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## 2. INTRODUCTION OF THE PROMOTORS

### 2.1 The Company

**PKLS Industries Pvt Ltd** is a company incorporated under Companies act, 1953 in 2017. It has Its corporate office at No 316-317, 1st Floor Sushant Golf City, Sultanpur Road, Lucknow (UP), INDIA, Pin 226030.

The PKLS Industries Pvt Ltd (PKLS Group) is a diversified holding company, active in a wide range of industries and businesses mainly in Uttar Pradesh (UP) & Madhya Pradesh (MP), INDIA. PKLS Group is backed by a team professional with a solid experience and track record of successfully setting up and running large companies in India and abroad. PKLS Group is focused on developing business by capitalizing on the potential of INDIA's rapid economic growth.

PKLS Industries Pvt Ltd. is a company working on **Renewal able Energy & Waste to Energy** Projects in UP & MP, INDIA. It is planning to venture into manufacturing and marketing of **Renewal able & Waste to Energy** projects of (CBG)Compressed Bio Gas, Bio Ethanol, Bio Coal/white Coal/Bamboo farming and its bi-products. It is also planning for backward integration into dairy, poultry, piggeries, bamboo & Napier grass farming to ensure self-sufficiency in **raw** materials for un-interrupted and smooth operations of bio fuels projects.

At **PKLS**, we have strong factors which would be of **immense benefit & interest to any investor to** partner in our growth together**.** These factors include but not limited to the following:

- Manufacture of CBG (Compressed Bio – Gas)
- Manufacture of Bio Fuel (Bio Ethanol)
- Manufacture of Bio Coal/White Coal
- Bamboo/Napier Farming.
- Setting up of Solar power farms
- Providing engineering & contracting services
- Education Division operating under auspices of **M/s PKLS Social welfare Trust**

## 2.2 Details of the company

| S. No. | Particulars | Details |
|---|---|---|
| 1 | Name of the applicant (Promoter) | PKLS INDUSTRIES PRIVATE LIMITED |
| 2 | GST | 09AAJCP2385N1ZU |
| 3 | PAN | AAJCP2835N |
| 4 | Incorporation Details | CIN- U45309UP2017PTC094651 |
| 5 | Type of Company | Private Limited |
| 6 | Mobile/Tel No | 9575058348 |
| 7 | Email of the Company | MD@PKLSGROUP.COM/ Profpksingh@gmail.com |
| 8 | Place of Registration | Uttar Pradesh |
| 9 | Date of Registration | 07-04-2017 |
| 10 | Income Tax No. | AAJCP2835N |
| 11 | Contact Person | Dr. L S Singh / Dr PK Singh |
| 12 | Designation | MD / Director |

## 2.3 The team behind PKLS

**Dr L S Singh – MD & CEO (Founder / Promotor)**

Dr L S Singh is a seasoned & matured professional having multiple qualifications –**BSc** (Chemistry), **MA** (Economics), **LLB.** (**Labour Law & Taxation** ) **WTM** from IIMM, **GDMM & PGDMM** from **IIMM**, **MBA**, **Lead Assessor** for ISO 9001:2000 from **RINA Egypt**, Research Fellowship/(Doctorate) **(Ph.D.)** in **ERP –Systems.**

He has 42 years' rich experience in the field of Overall management as Business Head/CEO/COO/ED/MD for Automobiles, Steel, Cement, Power & Construction Industries.

He has worked with market leaders in India viz. Jaiprakash Associates (**JAYPEE-Cement**), **JSW Steel (Jindal Group), Birla** group, **Lanco Power** and also in Senior/Top management roles abroad in steel manufacturing companies.

**Dr Singh** is a man with a mission & vision who mentors & guides the team and makes efforts to convert companies' dreams into reality.

### 1. Mr Ashim Kumar Mukherjee (Chief Advisory Officer)

He is a former bureaucrat from National External Wing (RAW) with a distinguished service career before taking voluntary retirement and then switched over to corporate sector in 2009. He has over 32 years' experience in corporate regulatory affairs, governance, comprehensive due diligence, business intelligence, strategy, compliance and government liaison. He is highly networked with govt institutions. He was CEO of Eisen Industries Ltd, Mumbai from Oct 2019- Dec 2020.

Currently he is engaged in advisory role under Make in India mission. He is working as advisor and senior consultant to many reputed companies.

He is with us as **Chief Advisory Officer** to the Board of Directors of our company for taking up liaison and approval of the projects with the authorities.

### Dr P K Singh (CEO)

He is MSc, PhD (Chemistry) from Rajasthan University, Jaipur. He has worked in public and private sector at various positions for over 40 years, mostly in cement industry. Later he joined an engineering university as a professor and superannuated from the position of Dean (Academics & Research) recently. He is a very mature and seasoned person having vast theoretical & practical experience and knowledge. He is working with us as CEO. He will look after all **green energy** projects of the company.

**Er. M E Pawar (CTO)**

He is a Graduate Engineer having over 24 years of experience, He is very sound techno-commercially and a dynamic person. He worked with **JSW group** at senior positions in various factories of the group such as Steel, Power, Cement. He did a stint at their corporate office too. He looked after planning and execution of several projects of the group. He is our CTO.

**2. Er Ajay Kumar Singh (Executive Director)**

He is a Graduate **Engineer and an MBA.** He is a dynamic person with 14 years' industrial experience in Cement and Steel sector in India and abroad. He is whole time Director and working as **Executive Director** to take care of day to day operational issues and planning for future strategy of entire operations our group companies.

**Mr Harinder Singh (CFO)**

He is a Cost & Management Accountant **(CMA)** having over 35 years' experience in companies engaged in production of soaps, detergents, cooking oil, white goods, wheat flour, steel D bars, chemicals, glass, sugar, alcohol, paper and power from natural gas. He has looked after finance and accounts function from planning stage till start of commercial operations and thereafter for many projects. He will lead the team for accounts, finance, commercial and compliance functions of the group company.

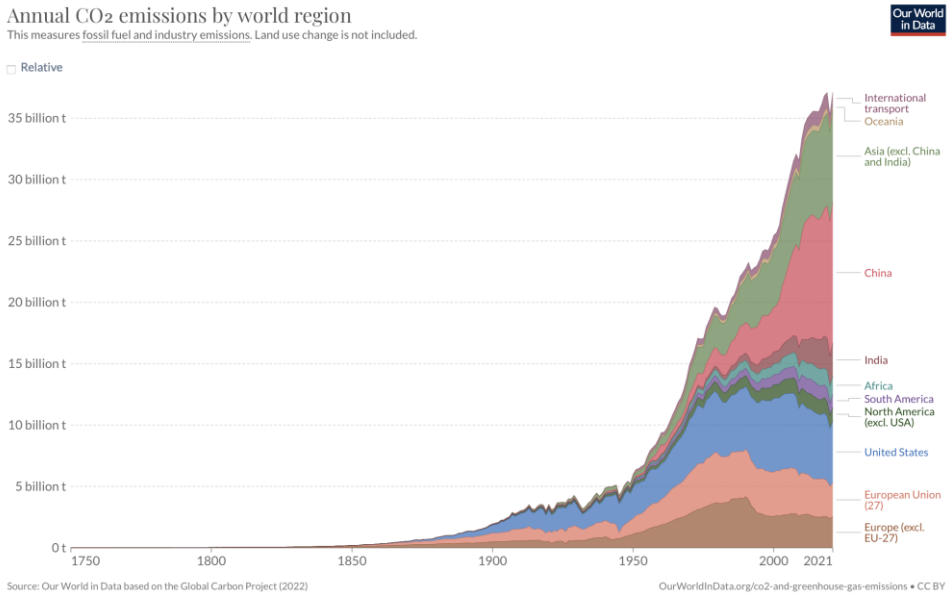
# 3. EXECUTIVE SUMMARY

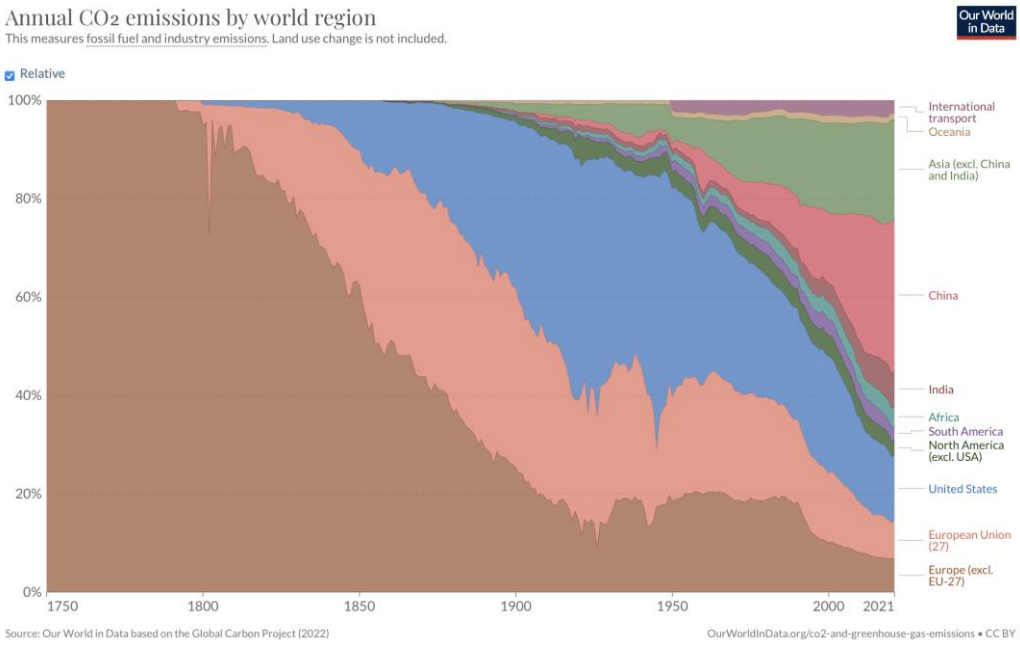
**Brief Executive Summary of the CBG Project**

The 25 MTPD Bio CNG plant is designed to run on 450 MTPD feedstocks like **Napier Grass, Paddy Straw, Agriculture Residue, Cow Dung, municipal waste** etc. The plant will be able to run throughout the year with these inputs since they are available all over the year.

## 3.1 Background

The energy crisis is a big problem faced by the world today. Economy and technologies today largely depend upon resources that are not replaceable. Energy demand has to be met with the available resources. The conventional sources are limited and cannot be used forever. Predicted estimates for the utilization rate of energy resources show that the coal deposits will deplete within the next 200 years and the petroleum deposits in the next few decades.




Pollutants generated from these sources (conventional) have led to climatic changes (global warming and cooling), acid rain etc, which will bring tremendous adverse effect on ecological cycles and the ecosystem. On the one hand, we have the problem caused by municipal and industrial wastes, which are disposed into the environment and on the other, we have the energy crisis, which is to be met by sustainable and cleaner technologies. The best possible option is the biological treatment of wastes using **anaerobic technology**. In this process, the wastes are converted with the help of anaerobic bacteria into biogas (energy) and mineralized sludge (organic manure).

## Benefits of the bio fuels projects to the society

- Replacement of fossil fuels & result in mitigation of GHG emissions & Environmental

Pollution.

- Organic manure from effluent of the biogas plant, will replace chemical fertilizers as well as enhance soil fertility
- Creation of rural jobs and employment
- Replacement of coal with bio pellets for industries
- Creation of direct job opportunities in the Biomass supply chain, Biogas/Bio-CNG plants, Compost unit, and (potentially) in Liquid CO2 units.
- Contribution to organic (or reduced chemical) farming through assured availability of organic manure.
- Contribute to skilling of local community.
- Improving farm income, through avoiding costs in stubble removal & reducing costs for chemical fertilizers. Also, providing opportunities for crop-diversification
- Creation of industrial work ethos, in rural areas, which will help catalyse growth in MSME's,
- In general, an improvement in the quality of life of the local people, living within the catchment areas of the projects

## 3.2 Site Location:

| S. No. | Particulars | Details |
|---|---|---|
| 1 | Name of the Industry | PKLS INDUSTRIES PRIVATE LIMITED |
| 2 | Village | Village Sejhari, Post- Chandai |
| 3 | Tehsil | Birsinghpur |
| 4 | District | Satna (MP) |
| 5 | Graphical Co-ordinates | Latitude: 24°33'37.1"N<br>Longitude: 81°19'15.2"E |
| 6 | Climate Conditions | Files attached |
| 7 | Humidity | Max: 84 % (August)<br>Min: 24% (April) |

| | | |
|---|---|---|
| 8 | Temperature | Max: 41°C (May)<br>Min: 10°C (January)<br>The hot season lasts for 2.2 months, from April 11 to June 18, with an average daily high temperature above 38°C. The hottest month of the year in Satna is May, with an average high of 41°C and low of 28°C.<br><br>The cool season lasts for 2.4 months, from December 1 to February 13, with an average daily high temperature below 80°F. The coldest month of the year in Satna is January, with an average low of 10°C and high of 23°C. |
| 9 | Seismic activity: | None |
| 10 | Rainfall | Max: 303 mm (July)<br>Min: 5 mm (April) |
| 11 | Nearest Village | |
| 12 | Nearest Town | Satna - District town and headquarters |
| 13 | Land Area | 15 Acres |
| 14 | Soil Type | Alluvial Soil |
| 15 | Nearest Water Bodies | 1. Tons river<br>2. Son river<br>3. Baisuni river |
| 16 | Nearest Highway | 3km at link road connected to Allahabad -Chitrakut (UP) highway to Satna (MP). |
| 17 | Interstate Boundary | Uttar Pradesh |
| 18 | Nearest Forest Reserve | Name: Bandhavgarh National Park<br>Distance from site of the Project: 166 kms |
| 19 | Nearest Railway station | Name: Satna Railway Station<br>Distance from site of the Project: 39 kms |
| 20 | Nearest Air Port | Name: Khajuraho Airport<br>Distance from site of the Project: 133 kms |

## 3.3 Raw Materials (Feedstock)

The type of feedstock to be used for CBG production and financial viability of a plant depends on many factors like cost of input feedstock, location of plant, etc. Availability of raw materials is abundant within 25-40 km area from proposed location of our plant.

The following are the estimated yield of various feedstocks as per discussions with various existing and proposed CBG Plants and various technology providers. However, these are only directional in nature and actual yield may vary depending on quality of feed stock.

| **Type of Biowaste** | **Dry Matter % per Ton** | **CNG Output (Percentage; Reference IOCL)** | **Slurry Output in Kg/Ton** | **Bio-Biofertilizer in Kg/Ton** |
|---|---|---|---|---|
| | % per Ton | % mass | Kg/Ton | Kg/Ton |
| Cattle Dung | 18 | 2.50% | 938.68 | 168.96 |
| Soybean/Paddy Straw | 86 | 18.18% | 649.65 | 558.70 |
| Napier Grass | 35 | 6% | 863.71 | 130.00 |

## 3.4 Co-Digestion

The Project is designed for use of combined feedstock of NAPIER GRASS, AGRICULTURE RESIDUE, COW DUNG, MUNICIPAL WASTE, FOOD PROCESSING WASTE ETC.

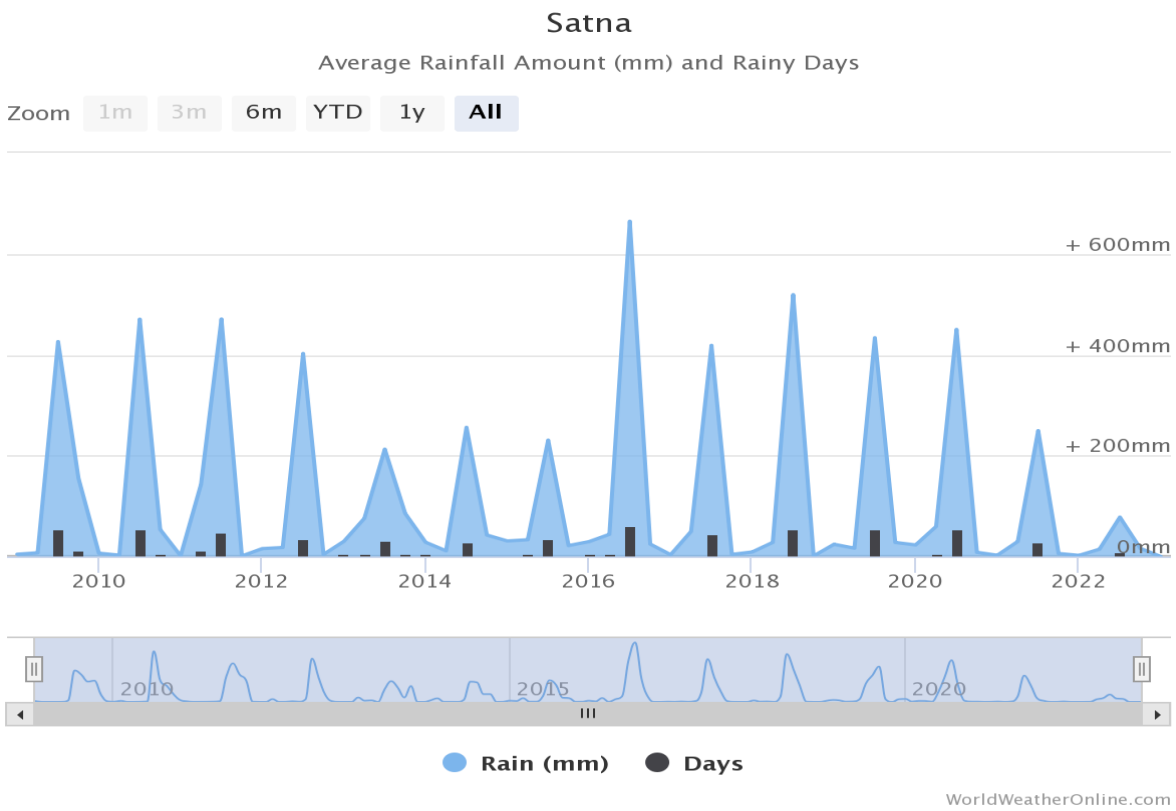
## 3.5 Source of Water and its Treatment

The ratio of water mixed with the input feedstock is 1:1. The daily water requirement is 60% of the input feedstock when the plant starts to produce the Biogas & runs steadily. The fresh water requirement is 450,000 Litre/day for the first 50 days for Bio gas Plant of input feedstock of 450 TPD. After 50 days when batch of slurry comes out of main digester, decanter can recover 40% of the slurry water which can be recycled and reused. So only 60 % of fresh water is required daily.

