, repayment of loans and potentially increase the building of such biogas systems at a faster pace since owners would no longer need foreign based donations for their implementation. The rising demand for fuelwood, agricultural residues and cattle/poultry dung, by the rapidly increasing population of Nepal, has helped accelerate the rates of deforestation, soil degradation and environmental decline in the densely inhabited areas of Nepal. In addition, the use of biomass fuels has significantly impacted the health and welfare of especially women and children who are most often subjected to the smoke and fumes associated with the use of these fuels.

Distribution of ecosystems by physiographic region

Physiographic region	Ecosystems		
	Number	%	Types
Terai	12	10.2	10 'forest' and two 'cultivated'
Churia	14	11.9	13 'forest' and one cultivated 'Dun'
Middle Mountains	53	44.9	52 'forest', and one 'cultivated'
High Himal and High Mountains	38	32.2	37 'forest' and one 'glacier/snow/ rock'
Others	1	0.8	'Water bodies; found in all zones, except the Siwalik
Total	**118**	**100**	

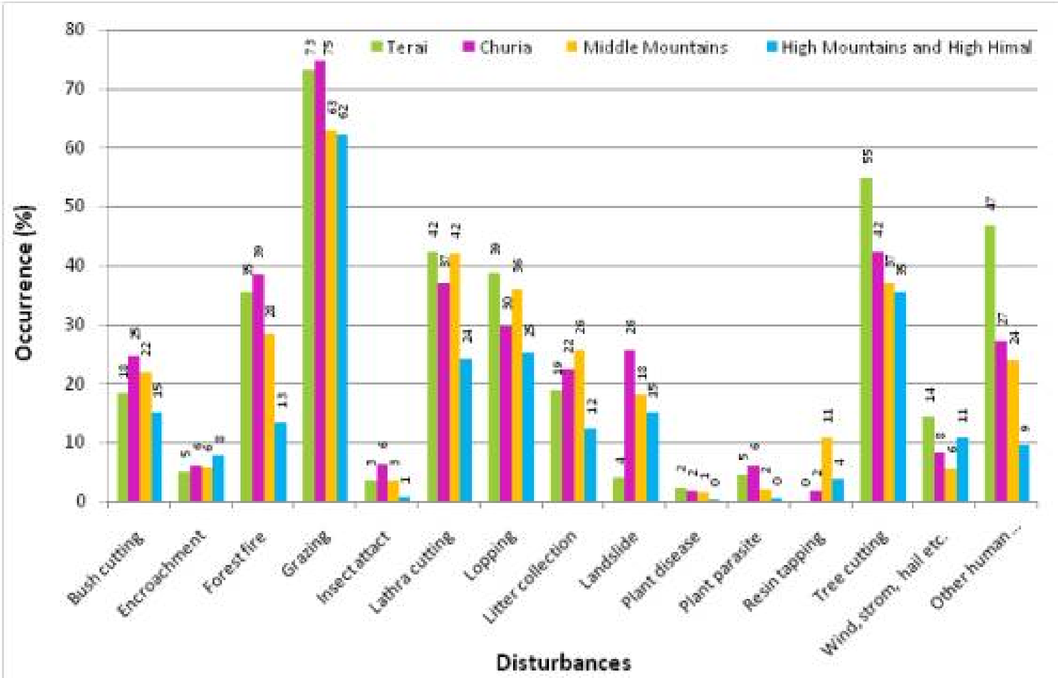
Source: BPP (1995)

A biogas plant of 20 m3 capacity is sufficient to provide cooking fuel to a three household family with four to five members each. Fuel wood scarcity has an impact directly on rural households, which are highly dependent on this fuel. Demand for fuel wood and logs from commons and forests have caused resource degradation to the extent that collection exceeds sustainable yield. The project activity will attenuate the rural thermal energy needs used for cooking and water heating.



Occurrence of forest disturbances

Nearly two-thirds of the total forest area in Nepal is affected by grazing. Tree cutting, bush cutting, lathra cutting, lopping and forest fire were also common. Other anthropogenic disturbances, such as bark removal from the base of a tree, snaring, foot trails, forest roads, etc. were observed in about one-quarter of the surveyed forest areas. (source: DFRS, 2015. State of Nepal's Forests. Forest Resource Assessment (FRA) Nepal, Department of Forest Research and Survey (DFRS). Kathmandu, Nepal).



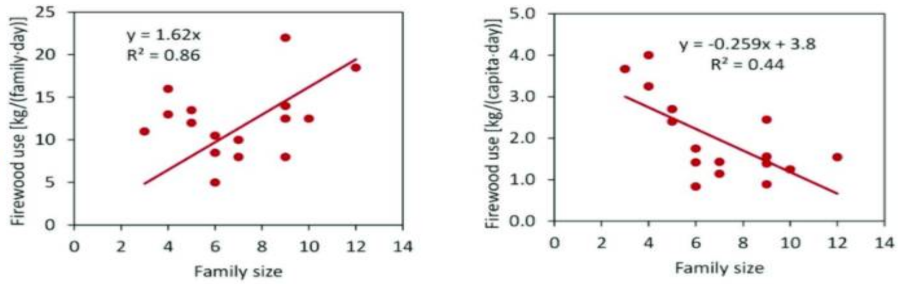
Proportional occurrence of forest disturbances by physiographic region

Nepal has low per-capita energy use and a majority of its rural residents use firewood as their primary energy source. Excessive use of firewood in improperly ventilated households degrades the indoor environment and health condition of the inhabitants.

Nepal is one of the poorest countries in the world with about 81 percent of its total population living in the rural areas as of 2017 (The World Bank, 2018). Being a Himalayan country, it has abundant water resources to produce hydroelectricity of more than 80,000 MW but until 2018 it has only succeeded in the generation of less than 1,000 MW (Kaini & Annandale, 2019). Due to the underutilization of its power capabilities predominantly due to lack of technical and financial abilities, the households and industries throughout the country had been facing power cuts for a decade until 2018 that hindered the growth of the country. Furthermore, the lack of connectivity and distribution networks of grid-power in the rural areas has been a constant cause of suffering for the people. With only about 72 percent of the rural areas connected to power, the people are compelled to rely on traditional biomass sources like firewood, charcoal, agricultural wastes and animal wastes for their daily cooking, lighting and heating needs.

In Asia, more than 75 per cent of households in Nepal depend on firewood. In communities from poor areas affected by deforestation or where nearby forests are protected, women and men need to take longer and longer trips to collect firewood.

Relationship between firewood consumption and family size: (a) Daily household firewood consumption and family size and (b) Daily per-capita firewood consumption and family size. Source: JOUR, Tika Ram, Pokharel Rijal, Hom, 2020/11/04, Hourly Firewood Consumption Patterns and CO2 Emission Patterns in Rural Households of Nepal, 10.3390/designs4040046



(a) (b)

With the increasing population, food waste, sewage sludge, and poultry litter management problem are scaling up even in low-income countries. The management of these wastes has therefore been challenging. Anaerobic digestion of food waste alone is not very stable due to its acidic nature and high degradability whereas sewage sludge and poultry litter have low biochemical methane potential and a high nitrogen concentration. Co-digestion, as is the case in theis project activity, leads to enhanced biogas production potential, system stability due to synergetic effects, and resolving the problem of waste management in the vicinity in a holistic approach.

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:**
- Reduces drudgery to women and children who spend long hours and travel long distances to collect fuel wood.
- Reduces indoor air pollution, thus eliminating health hazards for women and children.
- The project provides security of energy supply
- It leads to better manure management thus keeping the surroundings clean and reduce some of the disease causing pathogens
- Children are able to attend school in time as food will be cooked in time.