The normal annual rainfall of Satna district is 1,092 mm. The district receives maximum rainfall during south-west monsoon period (i.e. June to September) and about 87.7% of annual rainfall is received during this period. Only 12.3% of the annual rainfall takes place

between periods October to May. Rainfall forms the sole source of natural recharge to ground water regime and the rain water is available for recharge to ground water is mainly during south-west monsoon period only. The maximum normal annual rainfall received in the district is 1,106.5 mm at Satna and minimum is 1,056.1 mm recorded at Maihar.

## Rainfall Data of Satna




This provides sufficient ground water charging in the region. We will use bore hole water for our operations after necessary approvals.

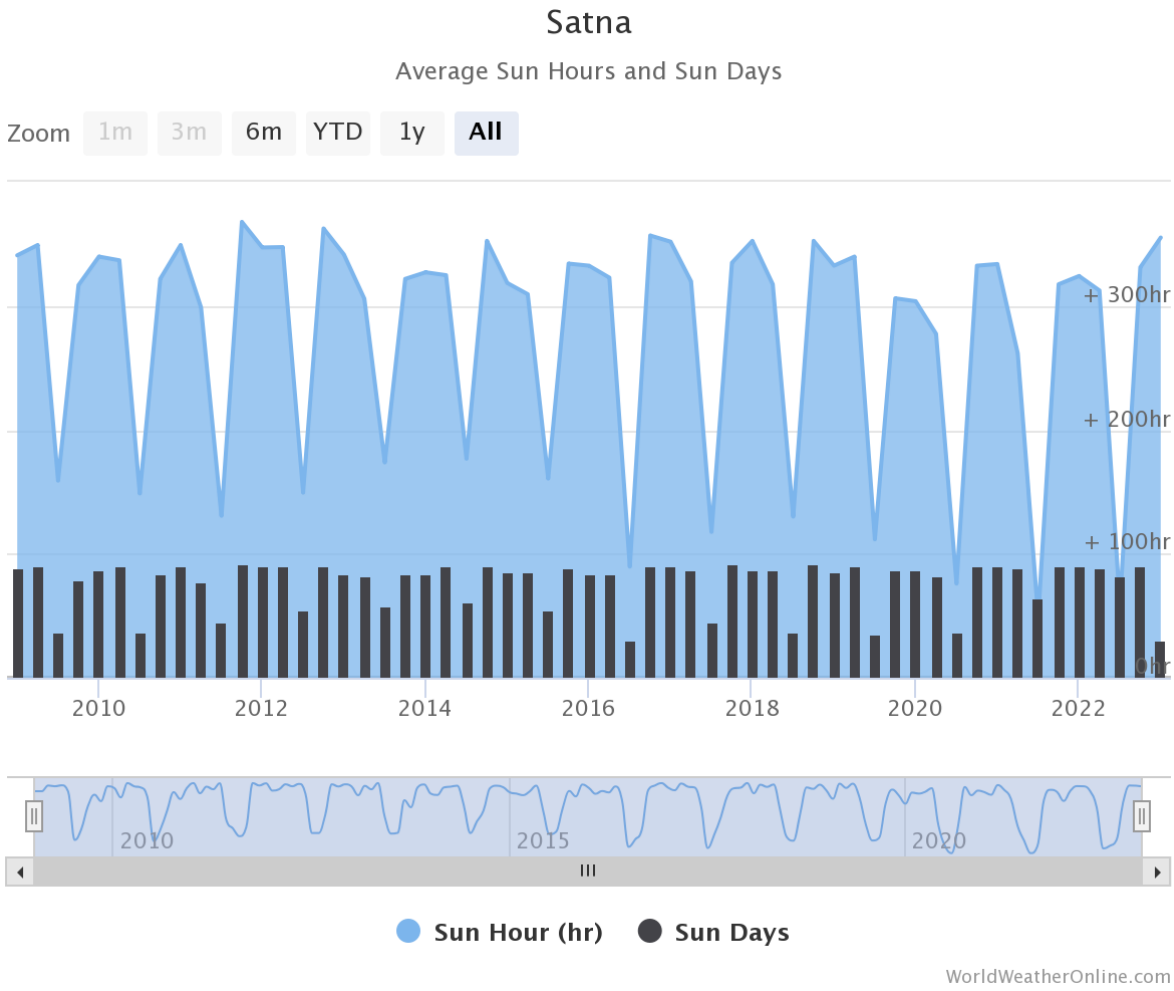
## 3.6 Advantages of Location

The proposed location offers several advantages in terms of availability of raw material, availability of civic amenities, and availability of ground water. The project has good revenue potential. The sale of the BIO-CNG generated, bio-fertilizer produced contributes to the project revenue.

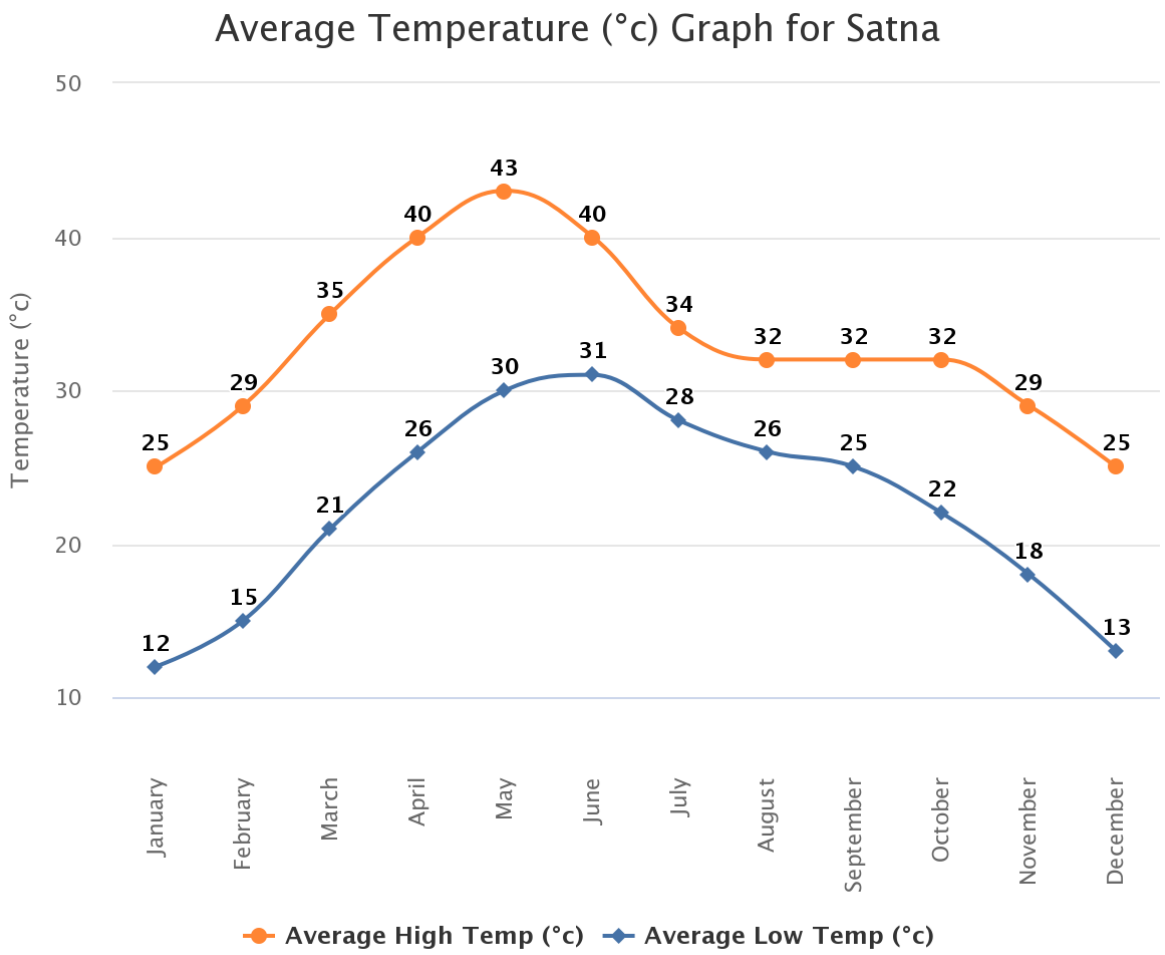
The site is well connected with nearby areas and ample market for CBG is available in the nearby regions.

## 3.7 Temperature & Humidity Graph of the location

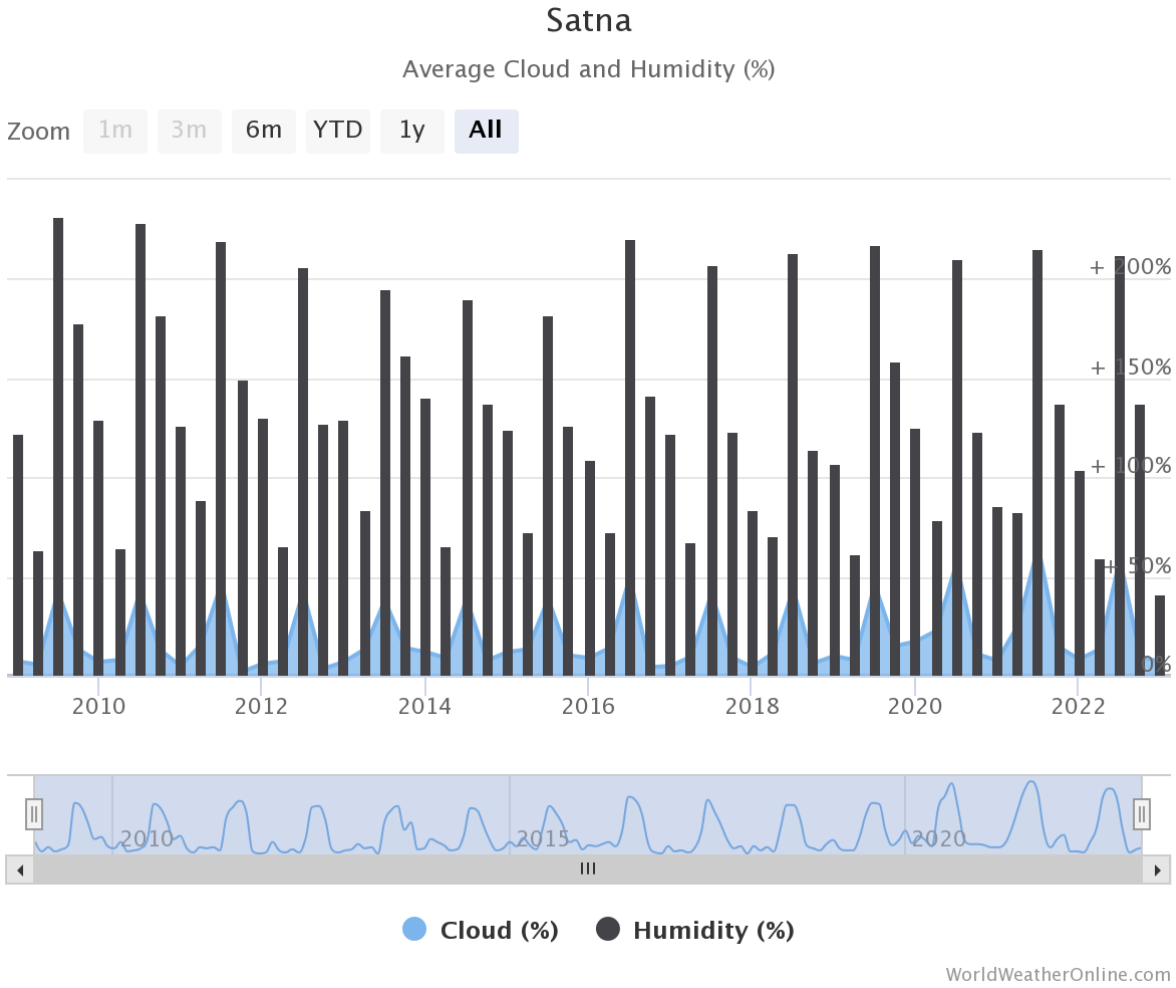
**Graph I – Average Sun Hours Graph for Satna**



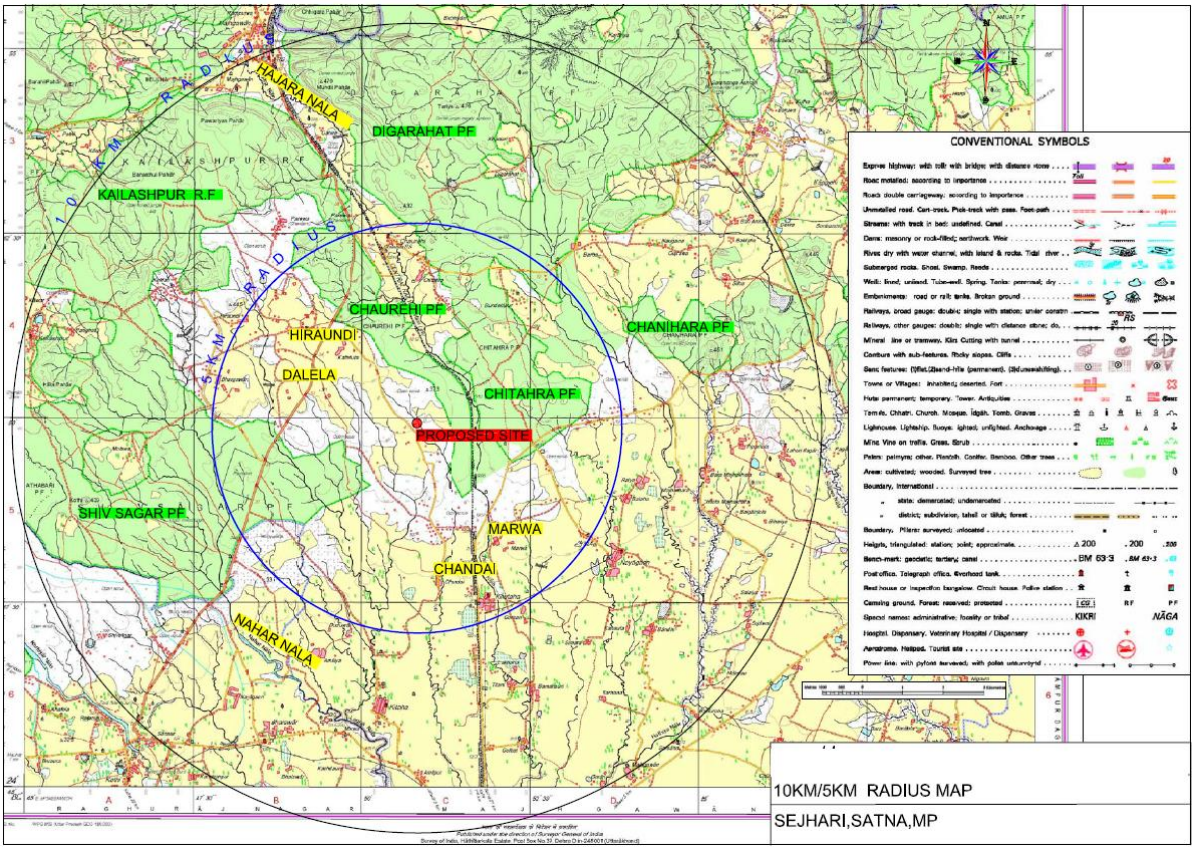
## Graph II – Average Temperature Graph for Satna



Graph III - Average Humidity Graph for Satna




***PROPOSED SITE LAND PLAN/MAP:***




## 3.8 Product & its Uses

Main products of the project are CBG, Bio Pellets & Manure. The raw biogas has Methane concentration of 55-60%. The gas can be purified and the Methane concentration can be increased to greater than 96% which can be used as used as fuel in vehicles.

Bio-Manure will be extracted from the slurry with 15-20 % of solids that depends on the type of waste used, same can be used as fertilizer.

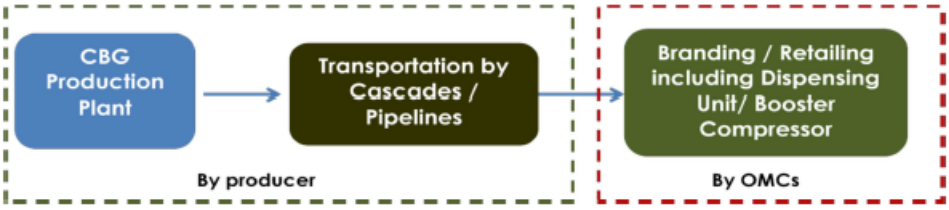
## 3.9 Market Potential

Biogas is a natural gas which is produced by anaerobic digestion of organic mass of biodegradable matter. It can be used as a fuel in order to supply energy. Biogas can be converted into bio CNG which can replace the current usage of fossil fuels. India is expected to be one of the largest contributors to non –OECD petroleum consumption growth globally. India's oil demand is expected to grow at a CAGR of 3.6% by 2040 while the demand for energy will more than double by 2040 as the economy will grow to more than 5 times its current size. This scenario presents a huge opportunity for bio fuels sector.

## ROLE OF OIL MARKETING COMPANIES (OMCS) IN BIO FUELS

The CBG Plants shall be set up by mainly through independent Entrepreneurs and in few specific cases, OMCs may consider setting up of CBG plant. The marketing of all the CBG produced through such plants will be through OMC network, under their respective brand names.

Producer(s) / Seller(s) (Party/Entrepreneur) shall deliver CBG (within 75 Km, an indicative maximum distance), at Public sector Oil Marketing Companies" existing or new Retail Outlet / stand-alone Selling Point, through Cascades. The equipment for dispensing CBG at Public sector Oil Marketing Companies" existing or new Retail Outlet / Stand-alone selling point shall be installed and maintained by Public sector Oil Marketing Companies", however, the CBG nozzles shall be manned and operated by RO Dealer. Electricity expenses towards dispensing of CBG through sale point shall be reimbursed to the Party who is actually bearing the costs. The meter installed in the CBG dispensing unit(s) at the Retail Outlet shall be the "Point of Sale". Detailed mechanism for measurement for supply of CBG would be described in definitive agreement. The cascade to remain connected to the compressor at retail outlet till the dispensation is operationally feasible.




## Pricing Framework of CBG (To be retailed through OMCs)

| S No | Lower Retail Selling Price of CBG in Slab | Higher Retail Selling Price of CBG in Slab | Procurement price of CBG | Procurement price of CBG |
|---|---|---|---|---|
| | including tax | including tax | Without GST | With GST |
| | Rs./kg | Rs./kg | Rs./kg | Rs./kg |
| 1 | Retail Selling Price of CBG up to 70 | | 54.00 | 56.70 |
| 2 | 70.01 | 75.00 | 55.25 | 58.01 |
| 3 | 75.01 | 80.00 | 59.06 | 62.01 |
| 4 | 80.01 | 85.00 | 62.86 | 66.01 |
| 5 | 85.01 | 90.00 | 66.67 | 70.01 |
| 6 | 90.01 | 95.00 | 70.48 | 74.01 |
| 7 | 95.01 | 100.00 | 74.29 | 78.01 |

*Note: The above table is applicable strictly for supply of CBG at a one-way distance up to 75 km from the CBG Plant. For distance beyond 75 km, the price will be first adjusted as defined in para (e) to bring it to 75 km distance table as above and then procurement price shall be fixed as per the table. For further increase in slabs beyond Rs. 100/kg, procurement price will be extrapolatedas per the above. If the RSP of CBG falls below Rs. 70/kg, there will be immediate revision in theprocurement pricing.*

Additionally, an element of Rs. 2 per kg of CBG towards cost of setting up of infrastructure e.g. booster compressor, dispensing unit, etc. at retail outlet and Rs. 0.50 per kg of CBG towards electricity charges for operation of booster compressor, dispensing unit, etc at retail outlet, shall be provided to OMC or APPLICANT, as per whosoever sets up infrastructure at retail outlet.

## DEMAND OF ORGANIC FARMING INPUTS - BY-PRODUCT OF CBG PLANT

- The organic food industry in India is expected to grow at a CAGR of 25%-30%.
- Increase in demand of organic input is directly co-related to an increase in demand for organic food, which is supposed to increase at a rate of at least 10% year on year.
- Agricultural Universities across the country are advocating the increase in the use of manure in all crops to counter the prevalent deficiency of organic carbon in the soil.
- Increased awareness of the harmful side effects of excessive use of chemical fertilizers has also resulted in the increased demand for organic farming inputs.
- The increasing trend of community organic gardens has led to an increase in the demand for organic farming inputs as well.
- An increase in the demand for organic produce has led to an expected increase in the producers of Organic Manure.

- This presents a very good revenue opportunity along with CBG for the entrepreneurs

## 3.10 Subsidies and Incentives as per MP **Renewable Energy** Policy 2022

- **Renewable Energy** potential in Madhya Pradesh (MP)
    - Solar energy: 61,000 MW
    - Wind energy: 11,000 MW
    - Small hydro project: 820 MW
    - Bio Mass energy: *figures not provided in the policy*
- State attempting to have 50% **renewable energy** by 2030
- Attempting to turn 20%, 50% & 100% state level Govt. departments and all heritage cities into **green energy** compliant by 2024, 2027 and 2030 respectively
- Policy to remain in force for 5 years from the date of the notification
- Incentives
    - 100% exemption in electricity duty
    - 50% exemption in stamp duties
    - Land at concessional rates
    - Carbon credits

## 3.11 Other Incentives

A. Ministry of New and **Renewable Energy** has launched a programme on energy from Agricultural Waste/ Residue in the form Of Biogas, Bio-CNG, Enriched Biogas/Power.

- The Projects based on bio waste from urban and agricultural waste cattle dung, agro-processing industry residue, **green** grasses etc., are eligible for Central Finance Assistance (CFA) in the form of capital subsidy and grant-in aid under the programme. Project with bio-CNG generation based on biogas generated from agricultural waste are eligible for **Rs.4 crores CFA per 4800 kg** of bio-CNG capacity per day.

B. Sustainable Alternative Towards Affordable Transportation (SATAT)

- On 1st October 2018, Minister of Petroleum and Natural Gas has announced an initiative with ***PSU Oil Marketing Companies (OMCs, i.e., IOC, BPCL and HPCL) inviting Expression of Interest (EoI) from potential entrepreneurs to set up Compressed Bio-Gas (CBG) production plants and make available CBG in the market for use in automotive fuels by better usage of agricultural residue, cattle***

***dung and municipal solid waste***. The policy aims to roll out 5,000 Compressed Bio-Gas plants across India in a phased manner. It is planned to roll out 250 plants by the year 2020, 1,000 plants by 2022 and 5,000 plants by 2025. It is expected that the proposed plants will be set up mainly through independent entrepreneurs. CBG produced at these plants will be transported through cascades of cylinders to the fuel station networks of OMCs for marketing as a **green** transport fuel alternative. The marketers/ entrepreneurs would be able to separately market the other by-products from these plants, including bio-manure, carbon-dioxide, etc., to enhance returns on investment. This initiative is expected to produce 50 million tonnes of bio-manure for crops.

C. Bio-CNG is classified under the **5% slab of GST**. Petrol and diesel are not under GST regime.

D. The policy envisages incentivizing the nascent 'Advanced Bio-fuel" industry with **fiscal incentives in the form of tax credits, advance depreciation on plant and machinery**.

E. **Exemption from Income Tax for 5 years**, however, Minimum Alternative Tax (MAT) need to be paid.

## 4. Statutory Clearances Required for The Proposed CBG Plant

### 4.1 Approval for Change of Land Use

The approval for change of land use from agriculture to industry will be obtained from Deptt of Town Planning being the project is under NRSE Policy-2012,

### 4.2 Approval from Factory Inspector

Approval for establishing the proposed Biogas/Bio-CNG plant will be obtained from the Chief Inspector of Factories.

### 4.3 Approval from Electrical Inspector

Approval for the electrical installations of Biogas/Bio-CNG Plant as well as Power receiving station etc., shall be obtained from the Chief Electrical Inspector, Government of Madhya Pradesh

### 4.4 Approval for Fire Protection Systems

Approval from the applicable authorities shall be obtained for the firefighting systems (hydrant system, portable fire extinguishers etc.) proposed to protect the

plant &machinery, switchyard, biomass depots, compost yard and other buildings. Appropriate Insurance Policy will be taken.

### 4.5 Approval from Petroleum & Explosives Safety Organization (PESO)

Consent order for establishment from the Petroleum and Explosives Safety Organization (PESO) will be obtained as per Gas Cylinder Rules 2016 under Explosive Act 1884

### 4.6 Consent for Establishment from Pollution Control Board

Consent order for establishment from the MP Government Pollution Control board will be obtained for air pollution, water pollution and noise pollution.

## 5. TECHNOLOGY SELECTION FOR THE PROJECT

### 5.1 Technology Selection

The Proposed Project is designed to treat 450 Tons/day of feedstock to produce 5-6% Bio CNG by Bio methanation Process (Commonly called Anaerobic Digestion, AD)

### 5.2 Bio Methanation

It is the process of conversion of organic matter in waste (liquid or solid) to biogas (rich in methane) by microbial action in the absence of air, known as Bio methanation "anaerobic digestion

### 5.3 Biogas & Biomethane

Biogas production, through anaerobic digestion of lingo-cellulosic Agri residues, can now be effectively done, employing advanced Pre-Treatment technologies. The Raw Biogas, would range between 10-12% of influent. Biogas production from Manure or co-digestion of Manure with Agri residues and other bio-waste is commercially proven technology. Compost would be a Co-Product, in all cases. Compressing upgraded Biogas would produce Bio-CNG which could be an effective transport fuel. Biogas & Biogas upgradation technologies are commercialized and field proven. Hence, they can be adopted for large scale replication, with potential to make significant contribution to mitigation of environment pollution as to well as enhance access to clean gaseous fuels, even in rural Districts.

### 5.4 Biogas Technology

The Indian biogas industry is exploring various substrates for the biogas production and these are mainly municipal solid waste, agriculture residue, cattle dung, spent wash,

bagasse, agriculture residue such as rice straw is a potential cheap **renewable energy** resource available in northern part of India and can be converted to clean energy 'Biogas' to reduce dependence on fossil resources for energy. These biogas plants help in:

1. Generation of clean energy
2. Environment friendly disposal of biodegradable waste, which is the need of the hour considering mass pollution everywhere.
3. Generation of high-quality bio mass pellet, which would be weed less and an excellent soil conditioner
4. Environmental protection by helping in maintenance of elemental cycles in the nature.

## 5.5 Design Criteria / Technical Specifications Of The Plant

| s.no | Description | Specifications/Details |
|---|---|---|
| 1 | Plant feed | • Cow Dung + Napier Grass + Paddy Straw (450 Tons/day) |
| 2 | Plant area required | • 15 Acres for scope of future expansion |
| 3 | Plant capacity | • 5-6% CNG of the input effluent |
| 4 | Design of the pre digesters | • 2 pre digesters with mixing system with a capacity of 1005 Cubic m per day each.<br>• ETP water and other water sources can be used for this purpose |
| 5 | Design criteria of the digester | • 10 digesters with a HRT of 45 days and SRT 55 days<br>• Volume: 5300 Cubic meters<br>• Should create optimal process and mixing conditions for anaerobic degradation of organic matter. |

| | | |
|---|---|---|
| | | • Agitation without moving parts/ Components placed inside the digester.<br>• Uniform feeding rate from pre digester to main digester by using force feeding pumps for mixing of the slurry in the digester.<br>• Multi outlets of Floating sludge withdrawal system from main digester to pre digester |
| 6 | Biogas storage balloon | • 10 number of biogas balloons with a capacity of 1000 cum storage volumn of the Biogas |
| 7 | BioGas upgradation system | • Biogas upgrading system by using water scrubbing VPSA Technologies with a capacity of 1000 cum/hr running for 16 hrs per day.<br>• The scrubbing system is an automatic operation with automatic elements of on-line gas monitoring system to check the gas quality online. For this system we consider gas online analysis like $H_2S$, Methane., $CO_2$ and dew point.<br>• The scrubbing system coupled with SCADA System will monitor all the parameters, by analysers to get hourly, daily data print-outs. |
| 8 | Compresser | • 250 bar Gas Compressors. With a capacity of 800 cum/hr |

| | | |
|---|---|---|
| 9 | Effluent handling system | • Decanter with pellet making machine |

# 6. TECHNICAL COMPONENTS & TECHNICAL PARAMETERS

## 6.1 Biogas Generation Scheme

**Biogas generation from influent shall include the following process components**:

a. Primary Digester
b. Anaerobic Digester
c. Recycle Chamber
d. Biogas Storage,
e. Pellet Production unit

## 6.2 Availability of Cattle Dung / Non-Woody Feed Materials / Other-Stocks

Identification of raw material –Napier Grass, Paddy Straw (agro waste) and cattle dung

## 6.3 Pre-Treatment/Slurry Preparation and Handling.

- No. of days pre-treatment to be mentioned for each of the feed-material types: 1 day
- Possibility of water recycling : Yes
- Size reduction : NA
- Type : Coated Steel
- Slurry charging : Pumping
- Special equipment for size reduction for slurry : NA

## 6.4 Biogas Digester Design and Sizing Suitable for Multi-Feed Stock

i) Digester retention time
a. (Hydraulic retention time (HRT) / Solid retention time (SRT)
b. Pre-Digesters : 1 Day
c. Main Digester : 40-45 Days
d. SRT : 55%
ii) Type of high-rate bio-methanation digester : RCC Digester

iii) Digester Mode : RCC Digester

iv) Digester retention time (HRT) : 40 Days Ability to handle different raw materials : Yes

v) Special design manufacturing, operation and : No Maint. requirement.

vi) Indigenous availability, import requirement : Indigenous

vii) Specific design, operation maintenance : No Requirement

IX) Specific advantages over conventional : Multiple Feed Design.

X) Handling, Digester Volume advantage : (High SRT against Low HRT)

## 6.5 Biogas Storage

i) Inbuilt in digester or separate storage : Separate balloon

ii) Type : PVC fabric

iii) Special material requirement and and availability (Including infrastructural needs) : No

iv) Expected Life time of the storage : 10 years

## 6.6 Biogas Upgradation / Enrichment Technology

i) Water scrubbing–using high/low pressure : VPSA System

ii) Biological scrubbing : Not Applicable

iii) Chemical scrubbing : Not Applicable

iv) Membrane separation : Not Applicable

v) VPSA, Molecular sieves : Yes Applicable

vi) Any other : Not Applicable

vii) Quality of upgraded gas : >96 % (CH4)

viii) Utilities, chemicals or any other requirement: No

ix) Availability of technology, Indian, imported.: The Netherlands

## 6.7 Post Treatment of Digested Slurry

i) Dewatering and recycling system : Yes

ii) Drying, pellet management : open storage

iii) Mechanical, Pneumatic : Mechanical

Concentration : Decanter

| | | |
|---|---|---|
| i) | Composting | : Manure with 25% solids |
| ii) | Value addition and packaging | : Packing. |

## 6.8 Biogas Distribution

| | | |
|---|---|---|
| i) | Pipeline | : No |
| ii) | Low pressure cylinder | : No |
| iii) | High pressure cylinders / cascade | : Yes |

## 6.9 Utility Requirement

| | | |
|---|---|---|
| i) Power (outside) | | : 750 KW Connection. |
| iii) | Water | : 450 KL (Waste Water from ETP-270,000 KL- 180,000 KL (Recycle) |
| iii) Any other Water | | : No. |

## 6.10 Chemicals and Other Requirements

| | | |
|---|---|---|
| i) | Nutrients | : No |
| ii) | Flocculants and additives | : No |
| iii) | Culture (anaerobic, aerobic) | : YES |
| iv) | Chemicals for PSA tech. | : No |
| v) | Any other | : No |

## 6.11 Operation and Maintenance Requirement

| | | |
|---|---|---|
| i) | Operation and maintenance Manuals | : Will be maintained as per |
| ii) | Spares and tools tackle requirement for Maintenance | : Yes |
| iii) | Availability of spares | : Yes |
| iv) | Training facility provided | : Yes |
| v) | Servicing set up and facility | : Provided. |

## 6.12 Process Design:

| | |
|---|---|
| Treatment Process | : Primary Digester, Secondary Digester, Biogas, Biogas up-gradation system & Bottling System and Manure Unit |
| Feedstock Load | : 450 MT/day |
| Primary digester | : 1 day |
| Secondary digester | : 45-60 days |
| Digester characteristics | : Continuous Stirred Type Reactor (CSTR) |
| Slurry storage tank | : 2 Numbers |