- **Environmental benefits:**
- Improves the local environment by reducing uncontrolled deforestation in the project area
- Avoids local environmental pollution through better waste management
- Leads to soil improvement by providing high quality manure
- Avoided global and local environmental pollution and environmental degradation by switching from non-renewable biomass to renewable energy, leading to reduction of GHG emissions
- Reduces deforestation, reduces indoor air pollution, and increases use of manure rather than chemical fertilizers.
- Using biogas as an energy resource contributes to clean environment.
- Poultry litter and food waste is transformed into high-quality enriched bio-manure/fertilizer.
- Hygienic conditions are improved through reduction of pathogens by utilizing the animal and other organic wastes in the bio-digesters.
- The high-quality manure produced will lead to improvement in soil conditions.
- Biogas is considered a better fuel than even natural gas and liquefied petroleum gas because it does not contain Sulphur. Sulphur on burning gets converted to sulphur dioxide which is responsible for many lung diseases. Also the danger of explosion is less as it contains carbon dioxide which acts as a fire extinguisher.

- Additionally, odours are controlled since all the gas is burned prior to release into the atmosphere. Pathogens and weed seeds are destroyed. Coliform bacteria, other pathogens, insect eggs and internal parasites also are destroyed or reduced to acceptable levels by anaerobic treatment.
- The enclosed anaerobic digestion systems for biogas production are not subject to pronounced influences of the weather, making effluents from digesters more stable and uniform.

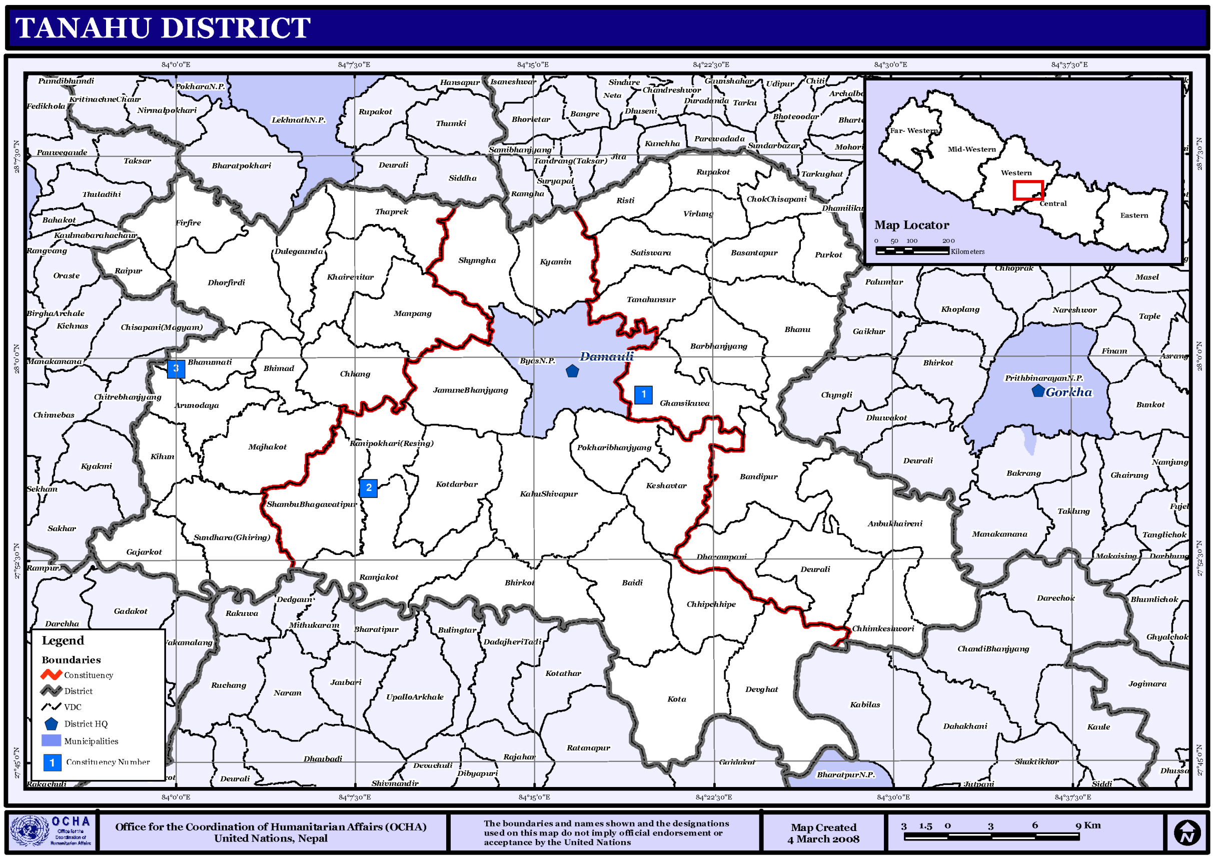
- **Economic benefits:**
- Higher productivity of family members as they have adequate cooking fuel supply
- Provides employment to local communities through construction and maintenance of biogas units.
- The project reduces cooking time, thus providing the three households to take up income generating activities like farming and other compost related sale activities.

Table below discusses the relevant Sustainable Development Goals (SDGs) addressed by the project:

SDGs	Targets
Good Health and Well beings	• By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination
Affordable and Clean Energy	• By 2030, ensure universal access to affordable, reliable and modern energy services • By 2030, increase substantially the share of renewable energy in the global energy mix • By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support
Climate Action	• Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning • Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

A.3. Location of project activity >>

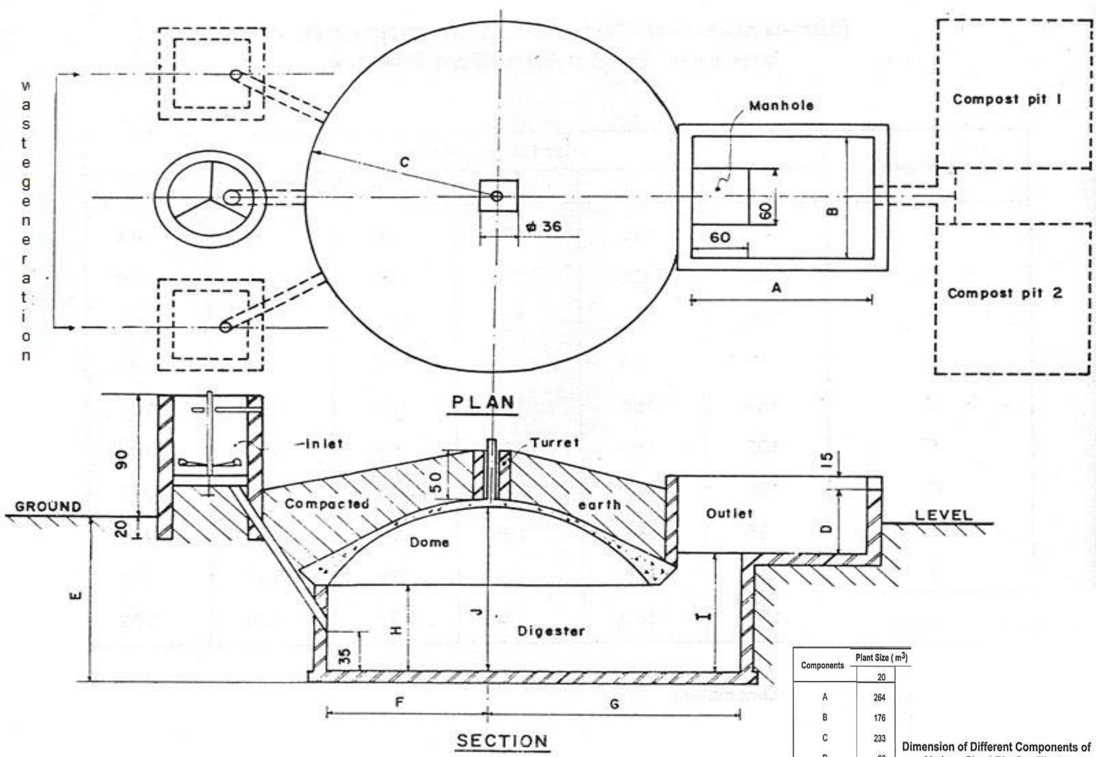
Country: Nepal.
District: Tanahu
Village: AnbuKhaireni
Area: Terai
Tehsil: Gandaki