## 6.13 Input Raw Material Mix

| **Type of Biowaste** | **Amount Available in tonnes** | **Rate** | **Transportation cost** | **Total Cost** | **CNG Output (Percentage; Reference IOCL)** | **RM Mix** | **Gas Output/ Cost (Percentage from max)** | **Total Waste (Tons Per day)** |
|---|---|---|---|---|---|---|---|---|
| | *Tons/Day* | *Rupees/Ton* | *Rupees/Ton* | *Rupees/Ton* | *% mass* | *%* | *%* | *Tons per Day* |
| Cattle Dung | 100 | 200 | 300 | 500 | 2.50% | 0.00% | **46.75%** | **0.0 TPD** |
| Poultry Waste | 80 | 1000 | 1000 | 2000 | 5.00% | 0.00% | **23.38%** | **0.0 TPD** |
| Soybean/Paddy Straw | 100 | 1500 | 200 | 1700 | 18.18% | 5.00% | **100.00%** | **20.0 TPD** |
| Mandi Waste ( Vegetable Matter) | 100 | 1000 | 250 | 1250 | 4.00% | 0.00% | **29.92%** | **0.0 TPD** |
| Napier Grass | 500 | 1000 | 500 | 1500 | 6.00% | 95.00 % | **37.40%** | **380.0 TPD** |

## Summary of input and output

| | |
|---|---|
| **Influent** | 450 TPD |
| **Plant efficiency** | 100.00% |
| **Optimum Production** | 26436 Kg/day |
| **Efficiency Equated Production** | 26436 Kg/day |
| **Total Palette %** | 15.14% |

| | |
|---|---|
| **Total Manure - by product** | 70 TPD |
| **Average Raw Material Cost** | 1,000 INR/Ton |
| **Average Transportation Cost** | 485 INR/Ton |
| **Average Total Cost** | 1510 INR/Ton |

## 6.14 Mechanical Components Characteristics:

| | |
|---|---|
| Feed preparation unit | Waste will be converted into slurry by using mixing equipment |
| Pumping & Recirculation station | To pass slurry from pre-digester to main-digester |
| Biogas up gradation system ($H_2S$ & $CO_2$ Scrubber) | Bio-Gas will be purified up to 95% purity by using water scrubbing & VPSA scrubbing system with 2%-5% losses. |
| Compressor | Purified Bio-Gas will be bottle by using 250 bar compressors |
| Liquid and Solid manure handling | Manure will be separated with decanter and pellets will be formed |
| | |

# 7. CIVIL, EQUIPMENT & MACHINERY INVOLVED

## 7.1 Civil Items

| Sl No | Description | No's | Unit | Size in m X m X m | Remarks |
|---|---|---|---|---|---|
| 1 | Loading Platform with ramp | 4 | Sqmt | Drawings will be provided | |
| 2 | RCC Pre Digesters | 2 | Cum | 16 m Dia 4.5 Height | circular with a storage of 1005 cum m slurry water |

| | | | | | |
|---|---|---|---|---|---|
| 3 | RCC Main Digester having 40 days HRT | 10 | Cum | 39 m dia x4.5m ht | RCC Digesters circular with a storage of 5300 cum slurry water |
| 4 | Slurry Outlet Tank 250 mm RCC wall thickness with lifting and mounting arrangement for slurry de-watering screw pumps, reinforcement as per structural details rate shall inclusive of RCC, masonry, shuttering, reinforcement, plastering and painting | 10 | Cum | Drawings will be provided | circular |
| 5 | Construction of Room for Solid liquid separator. Required foundation for the equipment is to be provided | 1 | Cum | Drawings will be provided | Room with RCC slab |
| 6 | Shed for Manure Storage | 1 | Sqft | Drawings will be provided | Open Shed |
| 7 | Construction of Shed above ground level is masonry structure with RCC/MS supports and sheeting. PCC flooring shall be provided structural details are to be provided. Required | 1 | Sqmt | Drawings will be provided | Open Shed |

| | | | | | |
|---|---|---|---|---|---|
| | foundation for the equipment is to be provided for Bio-Gas purification, bottling and PLC Control room & office room | | | | |
| 8 | Watchman room & Toilets | 1 | sqmt | Drawings will be provided | |
| 10 | Internal Roads | | Sqmt | Drawings will be provided | Gravel Road |

## 7.2 Equipment & Machinery Items Involved

| **Sl.No.** | **Equipment's** | **Description** | **Details** | **N of Unit** | **Capacity** |
|---|---|---|---|---|---|
| 1 | Weigh bridge | To measure the weight of the Waste | MS | 1 No | 30-50 Tons |
| 2 | Agitator in pre digester for Mixing system | To mixing the slurry inside of the pre digester | SS | 2 | -- |
| 3 | Pumps | To pump the slurry from the pre digester to main digester through bottom mixing unit | MS/SS | 2 | 80 cum/hr |
| 4 | Mixing system in | To mixing the surly from pre-Digester | SS | 2 Set | |

| | | | | | |
|---|---|---|---|---|---|
| | main Digester | to main digester pressure pump | | | |
| 5 | Biogas Domes over Main Digester | To store the raw biogas generated within the digester | PVC | Balloons will be used | To cover digester |
| 6 | Pumps | To pump the slurry from outlet slurry tank to decanter | MS/SS | Around 15 | 200 cum/hr |
| 7 | Decanter | To separate solids and liquids from the slurry | MS & SS | 1 No | 50 cum/hr |
| 8 | Manure Unit | Wet manure will be produced | MS | 1 NO | 15 ton/hr |
| 9 | Biogas storage balloon | To store the raw biogas before purification | PVC coated fabric | 10 No | 1000 cum/hr |
| 10 | Flare unit | To flare the excess biogas generated or to flare the gas if the up gradation unit is under | MS & SS | 1 unit | As mentioned above |

| | | | | | |
|---|---|---|---|---|---|
| | | maintenanc e | | | |
| 11 | $H_2S$ Scrubber with inlet blower | To Scrub the hydrogen Sulphide from the raw biogas | MS & FRP | 1 | As mentioned above |
| 12 | CO2 purification system | To Scrub the CO2 from the biogas | MS | 1 | As mentioned above |
| 13 | High pressure compressor | To compress the clean biogas from 0.3 bar to 250 bars | G.I/M.S. | 1 | As mentioned above |
| 14 | Manifold for bottling | To transport the clean gas from the high pressure compressor to the empty cascade (cylinders) | SS | 1 Set | As mentioned above |
| 15 | Piping for slurry and Gas | piping for the biogas plant slurry and Biogas | UPVC & PVC & SS | 1 set | -- |
| 16 | Panel board | To divide an electrical feed into supplement ary circuits | Wires | 1 set | -- |

| | | | | | |
|---|---|---|---|---|---|
| | | of the plant and machinery | | | |
| 17 | Electrical cabling | Entire cabling for the biogas plant | confirming to IS: 7098 (Part-II), | 1 set | -- |
| 18 | Fire Fighting | Firefighting system for the entire plant | MS | 1 set | -- |
| 19 | Cylinders & Cascades | To store the Bio CNG | MS | 50 Units of 1000 cum | For around 25 TPD of gas |

# 8. PROCESS DESCRIPTION

## 8.1 Process Steps

1. Feed Preparation: First the feedstock will be brought through tractors to the receiving area
2. Pre-Digester: Feedstock is dumped to pre-digester and mixed with recycled/slurry water to reduce solids from about 18% to 10%.
3. Anaerobic Digesters: 10 no. of Capacity of 5300 cum Biogas under Microbial process in the absence of air.
4. Gas Balloon: It is used to maintain fluctuation of raw biogas supply to purification/refinery system.
5. Biogas Scrubber: To remove non calorific value gas $CO_2$ and corrosive gas $H_2S$ from the raw biogas and enrich in $CH_4$ content more than 95%.
6. Biogas Boosting System: The purified biogas shall be boosted to a pressure of 250 bar with the help of compressor.
7. Compressed Biogas (CBG) Manifold System: Manifold System is used for Bio-CNG filling in CNG Cylinders.
8. Outlet Chamber of Biogas Digester: The digestate slurry from the Main Digester is let into the outlet chamber through overflow pipe.

9. Slurry Dewatering: Digestate slurry is passed through decanter/screw press to separate the solids and liquid. The recycled water from the decanter is used for raw material mixing.
10. Bio mass palletization plant:

## 8.2 Process in detail

The process of Biogas process broadly can be classified into the following sections:

**Biogas Plant**

Biogas plants are always case-specific. They are designed according to those particular conditions and characteristics and quantities of raw materials as intended when commissioning a plant. There are several technological and operational solutions to choose from and the length of the technology chain applied differ from smaller to larger scale according to factors, such as investment and operational cost, workload, the end-use of digestate intended, goals for energy production etc.

**DIGESTERS**

Biogas is produced in biogas plants which differ in size (scale) and technology. Generally agricultural biogas digesters can be divided into different scales by size:

- Small household digesters
- Agricultural biogas plants: farm-scale, farm cooperative
- Centralised biogas plants

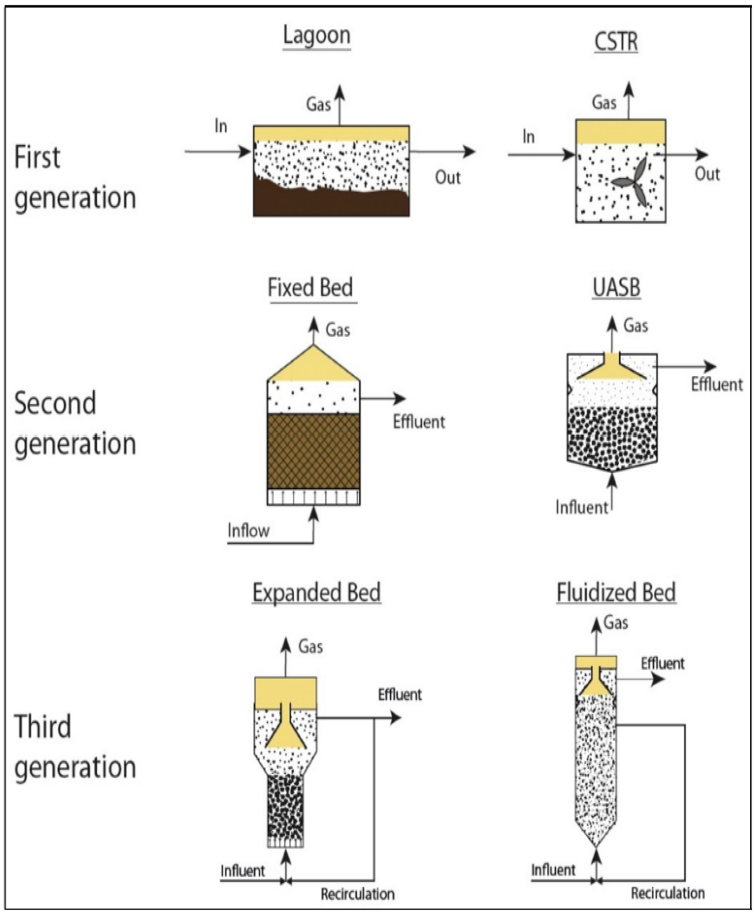



*Figure 5. Some examples of anaerobic digestion technologies: CSTR – Completely Stirred Tank Reactor; UASB – Upflow Anaerobic Sludge Blanket Reactor (Olsson et al., 2005; Chynoweth, 1987).*

Agricultural digesters are usually described by construction of digester and process technology (a rough overview of digester characteristics).

## 8.3 PRE-TREATMENT

Different pre-treatments may be used prior to the actual biogas reactor in order to i) improve the degradation of the raw materials (higher VS removal), ii) increase biogas production, iii) ensure the hygienic quality of the digestate, iv) facilitate technical functions (e.g. prevent blockages), v) ensure homogenous feed and reactor biomass (e.g. large particles of plant biomass float more easily than smaller ones), vi) remove potentially inhibitive compounds, and/or viii) enable process intensification (higher OLR, shorter HRT, smaller reactor size). Many of the pre-treatments used facilitate more than one of the benefits mentioned above simultaneously.

### SIZE REDUCTION

Many raw materials for biogas processes are macerated (food waste, industrial by-products) or chopped (plant biomass) before feeding into the digester in order to decrease the particle size. Of the different manure types, usually only solid manures with larger particles from bedding material may require maceration/chopping, while liquid manure is usually just pre-


mixed to ensure homogeneousness prior to feeding. For example, energy crops and crop residues are chopped into smaller pieces in order to increase the surface area for hydrolytic enzymes to attack and thus to release more soluble components (Palmowski & Müller 1999). This aims at facilitating improved degradation and higher biogas yield. The smaller particles are also easier to convey into the digester via e.g. feed screws as they do not entangle themselves into the feeding device nor into the mixers inside the reactor. They also stay more efficiently within the digester biomass and are less prone to floating. Legislation may

also require pre-maceration. E.g. the European Union regulation for using animal by-products (ABP) in biogas plants requires <12 mm particle size for materials also to be pre-hygienised or <50 mm for materials also to be pre-sterilised.

**THERMAL TREATMENT**

Hygienisation (70 °, 1 h; 1774/2002/EC) or sterilisation (133 °C, 3 bar 20 min; 1774/2002/EC) may be used as a pre-treatment to biogas processes, especially in plants treating ABPs or other raw materials with potential hygienic risks. Also, thermal hydrolysis (e.g. CAMBI-process: 165-170 °C, 6 bar, 30 min; Sargalski et al., 2007) is used. These thermal pre-treatments not only ensure the elimination of pathogens, but also loosen the solid structures via pressure changes (Bougrier et al., 2005) and result in more degradation (higher VS removal) and higher biogas production (Sargalski et al., 2007). For example, Mladenovska et al. (2006) reported the BMP of cattle manure to increase by 10-24% after thermal pre-treatment (100, 120 or 140 °C, 20 or 40 min), while during continuous experiments (HRT 18 d, 55 °C), the increase due to thermal pre-treatment (140 °C , 40 min) was 7%. Moreover, Paavola et al. (2006) noticed an increase in methane yield of 14-30% due to hygienisation, while co-digesting manure and food waste (feed 5 d/week).

## 8.4 POST TREATMENTS

**Post digestion Tanks**

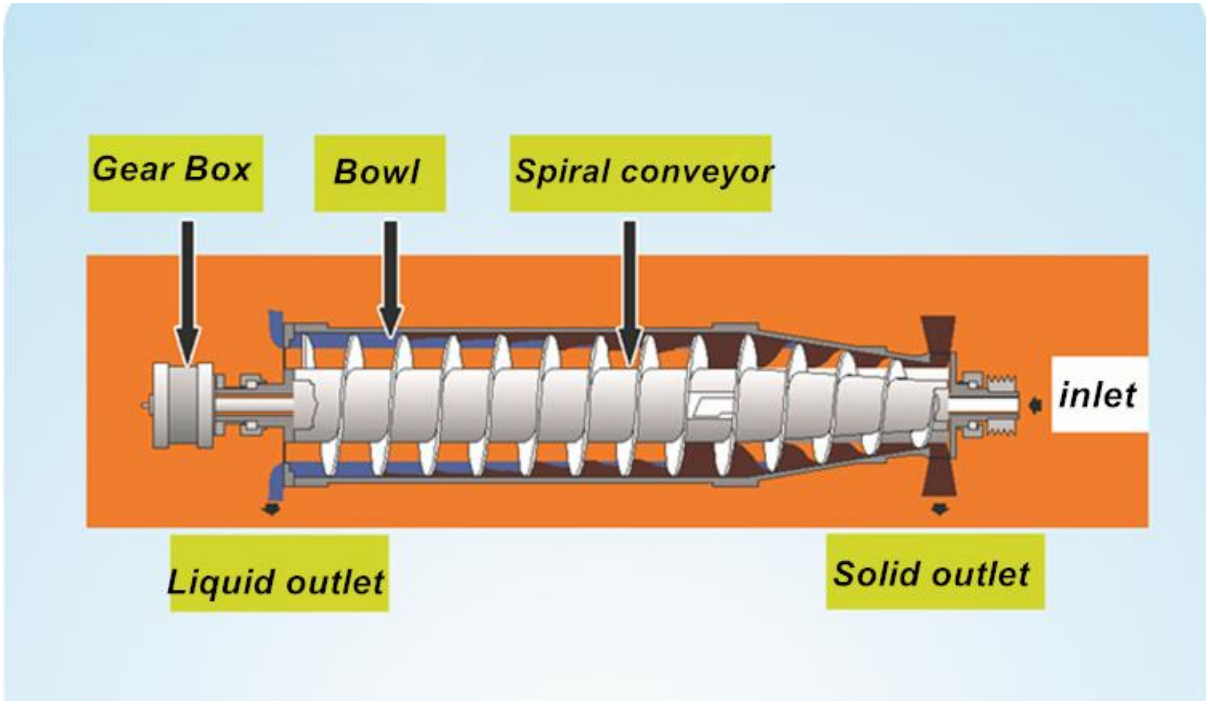
A post-digestion tank is an integral part of all biogas plants as it allows the feed to continue degradation and collects the remaining biogas potential in a controlled manner. This is not only important for minimising methane emissions of biogas plants, but also offers a significant increase in the overall biogas production of the plant.

The remaining biogas potential of any digester residue is significant and may provide 10-30% of the overall biogas production in a biogas plant. Post-digestion tank is thus situated after the actual digester. The bigger the biogas plant, the shorter the HRT in the post-digestion tank is, due to the large quantities of raw materials digested and the subsequent need for high post-digestion volume. The post-digestion tank is not heated as the digester, but the temperature may change depending on the tank design and weather conditions. When situated mostly underground and insulated, the digester temperature can almost be maintained (digester 37 °C, post-digestion tank 29-35 °C) despite no heating and very cold winters (-20…-30 °C for several weeks; Luostarinen, 2011).

**Mechanical Separation of Digestate**

The digestate can be mechanically separated into liquid and solid fractions which can then be utilised as fertilising and/or soil improving products as such or post-processed further. Mechanical separation can be performed with different technologies, and the technology choice affects the separation efficiency. Also, the characteristics of the digestate influence the end result. For example, settling (or sedimentation) of materials with high water content are based on differences in the mass and density of the components to be separated. Most of organic nitrogen and phosphorus are retained in the solid fraction, but soluble nutrients are left in the liquid fraction. Very fine materials pose a problem as their separation is difficult with mere settling (Vanotti & Hunt, 1999).

Centrifuging is also based on the differences in mass and density of the components to be separated, but the efficiency is significantly higher than with settling. By increasing the spinning velocity, 1000-4000 times higher acceleration than that of the globe can be achieved. Thus, centrifuging is reportedly the most efficient way to separate both phosphorus and solids. The efficiency can in some cases be further increased by addition of polymers (Hjorth, 2009).




There are different centrifuges available, a decanter centrifuge being the most common and efficient. When separating liquid manures, decanter centrifuge is estimated to be able to separate particles as small as 20-25 µm (Hjorth, 2009) and even part of the particles of <4 µm (Sneath, 1988).

Separation based on sieving can be implemented with different processes, such as screw dryers and press belts. The liquid is pressed through sieves or canvasses with the solid fraction being retained behind it. Sieving processes cannot separate particles smaller than the sieve size, usually 0.5-1 mm, which is larger than most particles in raw manure (Møller et al., 2002) and most likely even more so, when separating digestate.

## 8.5 Biogas Purification

In the present report, upgrading of biogas is defined as removal of carbon dioxide from the gas. The principle for the most common upgrading technique is water scrubbing. The PSA Technology used in Biogas Purification system in briefly described below.

**Pressure Swing Adsorption (PSA)**

With this technology, carbon dioxide is separated from the biogas by adsorption on a surface (usually activated carbon or zeolites) under elevated pressure. The surface material will be saturated with carbon dioxide and must then be regenerated (Petersson & Wellinger, 2009). The electrical demand for one PSA plant is estimated at 0.05 kWh electricity/kWh upgraded biogas (RVF, 2005).

## 8.6 Biogas Bottling

After upgrading, the biogas fuel has to be compressed (or liquefied) before fuelling a vehicle tank to a pressure of 200-250 bar. The amount of energy stored in compressed gas is significantly less than the energy stored in the same volume of liquid fuel as petrol or diesel (the energy content per tank volume of fuel biogas is about 20% of the energy per volume of petrol). Therefore, the operating range for a compressed biogas fuel vehicle is reduced compared with a petrol or a diesel vehicle.

There are two basic methods of fuelling compressed biogas fuel to vehicles: slow-fill and fast-fill. Slow-fill systems take gas directly from the compressor into the vehicle. Refuelling time for a large vehicle can take a couple of hours and these systems are only suitable when sufficient refuelling time is available outside the hours of operation (example: bus overnight). Fast-fill systems using cascade fuel storage tanks can refuel vehicles in about the same time or only slightly longer than in normal liquid fuel vehicles.

## 8.7 In short

**Biogas Plant:** The Main Machinery consists of:

Feed -Pre treatment

- Pre-Digester
- Bio Digester
- Biogas Storage System

**Bio Gas Refinery:** The raw gas generated will be purified here, through Bio Gas Scrubbing and the Purification System

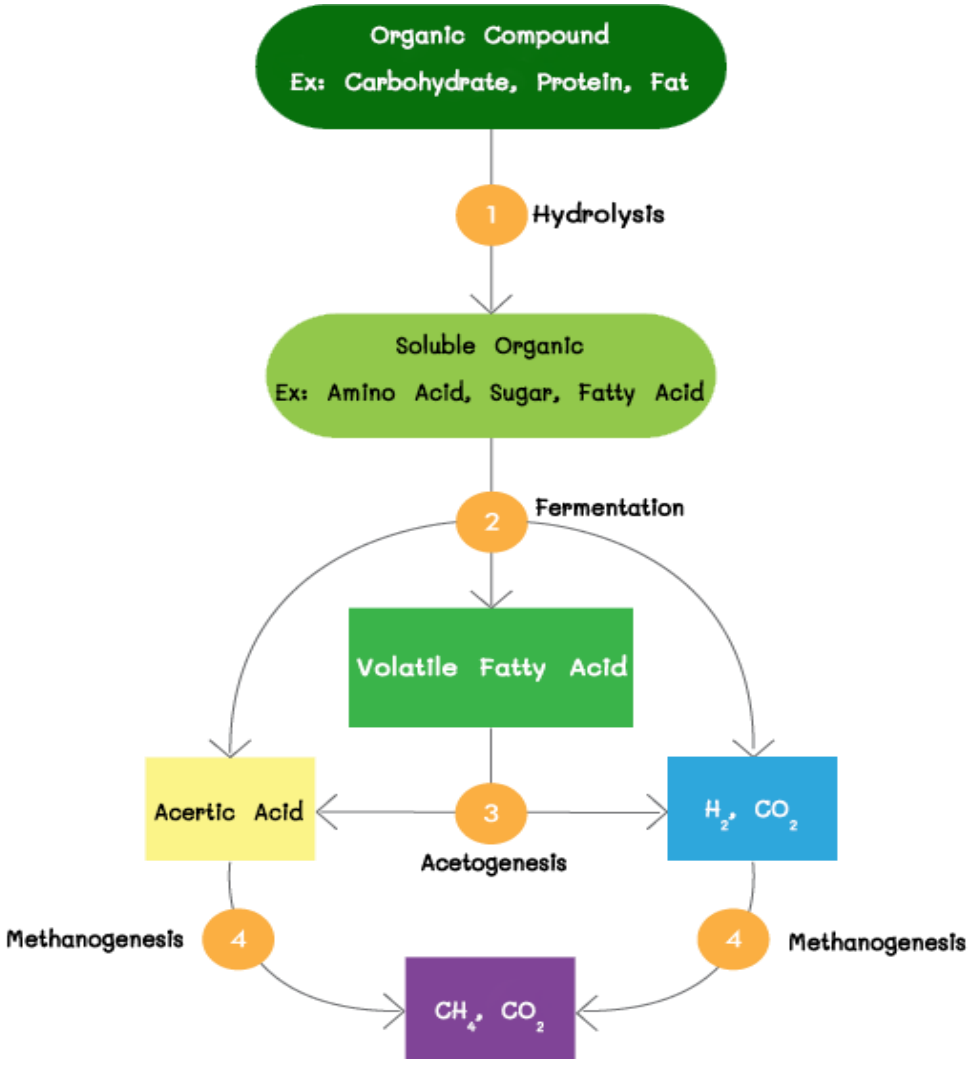
**Biogas Bottling:** The Purified Gas will be Bottled here as Cylinders through Booster Compressor

**Slurry Processing System:** The slurry Water will be separated in the Dewatering system by using Decanter.

## 8.8 Process Description

**The principle of Biogas Technology:**

Biogas technology is four steps of Biogas production process are as follows:1) Hydrolysis 2) Acidification 3) Acetogenesis and 4) Methanogenesis.




## 8.9 Biogas Generation in Main Digester

**Principle involved:** Anaerobic microbial digestion undergoing the following conversion i.e., acidification, acetogenesis and methanogenesis finally resulting in the production of methane.

**Acidification:** Acid forming bacteria involved in the second step converts the intermediates produced in the hydrolysis step into acetic acid, hydrogen and carbon dioxide. These bacteria, of the genus Bacillus, are aerobic and facultative anaerobic and can grow under acidic conditions.

**Acetogenesis:** To produce acetic acid, the bacteria use the oxygen dissolved in the solution or bonded oxygen. Hereby, the acid producing bacteria reduce the compounds with low molecular weight into alcohols, organic acids, amino acids, carbon dioxide, hydrogen sulphide and traces of methane.

**Methanogenesis:** Methane producing bacteria, involved in the last step, decompose compounds with low molecular weight. Under natural conditions, methane producing microorganisms occur wherever anaerobic conditions are provided, for instance under water, in ruminant stomach and in marshes. They are anaerobic and very sensitive to environmental changes. It is advisable to circulate the generated biogas back into the system using small compressor. This would enhance the reduction of carbon dioxide to methane and enrichment of methane fraction in the Biogas.

**Design of digester:**

The digester will be made of RCC with GFP and Epoxy coating in the inside of the digester. This will enable the digester to withstand high pressures and will have high load bearing capacity of 10 tons per square meter.

## 8.10 Raw Biogas Storage

The raw biogas from the biogas holder will be stored in biogas balloon.

These are PVC cloths balloons with UV protection and will be mounted vertical on the PCC platform with proper reinforcement to hold it and to protect it from wind.

## 8.11Biogas Flare

Biogas flare is an essential item and is used to flare the biogas when not in use, excess generation or during shut down. The biogas will be flared if there is excess generation or during shut down.

## 8.12 Biogas Upgradation/Scrubbing

The main output which is Bio-Gas will be purified using water scrubbing/PSA technology & Membrane Technology and then compressed at high pressure in gas cylinders for further

usage. The stored gas has more than 90% methane and can be used as an CNG for vehicles.

**PROCESS**

Each up gradation unit is designed for biogas @ 1000 M3/Hr per unit and, the operating days are considered as 365 days per year. The Input raw biogas quality is considered as per Design Basis indicated in the Technical Section.

**Gas analysis:**

The device is used for process monitoring of individual stages and to measure the concentration of the following components in the gas

- Methane $CH_4$
- Carbon dioxide $CO_2$
- Hydrogen sulphide $H_2S$
- Oxygen $O_2$

**Design data and compounds**

Treated Biogas (Input to Up gradation system)

| - Particulars | - Details |
|---|---|
| - Raw Biogas Flow rate | - Max. 2000x4 Nm3/hr |
| - Gas Temperature | - Ambient temperature (30 – 40 deg C) |
| - Inlet Pressure | - 0.2bar |

| **Particulars of Raw Biogas** | **Details** |
|---|---|
| Methane | 55-60% |
| Carbon Dioxide | 43% |
| Outlet-Gas from Up gradation System | |
| Methane | >96% |
| Carbon Dioxide CO2 | 3% |
| Others | 2% |

The purified Gas passed to Buffer Tank.

## 8.13 Bio-Gas Boosting Compressing System

Each Compressing unit is designed for biogas @ 400-500 M3/Hr per unit. The pure biogas shall then be sent to the buffer storage tank, from which it shall be sent to the booster compressor. Biogas Boosting System the purified biogas shall then be boosted to a pressure of 250 Kg/cm2g with the help of a booster compressor, which shall be complete with its flameproof motor, cooler and accessories. The compressor shall be a four stage, vertical, three-cylinder, oil lubricated, water cooled, methane gas compressor Bar and fed to the Bottling unit.

For filling of biogas in cylinders a manifold system shall be provided for manual filling of the cylinders. The manifold shall be complete with pressure release valves, check valves, pressure gauges, pressure switches, and other accessories.

Bottling part of the plant consists of a High-Pressure compressor, cascade of storage cylinders and a dispensing nozzle for filling the compressed purified gas in the vehicles. Dried and purified gas goes into the suction of High-Pressure Compressor, where it compresses the gas to desired working pressure (~250 Bar) and fills into the storage cylinder cascade. A CNG dispensing cable along with nozzle is used for filling of gas in the cylinders.

### Specifications of the Cylinders

The Compressed Natural Gas (CNG) cylinders are of cylindrical shape and are manufactured to withstand the working pressure up to 250 bar.

## 8.14 Bio Mass Palletizations Unit (Optional)

The Palletisation unit will use decanter and drying unit to remove the moisture from the output of the plant.

## 8.15 Pipelines, Electrical System/Control Unit

**Liquid and gas piping and valves system are as follows:**

A) Gas pipeline with valves from all digesters to purification system. (MOC-HDPE, MS)

B) Liquid pipe line from water tank to feed preparation tank, feed slurry pipeline from feed mixture to slurry pumps and slurry pumps to all digester tanks (MOC-HDPE). Overflow slurry pipeline, drain pipe line with valves from digester to decanter, and solid liquid separator. Recycling water line from solid liquid separator to feed mixture tank.

C) Whatever valves and instruments required for controlling and automation shall also be provided. Like pressure gauge/ switch, temp gauge, pressure transmitter, temperature transmitter, Ph sensor and analyser etc.

2. Electrical equipment – PLC control panel, power panel shall be as per following details.

a) Electrical feeder panel for all equipment's as per the list

b) Power panels for following equipment

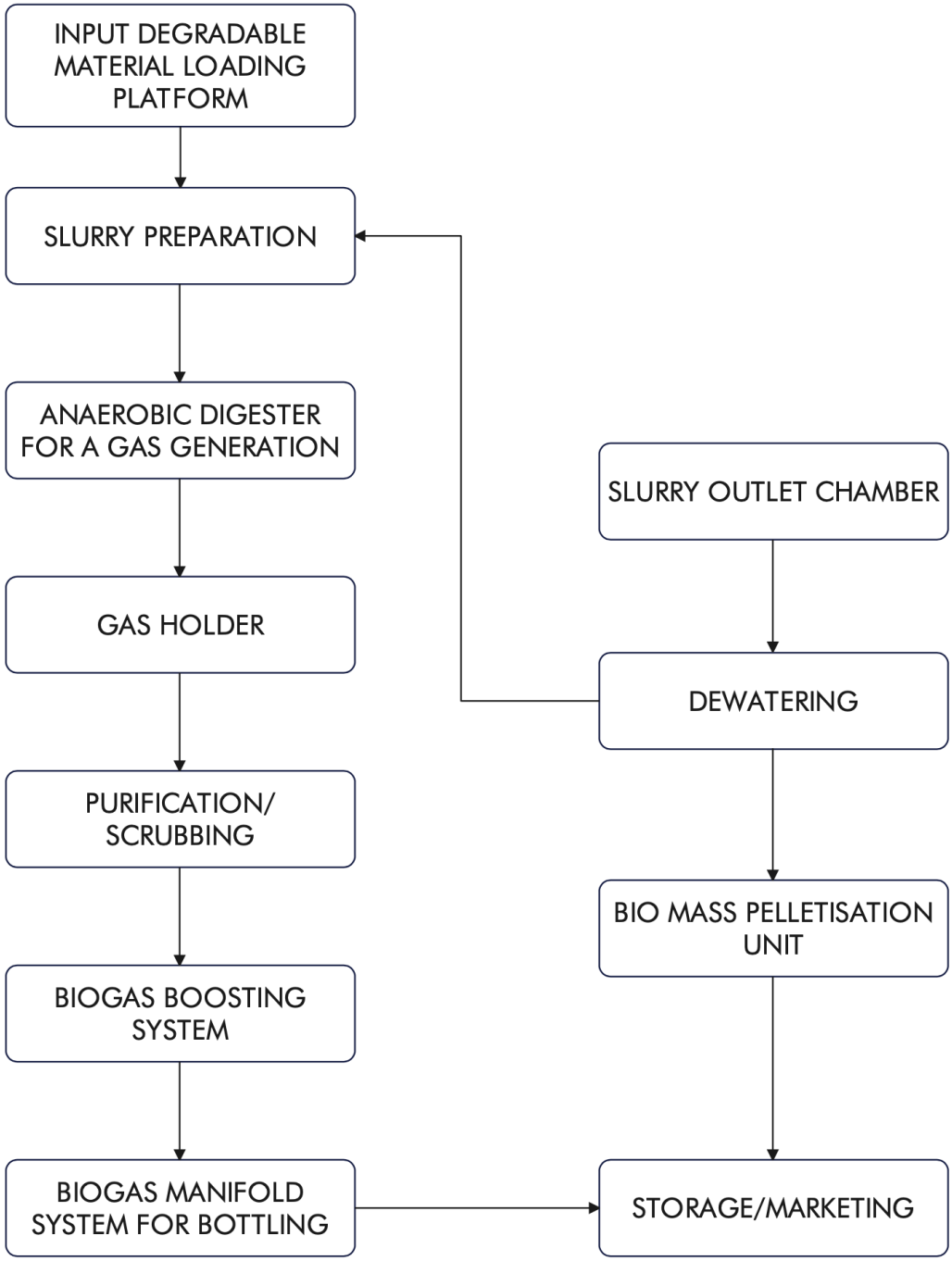
I. all pumps and agitators, blowers and control valves,

ii. MMCC power panel for all equipment

c) Instruments and electrical cabling with cable tray from field to control room

## 9. FLOW DIAGRAM, TECHNICAL AND CHEMICAL PARAMETERS

## Flow Chart-I: Indicating the Process flow




## 9.1 Technical Parameters

| **Characteristics** | **Values** | **Figures** |
|---|---|---|
| Quantity of Feed stock | Tons/day | 450 |
| Solid contain in the influent | % | Varying |
| Solid Loading Ratio | % | 10% |

| | | |
|---|---|---|
| Total loading quantity per each pre digester per day | Litres | 900,000 |
| Number of Pre-Digesters | Nos | 2 |
| Total Volume of each Pre-Digester | M3 | 1005 |
| Number of Main Digesters | pcs | 10 |
| Digester Volume | m 3 | 5300 * 10 |
| Pre-Board in the digester | % | 10 |
| Mi/RCC Digester | Yes | As per design |
| Temperature in the Digester | °c | 30-40 |
| Pressure in the Digester | kPa | 0.3 |
| Solid Fertilizer yield (20% wet) | Tons/day | 70 |
| Total Outlet Slurry Water | Lts/day | 324947 |
| Re-circulation Slurry Water | Lts/day | 180,000 |
| Fresh Water | Lts/day | 270,000 |
| Liquid Fertilizers (99% wet) | Lts/day | 150 |
| Scrubbing System | m3/H | 10000 $Nm^3$/hr |
| Compressor | M3/H | 3000 Nm3/hr with 250bar |