A.4. Technologies/measures >>

The project activity uses only one design i.e. GGC 2047 model. The biogas digesters are based on a uniform technical design and are manufactured and installed following established technical standards in Nepal. The digester itself is a closed underground container made of concrete or other materials.

GENERAL BIOGAS PLANT



Dimension of Different Components of Various Sized Bio-Gas Plants

Components	Plant Size (m^3)
	20
A	264
B	176
C	233
D	86
E	203
F	199
G	293
H	115
I	137
J	203

Note : All dimensions are in centimeters.

The biogas digester consists of five main structures or components. They are the inlet, outlet, digester, dome and the compost pits. The required quantity of dung and water is mixed in the inlet tank and this mix in the form of slurry is allowed to be digested inside the digester. The gas produced in the digester is collected in the dome, called as the gas-holder. The digested slurry flows to the outlet tank from the digester through the manhole. The slurry then flows through the overflow opening to the compost pit where it is collected and composted. The gas is supplied to the point of application through the pipeline.

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 biogas is extracted from the digester and transported to the stove.

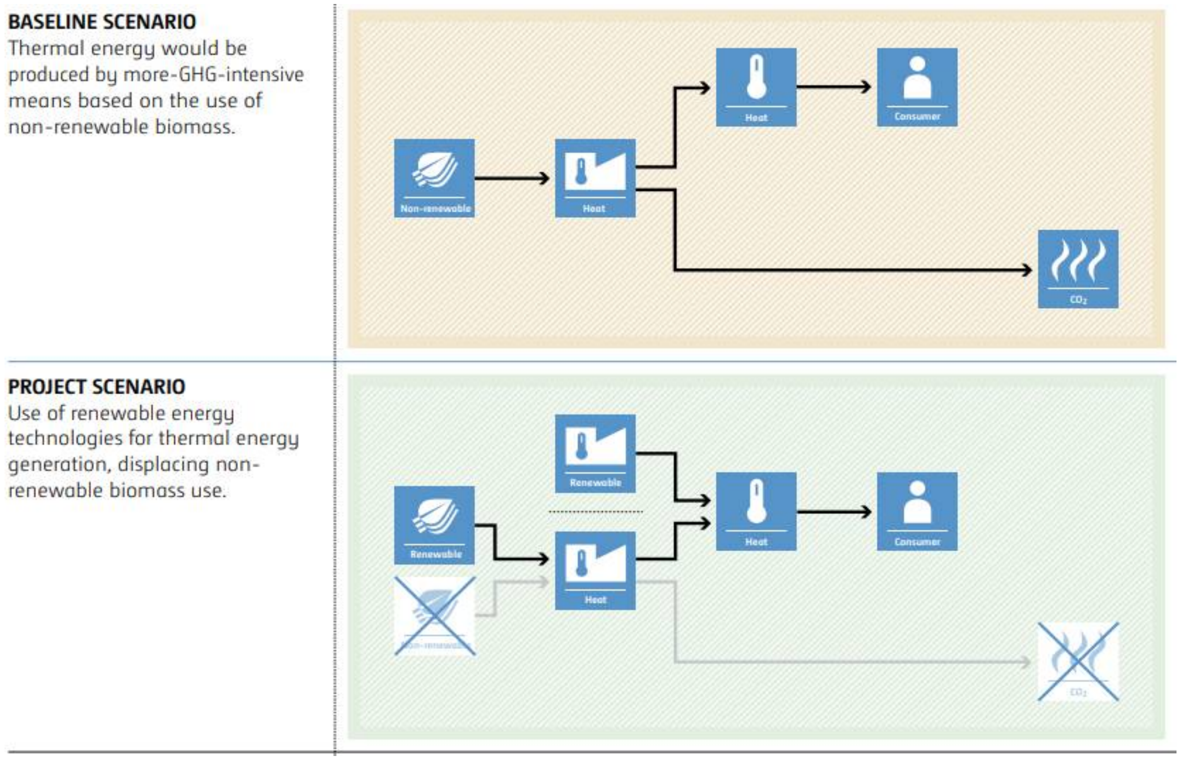
The technical specifications of the GGC 2047 model bio-digesters are as follows:

Specification	Value
Capacity per unit	20 m^3
Cooking Time /Day/household	4 hours
Number of units (digesters)	1
Feed Material Biogas Flow rate	Food Waste & Poultry Litter 0.9 m^3/hr
Number of Stoves	3
Efficiency of Burners	60.00%
Calorific Value Biogas (NCV_{biogas})	20 MJ/m^3
Unit Conversion rate MJ -> kWh	0.28
Rated Capacity (thermal) MW	0.003 MW_{th}

A.5. Parties and project participants >>

Party (Host)	Participants
Nepal	Nepal Urja Bikash Company Pvt. Ltd., Chaoubishkoti-10, Bharatpur, Chitwan, Nepal

A.6. Baseline Emissions>>



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

- thermal energy from fuel wood within the domestic households at the farm, of which a large part of it was non-renewable for domestic cooking and water heating. The baseline scenario is continued use of non renewable biomass (NRB) i.e. firewood for cooking. In addition to non renewable firewood, since fossil fuels like kerosene and LPG are hardly used. Only firewood consumption is considered for the baseline estimates. Thus, in the absence of the programme the beneficiaries would have continued the use of non renewable biomass (firewood) leading to its associated GHG emissions. Hence, use of non renewable biomass is considered as the baselines and emission reductions are claimed only for the displacement of non renewable fuelwood.

Thus, this project activity was a voluntary investment which replaced equivalent amount of thermal energy from renewable source, the biogas. 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 thermal energy from fuel wood and fight the impacts of climate change. The Project Proponent hopes that carbon revenues accumulated as a result of carbon credits generated will help repay the loans and in the continued maintenance of this project activity. The rural households across Nepal are primarily dependent on fuel wood for cooking and heating water.
Fuel usage correlates with income levels and lower income households tend to use more fuelwood as cost is still a barrier for use of LPG in rural areas. All the households were still using fuelwood as the dominant fuel for cooking and heating water for bath on inefficient mud/clay wood stoves that do not have chimney and grate.
Majority of the firewood users believe that cooking with this fuel improved their financial

wellbeing because selling firewood generated income, whilst collecting the fuel gave them an opportunity to socialise and is a tradition they would like to continue. They viewed LPG as a financial burden that gave food an undesirable taste and feared a fatal canister explosion. This shows that though LPG has been provided with subsidy to the rural communities, the refill is very expensive and rural households are still using traditional stove for cooking. Easy availability of biomass, affordability and concerns of safety issues deter households from adopting LPG and continue using fuelwood. The region is scarce of biomass and non-renewable biomass is part of the biomass used for cooking and heating water.

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)

TYPE I - Renewable Energy Projects

CATEGORY- AMS. I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User

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

For thermal applications of biomass, biofuels or biogas (e.g. the cookstoves), the limit of 45 MW_{th} is the installed/rated capacity of the thermal application equipment or device/s (e.g. biogas stoves).