## 9.2 Upgrading (Purification) Plant Design Parameters.

| **INLET GAS SPECIFICATION** | |
|---|---|
| B-GAS inlet flow | 6000 m3/hr |
| B-GAS inlet pressure | 30 m Bar g |
| B-GAS Pressure by After Blower | 1 Bar g |
| **B-GAS COMPOSITION** | |
| Methane | 55- 60% |
| Carbon Dioxide | Balance |
| Hydrogen Sulfide | 200-300 PPM |
| H20 | Saturated |
| O2 | < 0.3% |
| N2 | Nil |
| **OUTLET GAS SPECIFICATION** | |

| | |
|---|---|
| Outlet gas flow (B-CNG) | 2500 m3/hr |
| Outlet gas Pressure | 0.3 - 0.4 Bar g |
| **B-GAS COMPOSITION as per BIS 16087** | |
| Methane | 96% - 97% |
| Carbon Dioxide | < 3.5% |

| | |
|---|---|
| 5.1 Hydrogen Sulfide | < 8 PPM (+-5 PPM) |
| Water | Dew point (–) 70 deg C |
| N2 & O2 | Balance |

# 10. AUTHORIZATION OF TECHNOLOGY PROVIDER

## 10.1 Authorization of Technology Provider

Not Applicable

## 10.2 Structure of Total Works to Be Done

1. To fix the site boundaries for construction of 450 TPD input Bio CNG Plant
2. Preparation of Civil designs and drawings for construction of the Digesters and mounting of the machinery.
3. Preparation of the plans to submit the local authority to get the necessary permissions
4. Preparation of the structural designs as per Site soil testing report.
5. Preparation of Civil cost estimations as per the local available materials.
6. Preparation of Plant cost estimation as per the quotations of mechanical machinery and equipment.
7. Preparation of technical process flow chart and description of process.
8. Preparation of specifications of Civil, Machinery and equipment's.
9. Financial statements of the project cost for submission of Bank for loan

## 10.3 Technology Arrangements

- The project designed with a 10 RCC main digester capacity of 5300 m3 working volume of Biogas for 450 TPD bio waste handling
- Installation of 10 no's RCC digesters
- Installation of bottom mixing system in 10 digesters. Each digester works on bottom mixing system, which has provision of feeding, mixing
- Working principle of bottom mixing system: The pre digester slurry is fed into the main digester through bottom mixing system with the help of pressurized pump with continuous mixing and prevention of solids settling.
- Installation 4 numbers of 1000 $Nm^3$/hr. input Biogas upgrading system using VPSA system
- The scrubbing system is an automatic operation with automatic elements of on-line gas monitoring system to check the gas quality online. For this system we consider gas online analyses like $H_2S$, Methane., $CO_2$ and dew point. (Moisture content)
- Installation of 800 cum with 250 bar Gas Compressors.
- Installation of PROM Technology to enrich the Manure
- **Unique Features of Technology** Multi chamber, Multi Domes, Multi Inlets, Multi Outlets Digester to reduce the HRT and increase the SRT;

# 11. ENVIRONMENTAL MANAGEMENT PLAN (EMP) & SAFETY MEASURES

## 11.1 Environment Management Plan

The Environment Management Plan consists of all mitigation measures for each activity to be undertaken during the construction, operation and the entire life cycle of the project to minimize adverse environmental impacts. It would also delineate the environmental monitoring plan for compliance of various environmental regulations. It will state the steps to be taken in case of emergency such as accidents at the site including fire.

The Environmental management Plan (EMP) is always site specific plan which is developed to ensure that the project is implemented in an environmentally sustainable manner where all contractors and sub-contractors, including consultants, understand the potential environmental risks arising from the proposed project and take appropriate actions to

properly manage the risk. Also, the plan outlines roles and responsibility of the key personnel and contractors who are charged with the responsibility to manage the project site.

## The Environmental Management Plan (EMP):

The EMP follows the Guidelines as specified laid out by the CPCB

1. The EMP has been prepared in accordance with rules and requirements of the Ministry of Environment, Forest and Climate Change (MoEFCC) and the State Pollution Control Board.
2. Proper Care will be taken to ensure that the components of facility are operated in accordance with design;
3. All required precautions should be taken to addresses public complaints during construction and operation of the facility
4. The Plan shall ensure remedial measures and implemented immediately the plan always considered the treatments and discharge of unavoidable pollutant into the atmosphere, monitoring of physical environment external or internal, **green** belt development, housekeeping practices, the occupational health and safety concern, the socio-economic issues, energy conservation and recycling practices.

The benefits of Environment Management Plans are

1. It provides the infrastructure for managing its Environmental performance and continuous improvements.
2. It improves the quality of environment in the society. EMP includes following major elements:

**a**. **Commitment & Policy**: The proposed BioCNG Production Unit will implement the environmental management plan that incorporates all issues related to air, land and water.

**b. Planning:** This includes identification of environmental impacts, statuary requirements and to find and set environmental objectives.

**c. Implementation:** These is being resources available to the developers, accountability and responsibility of contractors, training and awareness to operational staff associated with environmental control facilities and documentation.

## EMP For Air Environment

Construction Phase To mitigate the impact of SPM (dust) and other emissions during the construction phase of the proposed project, the following measures are recommended for implementation:

- Dust Control Plan: The most cost-effective dust suppressant is water, because a source of water tends to be readily available on a construction site. Water can be applied using water trucks, handheld sprays and automatic sprinkler systems. The following measures shall be put to practice to minimize the impact on the air environment as the construction activities are likely to generate dust due to vehicular movement, excavation, emissions from the labour camp used by the construction workers. Provision shall be made for sprinkling of water on the roads used for transportation of materials; and speed of vehicle is being restricted to 15 Kms/hr.
- Arrangements shall be made for sprinkling water over the construction site to suppress any kind of dust emission. Any excavation that is deep and large in nature shall be done using mechanical measures so that the same is over within a short period. The debris and unutilized construction material and earth from the construction site shall be used within the premises.
- Controls of other Air Emissions:
    - It shall be ensured that vehicles which are employed by the Developers or by Contractor's ply with PUC Certificate.
    - Any generator to be installed by the Contractor at the site shall meet the guidelines as laid down by Central Pollution Control Board.

**Emissions Form Bio methanation:**

The action of micro-organisms upon organic matter under anaerobic conditions produces biogas which is typically a mixture of methane and carbon dioxide as well as a many trace gases and vapours. This action is harnessed within a number of anaerobic bioprocesses such as Anaerobic Digestion (AD) for the stabilization of polluting organic matter and water or recycled water (water from existing Discharged process water treatment plant).

Within the anaerobic conversion of organic material over 90% of energy available in the organic pollutant is retained within the biogas as methane - very little is used to form sludge and this is a major benefit when compared with aerobic bioprocesses. A consequence of this is that the methane rich biogas has a high calorific value and will be used as a fuel. There are also serious safety and environmental considerations associated with biogas because methane is a potent greenhouse gas and forms explosive mixtures when mixed with air.

Hydrogen Sulphide, Carbon Dioxide, Carbon Monoxide are the major contaminants of the crude Biogas. These gases are scrubbed by installing a scrubbing system which reduces the

contaminant gases to levels below the emission norms of the PCB. The scrubbed Carbon dioxide and Hydrogen sulphide will be recycled to the pre-digester tank to maintain the pH of the Raw material slurry and enhance the Total Volatile solids conversion in the Pre-digester step.

**Biogas Flaring Unit:**

A biogas flare system for burning extra biogas generated in the plant or flaring the gas only when there is any minor maintenance of the compressor or pipelines. Excess gas generated during maintenance hours needs to be flared at a proper height (i.e. above 5 metres), the single flaring unit system will be comprising:

- A least one burner for igniting a mixture of biogas and air.
- A main supply line for supplying the mixture of biogas and air to said burner;
- A shell surrounding said burner and having an open top for exhaustion of combustion products; and
- At least one damper located in said shell for supplying quench air to said burner.

Hence utmost care has been taken in the project and no methane will be released ever in the atmosphere and will be converted into CBG without any leakages in the system and the excess gas if any will be flared as discussed above.

## 11.2 Green Belt Development

Increasing vegetation in the form of **green** belt is one of the preferred methods to mitigate air pollution. Plants generate oxygen, serve as a sink for pollutants, act as a barrier to break the wind speed as well allows the dust and other particulate to settle out there. It also helps to reduce the noise level to some extent. A **Green** belt will be provided in an area equivalent to 33% of the total area of the plant.

The Following species can be used as in a **green**belt to serve as noise breakers: Ficusbenjamina, Butea monosperma (palash), Leucanaleucocephala (Subabual), Mangiferaindica (Mango) and DelbergiaSissoo (Shisham).

## 11.3 EMP For Noisy Environment

Construction Phase to mitigate the impact of noise from construction equipment during the construction phase, following measures is recommended for implementation:

- Noisy construction equipment will not be permitted during night hours.

- Job Rotation and Hearing Protection – Workers employed in high noise areas will be rotated. Hearing protection such as earplugs/muffs will be provided to those working very close to the noise generating machinery.
- Regular Maintenance**:** The mitigation measures shall include regular maintenance of construction machinery.
- Operation Phase**:** To mitigate the impact of noise from diesel generator sets during the operational phase the following measures are recommended for implementation:
    - It would be ensured that the manufacture provides acoustic enclosure as an integral part with diesel generator sets. Diesel generator sets is being enclosed in a suitable acoustic enclosure so that noise level at a distance of 1 meter does not exceed 75 dB (A) at 75 % load as per CPCB standards or is meeting the ambient standard whichever is higher. The mitigation measures shall also include regular maintenance of DG Sets as advised by the manufacturer.

## 11.4 EMP For Water Environment:

**Construction Phase:** To prevent degradation and maintain the quality of the water source, adequate control measures have been proposed to check the surface run-off, as well as uncontrolled flow of water into any water body.

Following management measures are suggested to protect the water quality during the construction phase.

- There will be very little excavation as foundations are on piles. Excavation during monsoon season will be avoided.
- Care will be taken to avoid soil erosion.
- An area for loose debris within the site shall be planned.

Construction activities generate disturbed soil, concrete fines, oils and other wastes. On-site collection and settling of storm water, prohibition of equipment wash down, and prevention of soil loss and toxic release from the construction site are necessary to minimize water pollution.

All stacking and loading areas should be provided with proper drains equipped with baffles to prevent runoff from the site to enter any water body. Water conservation and development measures shall be taken including all possible potential for reuse and recycling of water.

Water Source Development: Water source development shall be practiced by adoption of scientifically design **rainwater harvesting system**. The water is being used for recharge of aquifers. Rainwater harvesting promotes self-sufficiency and fosters an appreciation for water as a resource. Minimizing Water Consumption is being minimizing by a combination of water saving devices and other domestic water conservation measures. Furthermore, to ensure ongoing water conservation, an awareness Programme will be introduced for all the workers and staff.

## 11.5 Storm Water Management

As discussed earlier most of the storm water produced on site is being harvested for ground water recharge, thus proper management of this resources is must to ensure that it is free of contamination. Contamination of storm water is possible from the following sources:

i. Silt from soil erosion in gardens
ii. Spillage of sludge from sludge drying area of Sewage

A detailed "Storm Water Management Plan" is being developed. This will consider the above sources. The run-off from landscaped, roof top and complexes would be used for recharging.

The design of pits is being done taking into consideration retention time for the run-off water in the harvesting pit. The plan will incorporate best management practices which will include following:

- Regular inspection and clearing of storm drains and all covered drains.
- Cover waste storage areas.
- Avoid application of pesticides and herbicides before wet season.
- Secondary containment any dykes in fuel/ oil storage facilities
- Conducting routine inspections to ensure cleanliness
- Preparation of spill response plan, particularly for fuel and oil storage areas.
- Provision of slit traps in storm water drains
- Good housing in the above areas.

## 11.6 Water Pollution Management

**Construction Phase:** Water requirement during construction phase is expected to be about 5 $m^3$/ day, which will be primarily sourced through borewells. The following control measures will be adopted in order to minimize the construction impacts on water quality of the area:

- Monsoon season would be avoided for construction activity.
- Appropriate sanitation facilities will be provided for the labourers to reduce impact on water quality.
- No construction wastewater will be discharged directly on land or into the river. A couple of Sediment traps with retention period of half an hour will be constructed during the construction stage, where all construction wastewater will be collected. After the sedimentation of the construction wastewater, the comparatively cleaner water will be reused for wetting of building materials & structures.

**Operation Phase**:

The total water requirement for the proposed Bio CNG plant 450 KL/Day. 270,000L of the water is used from fresh source and 180,000 L water will be recycled from the outlet slurry tank. The outlet of the slurry tank about 4,50,000 of the daily discharges to the Settling tank this water can us a liquid fertilizer agricultural. The settling tank cum clarifier system will remove the suspended fines and solids. The clarified water is treated in the tank using microalgae and the water is reused in the Bio-digestion process. The requirement for fresh water is drastically reduced and no effluent is generated in this process. As the process water is completely reused, there is no discharge of effluent into any streams.

**Process Water Discharge Plan:**

Approximately 450 KLD process discharge water will be generated from the proposed Bio-CNG project. The proposed project will adopt 100% recycling of treated slurry water. While 180 KLD is directly recycled back to the Process without any treatment, 270 KLD of the process discharge shall be collected in a settling tank and treated by using microalgae. The algal treated process water is used as a liquid manure.

Characteristics of process slurry water from proposed Bio CNG Production Unit will be as under;

| Sl.No. | Parameters | Expected Conc. of Generated slurry water. |
|---|---|---|
| 1 | pH | 7.0- 8.0 |
| 2 | Suspended Solids mg/l | 1000-2000 mg/l |
| 3 | BOD (3 days at 270C) mg/l | 50-100 mg/l |
| 4 | COD mg/l | 200-300 mg/l |
| 5 | Po& Grease mg/l | 10-15 mg/l |

The Process Discharge treatment is based on algal remediation technology of a 450 KL collection cum algal bio pond will be installed for treatment and reuse of Process waste water.

In this process the discharge will flow via gravity through a bar screen chamber & Grit Chamber to an Algal Bio-pond. A bar screen shall be provided at the inlet point in the bar screen chamber and the waste water will flow through this bar screen in to the Tank. Bar screen shall be so designed that it can be cleaned manually from outside the Tank, the sand, mud and minute particles from the Grit Chamber would have to be removed manually.

Waste water from the equalization tank shall be transferred by pumps in to the primary clarifier where dirt, suspended solids will be separated in a tube settler. The clarified process slurry water shall then flow into the Algal Bio-pond where it will be mixed with microalgae in presence of air & air shall be introduced through paddle mixing system. After achieving a complete mixing of algae over a retention period of 120hrs, the process water discharge is now devoid of BOD and COD. The algal biomass will add around 2-3% Bio-solids which will improve the Biogas yields while completely using the process water in the Bio gasification process. Any algal biosolids which may settle at the bottom of the Algal Bio-pond shall be intermittently pumped back in to the Biodigester tank by sludge recycle pumps. The sludge accumulated in the primary clarifier and algal bio-pond shall be transferred to the Bio-digester plant where the solids from the processing operations shall be mixed and additional methane is generated.

## 11.7. EMP for Solid Waste Management

The recovered biosolids generated in the slurry water treatment plant after clarification will be used as nitrogen amendment to the anaerobic microbes in the anaerobic digester. The unique design of the system consisting of a pre-digester converts the fibrous matter into organic acids which improve methane production. The pre-digester also reduces the insoluble matter as compared to conventional bio-methanation systems. The solid sludge generated in the bio-methanation plant is rich in humus, plant growth promoting microbes and is a nutrient rich manure. The liquid filtrate from the bio-methanation system along with the concentrated solids shall be given to farmers as a soil amendment.

**Management of Toxic and hazardous wastes:**

The containers with toxic chemicals, oils and used batteries, plastics and polythene bags shall be stored in a separate area and disposed to manufacturers or recyclers authorized by the Government.

The proposed Bio-CNG Plant shall strictly abide by the regulations of the PCB and shall adopt advanced technologies for pollution abatement, waste management and optimal use of resources to have a minimum impact on the surrounding environment. Also, continuous up-gradation in processing technologies, equipment and plant maintenance at scheduled intervals shall be adhered to strictly ensure a pollution free process.