The project activity is biogas cook stove for households and provides thermal energy from cattle dung that is renewable. It replaced the baseline technology mud/clay, three-stone traditional cook stove that used non-renewable biomass at the household level. The biogas produced is also used for captive power generation. Both the biogas units are of $15m^3$ capacity and distinct from each other.
Biogas produced by the are used or flared.
The annual average temperature of the biogas site is located is higher than 5°C
The storage time of the food waste and poultry litter after removal from the project site, including transportation, does not exceed 45 days before being fed into the digesters.
The livestock population in the farm is managed under confined conditions. Manure or the streams obtained after treatment are not discharged into natural water resources (e.g. river or estuaries).
The residual waste from the animal litter management system shall be handled aerobically.
The communities across Nepal are using non-renewable biomass since 31st December 1989. This is based on using published literature, official reports and statistics.
The project activity does not use renewable biomass. The renewable source is food waste and poultry litter.
The project activity is biogas cook stove and is not electric cook stoves.
There is a technology switch from traditional stove to biogas stove.
Project activity displaces use of non-renewable biomass by introducing biogas digesters and stoves, i.e. a renewable energy technology. This is a small scale project with total thermal capacity of 0.003 MW_{th} which is not greater than 1% of small scale thresholds defined by the applied methodology I.E. under Type I – renewable energy project activity, i.e. not greater than 45 MWth . Hence this project activity is a microscale project.

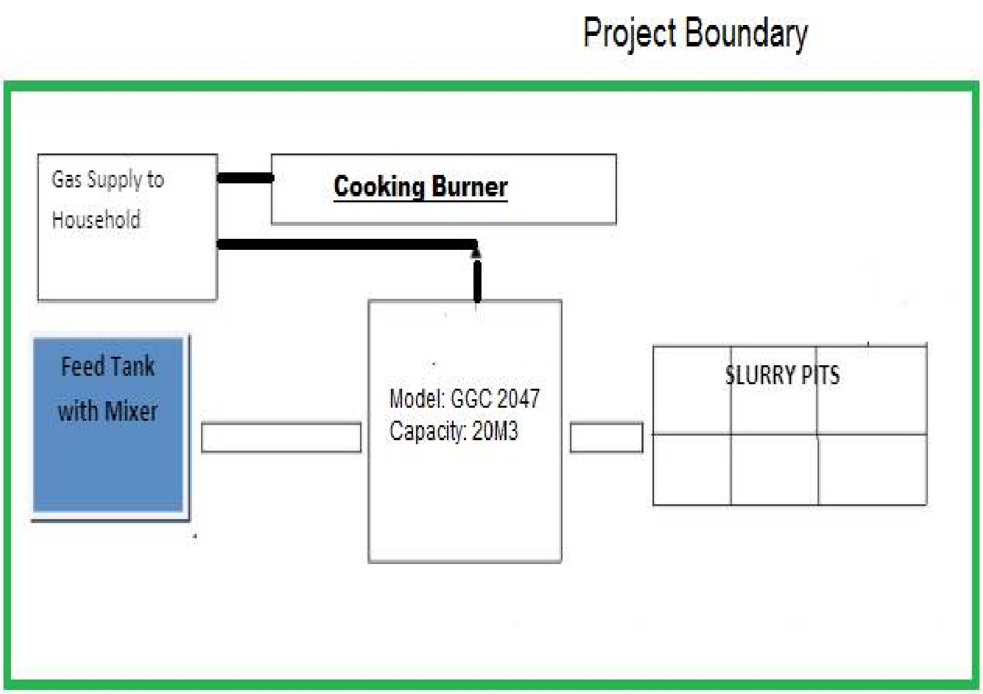
B.3. Applicability of double counting emission reductions >>

The biogas unit is constructed by the project proponent close to the household. The biogas unit has a unique ID, which is visible on the biogas unit. Records available are: Biogas Digester code. . - dome gas pipe number (a unique ID code), - the Biogas Company that supplied the digester, - the name of the owner, - address, - the size of the digester and date of commissioning of the digester

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

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

- Biogas digesters;
- Households using biogas for heating and cooking



	Source	GHG	Included?	Justification/Explanation
Basel ine	Emissions from burning non-renewable wood	CO_2	Included	Major source of emission
		CH_4	Excluded	Major source of emission
	Emissions from animal manure stored on site	N_2O	Excluded	Excluded for simplification. This is conservative
Proje ct Activ	Emissions from residue from anaerobic digester	CO_2	Excluded	Excluded for simplification. This is conservative
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative

Leakage Emissions is not applicable as the project cook stove is not switching to charcoal or processed renewable biomass.