This Environmental management Plan has been prepared in accordance to the Regulations of the State Pollution Control Board of Madhya Pradesh.

**Office Wastes:**

The Wastes Generated in the site office is mainly paper of which around 0.10-0.25 Kgs will be generated daily. As this waste is cellulosic in nature it will be sent to the Biodigester for bio-methanation. Any plastic wastes such as discarded plastic packaging, used printer cartridges, etc., shall be disposed of to registered recyclers.

## 11.8 EMP for Land Environment:

**Construction Phase:** As discussed earlier waste generated from construction activity includes construction debris, Biomass from land cleaning activities, waste from labour camp, and hazardous waste. Following section discusses management of each type of waste. Besides waste generation management of topsoil is an important area of concern. Construction Debris Construction Debris is bulky and heavy re-utilization and recycling is an important strategy for management of such waste. As concrete and masonry constitute the majority of waste generated, recycling of this waste by conversion to aggregate can offer benefits of reduced landfill space and reduced extraction of raw material for new construction activity. This is particularly applicable for proposed project as the construction is to be completed in progressive stages. Recycled aggregate will be used for filter application, and as a sub-base for road construction. Mixed debris with highs gypsum, plaster if any, shall not be used as fill, as they are highly susceptible to contamination, and will be given to recyclers. Metal scarp from structural steel, piping, concrete reinforcement and sheet metal work shall be removed from the site by construction contractors. A significant portion of wood scarp can be reused on site. Recyclable waste such as plastics, glass fibre insulation, roofing etc. shall be sold to recyclers. Hazardous waste Construction sites are sources by many toxic substances, such as paints, solvents, wood preservatives,

pesticides, adhesives and sealants. Hazardous waste generated during construction phase shall be stored in sealed containers, labelled, and disposed of as required by the Hazardous Waste Management and Handling Act Amendment Rules 2003

## 11.9 Top Soil Management:

To minimize disruption of soil and for conservation of top soil, the contractor shall take the top soil out separately and stockpile it. After the construction activity is over, top soil shall be utilized for landscaping activity. Other measures, which would be followed to prevent soil erosion and contamination include: Maximize use of organic fertilizer for landscaping and **green** belt development. Removal of as little vegetation as possible during the development, and re-vegetation of bare areas after the project. Working in small area at a point of time (Phase wise construction)

## 11.10 Architectural Design:

Public areas will be cooled by natural ventilation as opposed to air conditioning. Maximize the use of natural lighting through design.

## 11.11 Energy Saving Practices:

- Promoting use of solar/Biogas based water heating.
- Purchase of energy efficient appliances.
- Constant monitoring of energy consumption and defining targets for energy conservation. Adjusting the settings and illumination levels to ensure minimum energy used for desired comfort levels.
- Use of compact fluorescent lamps and low voltage lighting.
- Behavioural change on consumption: Promoting staff awareness on energy conservation.

## 11.12 Safety Measures: Fire Fighting System:

The development of the BioCNG Plant shall follow all guidelines as per National Building Code of India. For every 100 $m^2$ area of the Bio methanation plant, one DCP type and one $CO_2$ type fire extinguisher will be provided. Biogas enclosure, compressor enclosures, control room, laboratory etc. will have the fire extinguishers and sand bucket racks. "Nonsmoking"

and hazard/ danger warning stickers will be put up at appropriate places. All personnel deployed for the construction, erection and operation of bio-gas plant will be given proper training for fire drill. Emergency numbers will also be put up at appropriate places. Empty fuel drums / tanks and other inflammable material will be removed from the premises as soon as possible. Storage yard for chemicals and fuel lubricants will also be provided with fire extinguishers and bucket racks.

Safety Measures appropriate to the process: The general safety features adopted are - provision of fire extinguishers, over pressure relief devices, safest or age of all chemical and fuels, grounding of all electric equipment, safe location of auxiliary electric gear, proper building and equipment layout, instrumentation alarms, guard railings, security personnel. The biogas line will have pressure relief valves, flame proof motors with safety guards, flare pipe, flame arrester, water seals etc.

For the building, engine room, substation and engine room, substation and control room's suitable portable fire extinguishers will be provided as per norms. For the outdoor areas like feed stock silage, digesters etc., fire hydrants as per norms will be provided.

## 11.13 Safety Earthing

A Safety Earthing system comprising of buried mild steel/RCC conductor earthing grid will be provided for the plant buildings, switch yard and other outlying areas. This will be connected to the earth grids in various buildings. The buried earthing grid will be further connected to the earthing electrodes buried in ground and located at representative points. All exposed earthing conductors will be galvanized steel.

All accessories will be mounted as per The Petroleum and Explosives Safety Organisation (PESO) Norms.

## 11.14 Management Practices That Shall Be Followed Are:

- Herbicide and pesticide will not be over applied (small-scale applications) and not applied prior to rain.
- Paintbrushes and equipment for water and oil based paints shall be cleaned within a contained area and shall not be allowed to contaminate site soils, watercourses, or drainage systems.

- Provide adequate hazardous waste storage facilities, hazardous waste collection containers are conveniently located and designed hazardous waste storage areas are away from storm drains or watercourses.
- Segregate potentially hazardous waste from non-hazardous construction site debris. Clearly label all hazardous waste containers with the waste being stored and the date of generation. Preferably, these will return back to the manufactures.
- Educate employees and subcontractors on hazardous waste storage and disposal procedures.
- Instruct employees and subcontractors in identification of hazardous and solid waste.
- Even with careful management, some of these substances are released into air, soil and water, and many are hazardous to workers. For these reasons, the best choice is to avoid their use as much as possible by using low toxicity substitutes and low VOC (volatile organic compound) paints.

## 11.15 Environmental Management Plan and Monitoring Plan

It is also necessary to have a permanent organizational set up charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring. No plan can succeed without monitoring.

The major duties and responsibilities of person (normally Maintenance-In charge) shall be as given below:

- To implement the environmental management plan,
- To assure regulatory compliance with all relevant rules and regulations,
- To ensure regular operation and maintenance of pollution control devices,
- To minimize environmental impacts of operations as by strict adherence to the EMP,
- To initiate environmental monitoring as per approved schedule.
- Review and interpretation of monitored results and corrective measures in case monitored results are above the specified limit.
- Maintain documentation of good environmental practices and applicable environmental laws as ready reference, Maintain environmental related records.
- Co-ordination with regulatory agencies, external consultants, monitoring laboratories. Maintaining log of public complaints and the action taken. Proper **Green** belt & landscaping will be developed for better air environment, because man needs inhalation every moment, so also is Flora and Fauna dependent on it.

# 12. SALIENT FEATURES OF THE PROJECT

## 12.1 Salient Features of The Project

- **Raw Material: -**The Biogas Plant will be designed 450 TPD input of **Napier Grass, Paddy Straw, Agri waste and Cattle Dung** as the potential feedstock.
- **Products:** CBG around 25 TPD
- **By- Products:** Bio-fertilizer 70 TPD
- **Grid Connectivity Captive/ Off-grid**: Off-grid
- **Plant area (private land):** 15 acres
- **Feedstock Availability: -** Ample availability of feedstock in the nearby villages.
- **Biogas & Biomethane**: - Bio gas recovery from the proposed feed will range about 5-6% of the total dry input. Biogas production from dung or co-digestion of dung with Agri residues and other bio-waste is commercially proven technology. Compost would be a Co- Product, in all cases.
- **Biogas upgradation**: - involves removal of $H_2S$ (<20 ppm) and $CO_2$ (<4%) to be suitable for transport application. Methane content would be 96% and Methane losses maintained <0.5%. Upgraded Biogas (95% methane) has heating value, per cu m, close to 0.9 litre of Petrol or 0.8 Kg of LPG. Compressing upgraded Biogas would produce Bio-CNG which could be an effective transport fuel.
- **Likely date Of Commission:** 14 months from date of commencement and government approvals, issue of PO & 30% Advance Money
- **Technical Details:** Vacuum Pressure Swing Adsorption Technology
- **Waste energy Process:** Bio methanation
- **Whether Bio gas Plant/diester(s) is new/old:** New
- **Sales:** The Bio CNG will be sold at 80% of the current market price of CNG to the Oil Marketing Companies (OMCs) like IOCL, BPCL, GAIL etc. *Sale Price OF the Bio CNG: Rs. 64.00 / Kg (Pessimistic Value)*. Sale Price of the Bio mass manure: Rs. 3 per Kg (Pessimistic Value) These prices have been taken in financial projections.
- **Average Purchase price of raw material Per ton with Transportation:** Rs 1485 Per Ton
- **Promoters: PKLS INDUSTRIES PRIVATE LIMITED** is promoted by a group of businessmen including Dr. L S Singh / Dr PK Singh as MD / Director.
- **Name of Consultant:** Finsen Ritter Technologies Private Limited
  CIN: U74110MP2020PTC051346 PAN: AAECF0760F

### 12.2 Implementation Schedule

| WORK PLAN | MONTHS | PROCESS INDICATORS |
|---|---|---|
| FEASIBILITY STUDY | 2 | Waste quantities, calorific values, capacity, siting, energy, sale, organization, costs, and financing in detail |
| CONSTRUCTION & SUPERVISION | 6 | Construction by selected contractor and supervision by independent consultant |
| COMMISSIONING | 6 | Test all performance specifications, settlements, commissioning, training of staff, and start, emission control checks and Stabilization |
| OPERATIONS AND MAINTENANCE | 2 | Continuous operation and maintenance of plant |

## 13. ESTIMATED COST OF CBG PROJECT

### 13.1Break up of various components of project

| S.No | Specifications | Type of Work | Client's Scope | Finsen Ritter's Scope | Scope of Work |
|---|---|---|---|---|---|
| 1 | Land | Administrative | INR 3,00,00,000 | INR 0 | Client's Scope |
| 2 | DPR | Administrative | INR 97,50,000 | INR 0 | Client's Scope |
| 3 | Various Government Approvals | Administrative | | | |
| 4 | Office Furniture | Administrative | | | |
| 5 | Electrical connection from the DISCOM | Administrative | | | |

| | | | | | |
|---|---|---|---|---|---|
| 6 | Financing process of the project | Administrative | | | |
| 7 | PESO Approvals | Administrative + Technical | | | |
| 8 | Furnishing of Engineering Drawings | Administrative + Technical | INR 0 | INR 34,85,000 | Finsen Ritter's Scope |
| 9 | Training and SOPs for the functioning of the plant | Administrative + Technical | | | |
| 10 | Pumps (All Pumps) | Chemical Engineering | INR 0 | INR 8,46,00,000 | Finsen Ritter's Scope |
| 11 | Biogas Purification Unit (VPSA system) | Chemical Engineering | | | |
| 12 | H2S Scrubber | Chemical Engineering | | | |
| 13 | Gas Dryer | Chemical Engineering | | | |
| 14 | Moisture Trap | Chemical Engineering | | | |
| 15 | Water Pre Heating System | Chemical Engineering | | | |
| 16 | Machinery like Air Compressors, Blowers, Dryers | Chemical Engineering | | | |
| 17 | Biogas Domes over Main Digester (To store the raw biogas | Chemical Engineering | | | |

| | | | | | |
|---|---|---|---|---|---|
| | generated within the digester) | | | | |
| 18 | Piping for slurry and Gas | Chemical Engineering | | | |
| 19 | Chillers | Chemical Engineering | | | |
| 20 | Fire Safe Flange End Valves | Chemical Engineering | | | |
| 21 | Flare unit (To flare the excess biogas generated or to flare the gas if the up gradation unit is under maintenance) | Chemical Engineering | | | |
| 22 | Heat Exchanger | Chemical Engineering | | | |
| 23 | PLC Automation System | Chemical Engineering | | | |
| 24 | Water lines | Chemical Engineering | | | |
| 25 | Drain lines | Chemical Engineering | | | |
| 26 | Manifold for bottling & Crane | Chemical Engineering | | | |
| 27 | Land Survey | Civil Engineering | INR 0 | INR 68,000 | Finsen Ritter's Scope |
| 28 | Civil Works for Digesters | Civil Engineering | INR 13,72,00,000 | INR 0 | Client's Scope |

| | | | | | |
|---|---|---|---|---|---|
| 29 | Civil Works for Pre Digesters | Civil Engineering | | | |
| 30 | Civil Works for Weight Bridge | Civil Engineering | | | |
| 31 | Civil Works for Decanter Room | Civil Engineering | | | |
| 32 | Civil Works for Mixing Tank | Civil Engineering | | | |
| 33 | Civil Works for Material Handling Equipment | Civil Engineering | | | |
| 34 | Civil Works for Flare Unit | Civil Engineering | | | |
| 35 | Civil Works for Lagoons & ETP | Civil Engineering | | | |
| 36 | Civil Works for Shed of Purification Plant & Bottling Station | Civil Engineering | | | |
| 37 | Misc. Civil Works | Civil Engineering | | | |
| 38 | Office Rooms, Guard Room, Toilets, Resting Room, Other Office Related works | Civil Engineering | | | |
| 39 | Shed for Storage 25000 sq. feet | Civil Engineering | | | |
| 40 | Civil Works for Plant Shed 5000 Sq. feet | Civil Engineering | | | |

| | | | | | |
|---|---|---|---|---|---|
| 41 | Internal Roads | Civil Engineering | | | |
| 42 | Earthworks and Levelling | Civil Engineering | | | |
| 43 | Borewell and water connection | Civil Engineering | | | |
| 44 | Weigh bridge (To measure the weight of the waste) | Civil Engineering | | | |
| 45 | Lagoons Construction | Civil Engineering | | | |
| 46 | Electrical cabling & Internal Electrical Works | Electrical Engineering | INR 0 | INR 34,00,000 | Finsen Ritter's Scope |
| 47 | Street Lights | Electrical Engineering | | | |
| 48 | Panel boards | Industrial Electronics | INR 0 | INR 37,63,00,000 | Finsen Ritter's Scope |
| 49 | Transportation at site + Packaging & Forwarding + Installation | Mechanical Engineering | | | |
| 50 | Material Handling Equipment, Cranes, Loaders, etc | Mechanical Engineering | | | |
| 51 | Crushing Unit and Dump Pit with conveyer | Mechanical Engineering | | | |

| | | | | | |
|---|---|---|---|---|---|
| 52 | Pre Digesters | Mechanical Engineering | | | |
| 53 | Main Digesters | Mechanical Engineering | | | |
| 54 | Slurry Outlet Tank | Mechanical Engineering | | | |
| 55 | Decanter Structure | Mechanical Engineering | | | |
| 56 | Agitator in pre digester for Mixing system (To mixing the slurry inside of the pre digester) | Mechanical Engineering | | | |
| 57 | Heat Recovery Mechanism | Mechanical Engineering | | | |
| 58 | Decanter | Mechanical Engineering | | | |
| 59 | Fire Fighting | Mechanical Engineering | | | |
| 60 | High pressure compressor (To compress the clean biogas from 0.3 bar to 250 bars) | Mechanical Engineering | | | |
| 61 | 750 Cylinders & Cascades (To store the Bio CNG) | Mechanical Engineering | INR 7,50,00,000 | INR 0 | Client's Scope |
| 62 | Tractors, dump vehicles and other accessories | Operations | INR 2,70,00,000 | INR 0 | Client's Scope |

| | | | | | |
|---|---|---|---|---|---|
| 63 | IT Systems and Accounting Systems & Office Furniture | Operations | | | |
| 64 | Hiring of Human Resources | Operations | | | |
| 65 | Operation and Management after commissioning of the project | Operations | | | |
| TOTAL COST | | | **INR 27,89,50,000** | **INR 46,78,53,000** | |

## 13.2 Summary of investment

| | | |
|---|---|---|
| Total Exclusive of GST | INR 74,68,03,000 | |
| GST of Civil 12% | INR 1,64,64,000 | |
| GST of Other Items 18% | INR 10,97,28,540 | |
| Total Inclusive of GST | INR 87,29,95,540 | |
| Working Capital | INR 11,0595,207 | 90 Days of Cost |
| Interest Cost | INR 8,75,00,000 | 12 Months Interest |
| Contingency | INR 2,89,09,253 | |
| | | |
| **Grand Total** | **INR 1,10,00,00,000** | |

## 13.3 Funding Details

Promoters of the project are looking at following sources for financing the project

- Venture capital
- Strategic Investor
- Government Subsidies (will be available only after commissioning of project)

***Promotors are open to joint ventures and equity participation by the investors***

***A debit equity ratio of 3:1 has been used for financial projections.***

# 14. FINANCIALS

## 14.1 Payback and cash flows

ALL AMOUNTS IN RS LAKHS

| | | | | | |
|---|---|---|---|---|---|
| Capacity of Plant in Input (Tons per day) | 400 | Equity in Lakhs | 2,750 | Yearly Cost Escalation | 6% |
| Total CNG Per day (KG/Day) | 26.436 | Term Loan in Lakhs | 8,250 | Tariff escalation | 6% |
| Total yearly Production (Tons/year) | 9,649 | Bank Rate of Interest in % | 10 | Project Tenure | 15 |
| Project Cost Rs. In Lakhs | 11,000 | Term Loan Tenure Years | 7 | Plant Degradation | 0.8% |
| Days | 365 | Debt to equity ratio % | 75 | | |