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

The baseline scenario identified for the project activity is thermal energy from fuel wood, of which a large part of it was non-renewable for domestic cooking and water heating. Thus, this project activity was a voluntary investment which replaced equivalent amount of thermal energy from renewable source, the biogas. The project activity replaces non-renewable biomass by introducing the biogas digester producing renewable energy. 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 thermal energy from fuel wood. The methodology requires choosing options mentioned for calculating the "Quantity of woody biomass that is substituted or displaced". The UCR Standard option has been selected, as it is feasible and conservative in its estimation as against surveys conducted across similar UNFCCC CDM projects conducted across Nepal that is based on number of households multiplied by the estimate of average annual consumption of woody biomass per household substituted (tonnes/household/year) derived from historical data or estimated using survey methods. The CoUs or emission reductions for small-scale biogas units are based on approved fossil fuel emission displacement rates established by the UCR Standard. These rates have taken into account the size of the biogas unit, fossil fuel displaced and size of a household.

1-2 cubic meter	3 cubic meter	4 cubic meter	5 cubic meter	>5 cubic meter
3.5 CoUs/year	4.5 CoUs/year	5.3 CoUs/year	5.5 CoUs/year	Biogas units that have a capacity above 5 cubic meters that follow this UCR Protocol will be credited at the 5 cubic meters rate

Estimated Annual Emission Reductions: $BE_y = HG_{ythermal} \times EF_{FF, CO2}$

BE_y = Emission reductions from the use of non-renewable biomass as per the UCR protocol in a year y.

where:

$HG_{y, thermal}$ = Total thermal capacity of the number of digesters in year y

$EF_{FF, CO2}$ = CO_2 emission factor of the fossil fuel displaced in the baseline as determined by the UCR Standard based on a $2m^3$ digester.

GWP_{CH4} = 21 is the default IPCC value of CH_4 applicable to the crediting period (tCO_{2e}/t CH_4)

NCV_{CH4}= NCV of methane (MJ/Nm^3) (default value: 35.9 MJ/Nm^3)
$NCV_{biomass}$ = Net calorific value of the non-renewable biomass as per UCR Standard (0.015 TJ/tonne)

Estimated annual baseline emission reductions (*BE_y*) = 22 CoUs /year (22 tCO_{2eq}/yr)

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:	f_{nrb}
Data unit:	Fraction of woody biomass saved by the project activity in year y that can be established as non-renewable biomass
Description:	Determination of the share of NonRenewable woody biomass
Source of data:	UCR Standard
Measurement procedures (if any):	Fixed
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data/Parameter	Number of Functional digesters
Data unit	N
Description	Number of functional digesters in households in the project activity in year y
Source of data Value(s) applied	Monitoring Report As and when commissioned
Measurement methods and procedures	The repair and maintenence sheets are maintained from its initiation to completion dates for the biogas unit.
Monitoring frequency	As per sample survey
Purpose of data	To estimate baseline emissions

Data/Parameter	B_y
Data unit	tonnes/household/year
Description	Average annual consumption of woody biomass per household in the project before the project activity.
of data Value(s) applied	UCR Standard Protocol As per Standard
Measurement methods and procedures	Fixed
Monitoring frequency	NA
Purpose of data	To estimate baseline emissions

Data/Parameter	Firewood Consumption in Baseline
Data unit	tonnes/household/year
Description	Average annual consumption of woody biomass per household in the preproject devices during the project activity.
of data Value(s) applied	UCR Standard Protocol As per Standard
Measurement methods and procedures	Fixed
Monitoring frequency Purpose of data	NA To estimate baseline emissions