**PROJECTED FINANCIALS**

| **Details/Years of operation** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
|---|---|---|---|---|---|---|---|---|---|---|
| Total yearly Production (Tons/year) | 9,649.14 | 9,649.14 | 9,649.14 | 9,649.14 | 9,649.14 | 9,649.14 | 9,649.14 | 9,649.14 | 9,649.14 | 9,649.14 |
| Plant Efficiency | 100% | 99.20% | 98.41% | 97.62% | 96.84% | 96.06% | 95.29% | 94.53% | 93.78% | 93.03% |
| Available Production (MT/Year) | 9,649.14 | 9,571.95 | 9,495.37 | 9,419.41 | 9,344.05 | 9,269.30 | 9,195.15 | 9,121.59 | 9,048.61 | 8,976.22 |
| Yearly Billing for Fertiliser (Rs./Year in Lakhs) | 657.0 | 689.8 | 724.3 | 760.5 | 798.6 | 838.5 | 880.4 | 924.4 | 970.6 | 1,019.2 |
| CNG purchase rate (Rs/Ton) | 64,000.00 | 67,200.0 | 70,560.0 | 74,088.0 | 77,792.4 | 81,682.0 | 85,766.1 | 90,054.4 | 94,557.1 | 99,285.0 |
| CNG Billing Rs. Lakhs | 6,175.4 | 6,432.3 | 6,699.9 | 6,978.7 | 7,269.0 | 7,571.4 | 7,886.3 | 8,214.4 | 8,556.1 | 8,912.0 |
| **Total Billing in Lakhs (CNG + Fertiliser)** | **6,832.4** | **7,122.2** | **7,424.2** | **7,739.2** | **8,067.5** | **8,409.8** | **8,766.7** | **9,138.8** | **9,526.8** | **9,931.2** |
| | | | | | | | | | | |
| **Expenditures** | | | | | | | | | | |
| Electricity | 818.20 | 867.29 | 919.33 | 974.49 | 1032.96 | 1094.93 | 1160.63 | 1230.27 | 1304.08 | 1382.33 |
| Waste | 1459.60 | 1547.18 | 1640.01 | 1738.41 | 1842.71 | 1953.27 | 2070.47 | 2194.70 | 2326.38 | 2465.96 |
| Transportation for delivery | 690.64 | 732.08 | 776.00 | 822.56 | 871.92 | 924.23 | 979.69 | 1038.47 | 1100.78 | 1166.82 |
| Human Resource | 445.00 | 471.70 | 500.00 | 530.00 | 561.80 | 595.51 | 631.24 | 669.12 | 709.26 | 751.82 |
| Maintenance | 249.20 | 264.15 | 280.00 | 296.80 | 314.61 | 333.49 | 353.49 | 374.70 | 397.19 | 421.02 |
| Misc | 712.00 | 754.72 | 800.00 | 848.00 | 898.88 | 952.82 | 1009.99 | 1070.58 | 1134.82 | 1202.91 |
| | | | | | | | | | | |
| Total Cost (in Lakhs) | 4,374.6 | 4,637.1 | 4,915.3 | 5,210.3 | 5,522.9 | 5,854.3 | 6,205.5 | 6,577.8 | 6,972.5 | 7,390.9 |
| Balance of Principal Amount at year end | 8,250.0 | 7,071.4 | 5,892.8 | 4,714.2 | 3,535.6 | 2,357.0 | 1,178.4 | (0.2) | (0.2) | - |
| Principal Amount Repayment | 1,178.6 | 1,178.6 | 1,178.6 | 1,178.6 | 1,178.6 | 1,178.6 | 1,178.6 | | | |
| Interest Payment | 766.1 | 648.2 | 530.4 | 412.5 | 294.6 | 176.8 | 58.9 | | | |
| | | | | | | | | | | |
| Net Cash Flow | 513.1 | 658.2 | 799.9 | 937.8 | 1,071.4 | 1,200.2 | 1,323.7 | 2,561.0 | 2,554.2 | 2,540.4 |
| Cumulative Cash Flow | 513.1 | 1,171.4 | 1,971.3 | 2,909.1 | 3,980.5 | 5,180.7 | 6,504.4 | 9,065.4 | 11,619.6 | 14,160.0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **PRE TAX Equity IRR** | (2,750.0) | **43.07%** | | | | | | | | |
| Equity Cash Flow | 513.1 | 658.2 | 799.9 | 937.8 | 1,071.4 | 1,200.2 | 1,323.7 | 2,561.0 | 2,554.2 | 2,540.4 |
| | (2,236.9) | 658.2 | 799.9 | 937.8 | 1,071.4 | 1,200.2 | 1,323.7 | 2,561.0 | 2,554.2 | 2,540.4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **DSCR** | 1.26 | 1.36 | 1.47 | 1.59 | 1.73 | 1.89 | 2.07 | na | na | na |
| Average DSCR | **1.62** | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| PRE TAX PROJECT IRR | (11,000.0) | **25.82%** | | | | | | | | |
| Project Cash Flow | 2,457.8 | 2,485.0 | 2,508.9 | 2,528.9 | 2,544.6 | 2,555.6 | 2,561.2 | 2,561.0 | 2,554.2 | 2,540.4 |
| | (8,542.2) | 2,485.0 | 2,508.9 | 2,528.9 | 2,544.6 | 2,555.6 | 2,561.2 | 2,561.0 | 2,554.2 | 2,540.4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Project Pay Back | **3.5 Years** | | | | | | | | | |
| | (8,542.2) | (6,057.1) | (3,548.2) | (1,019.3) | 1,525.3 | 4,080.9 | 6,642.1 | 9,203.1 | 11,757.3 | 14,297.7 |

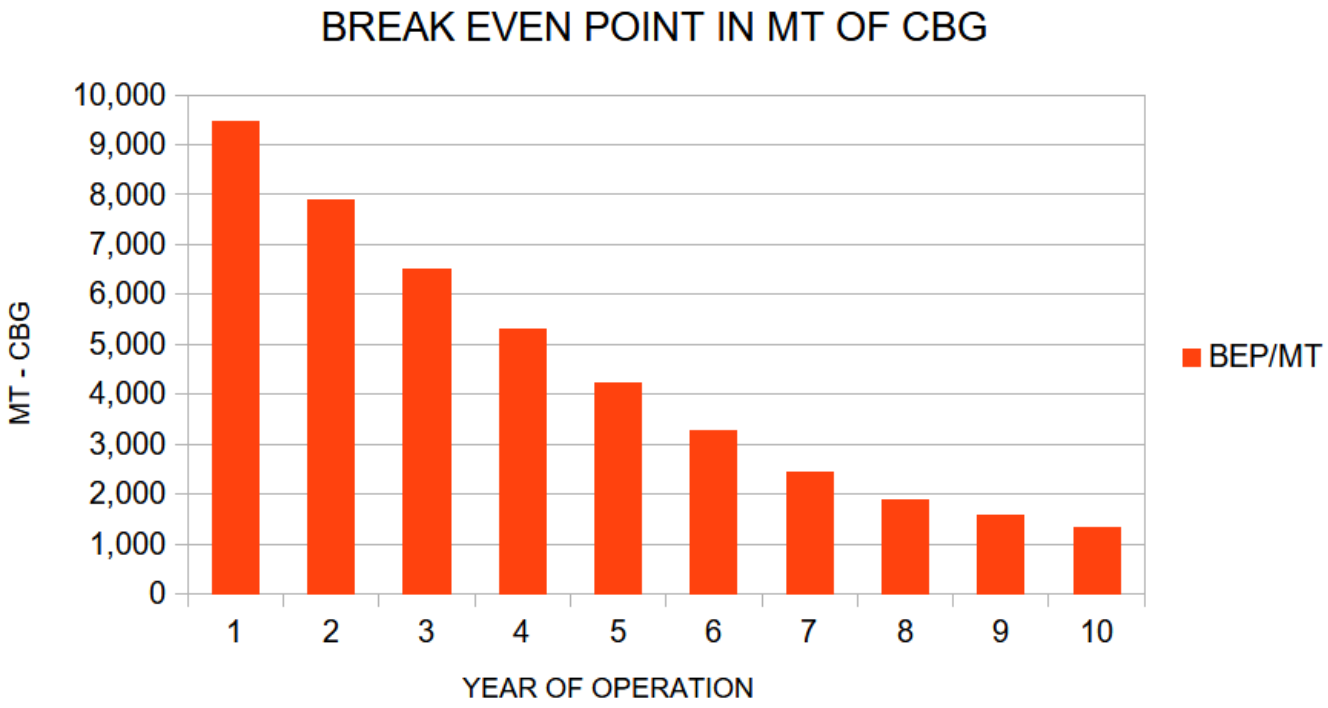
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depreciation on WDV | 1650.0 | 1402.5 | 1192.1 | 1013.3 | 861.3 | 732.1 | 622.3 | 529.0 | 449.6 | 382.2 |
| Taxable Value – GM-INTT-DEP – NP | 41.7 | 434.3 | 786.4 | 1103.1 | 1388.7 | 1646.7 | 1880.0 | 2032.0 | 2104.6 | 2158.2 |
| Taxes – MAT @ 18.5% | 7.72 | 80.35 | 145.49 | 204.08 | 256.91 | 304.64 | 347.80 | 375.92 | 389.36 | 399.27 |
| Net Cash flow After Taxes | 505.39 | 577.89 | 654.46 | 733.74 | 814.50 | 895.57 | 975.89 | 2,185.05 | 2,164.89 | 2,141.09 |
| Cumulative Net Cash Flow After Taxes | 505.39 | 1,083.28 | 1,737.74 | 2,471.49 | 3,285.98 | 4,181.55 | 5,157.44 | 7,342.49 | 9,507.38 | 11,648.48 |
| Profit After Tax (PAT) | 33.99 | 353.99 | 640.94 | 899.04 | 1,131.78 | 1,342.05 | 1,532.20 | 1,656.10 | 1,715.28 | 1,758.93 |
| PAT % | 0.50 | 4.97 | 8.63 | 11.62 | 14.03 | 15.96 | 17.48 | 18.12 | 18.00 | 17.71 |
| PBT % | 0.61 | 6.10 | 10.59 | 14.25 | 17.21 | 19.58 | 21.44 | 22.24 | 22.09 | 21.73 |

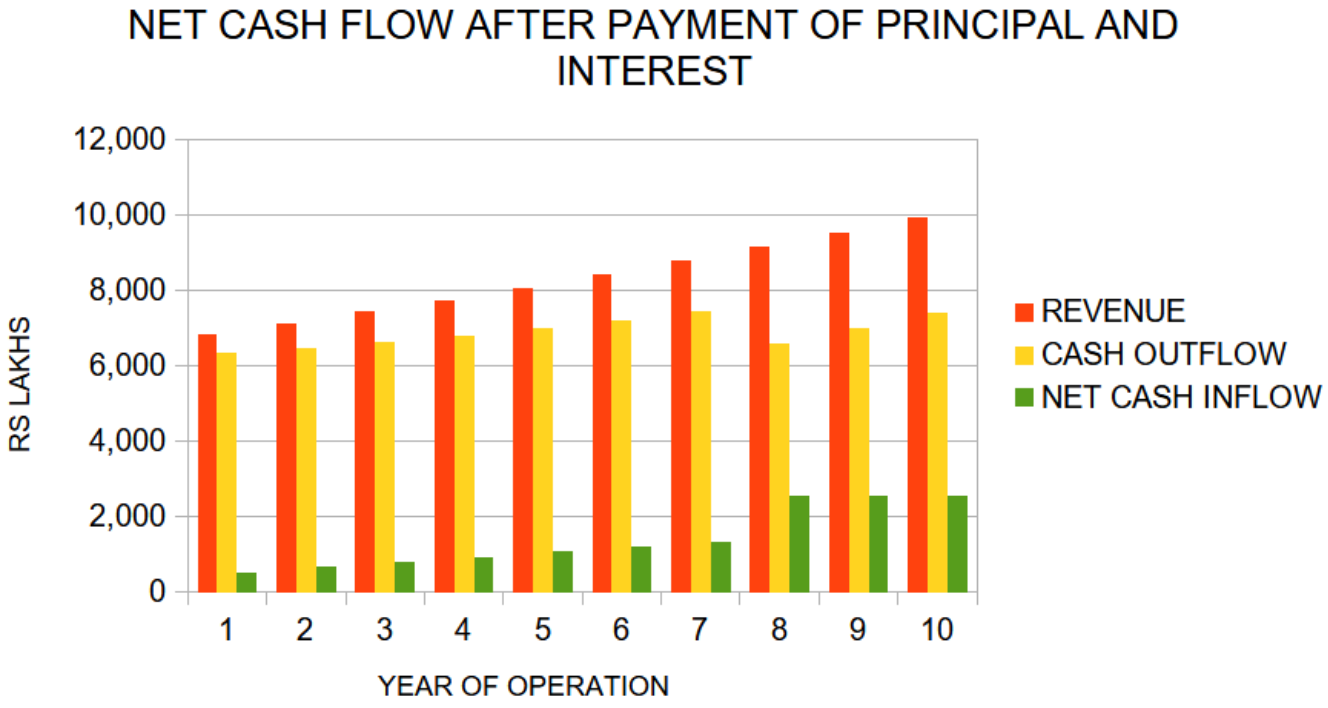
## 14.2 Internal Rate of Return

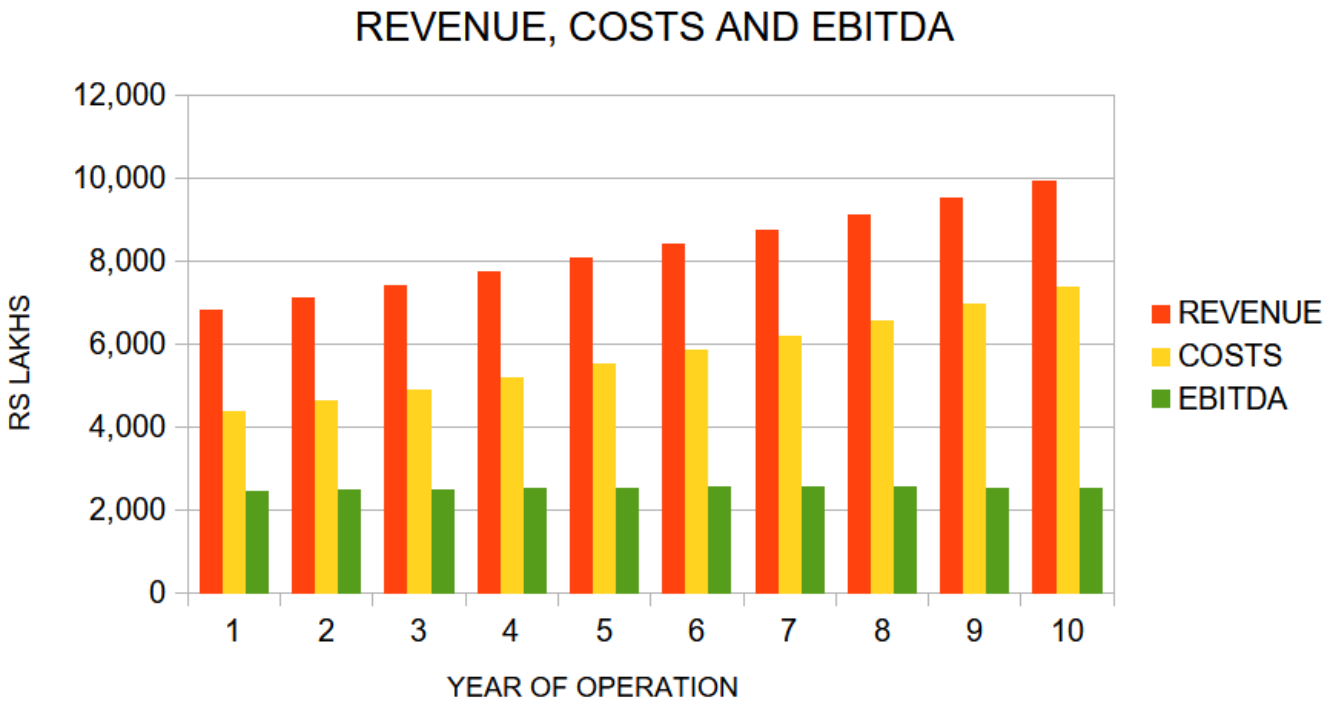
| **SUMMARY** | |
|---|---|
| Pre Tax Project IRR | **25.82%** |
| Average DSCR | **1.62** |
| Project Pay back | **3.5 Years** |

***NOTE: 1) Very conservative prices for products have been adopted while preparing the financials. We are confident that actual financial results will be much better.***

***2) Financial do not Include Incentives and subsidies available to such projects.***


BREAK EVEN POINT IN MT OF CBG
MT - CBG
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1
2
3
4
5
6
7
8
9
10
YEAR OF OPERATION
BEP/MT


NET CASH FLOW AFTER PAYMENT OF PRINCIPAL AND INTEREST
RS LAKHS
12,000
10,000
8,000
6,000
4,000
2,000
0
1
2
3
4
5
6
7
8
9
10
YEAR OF OPERATION
REVENUE
CASH OUTFLOW
NET CASH INFLOW




# 15. CONCLUSION AND RECOMMENDATION

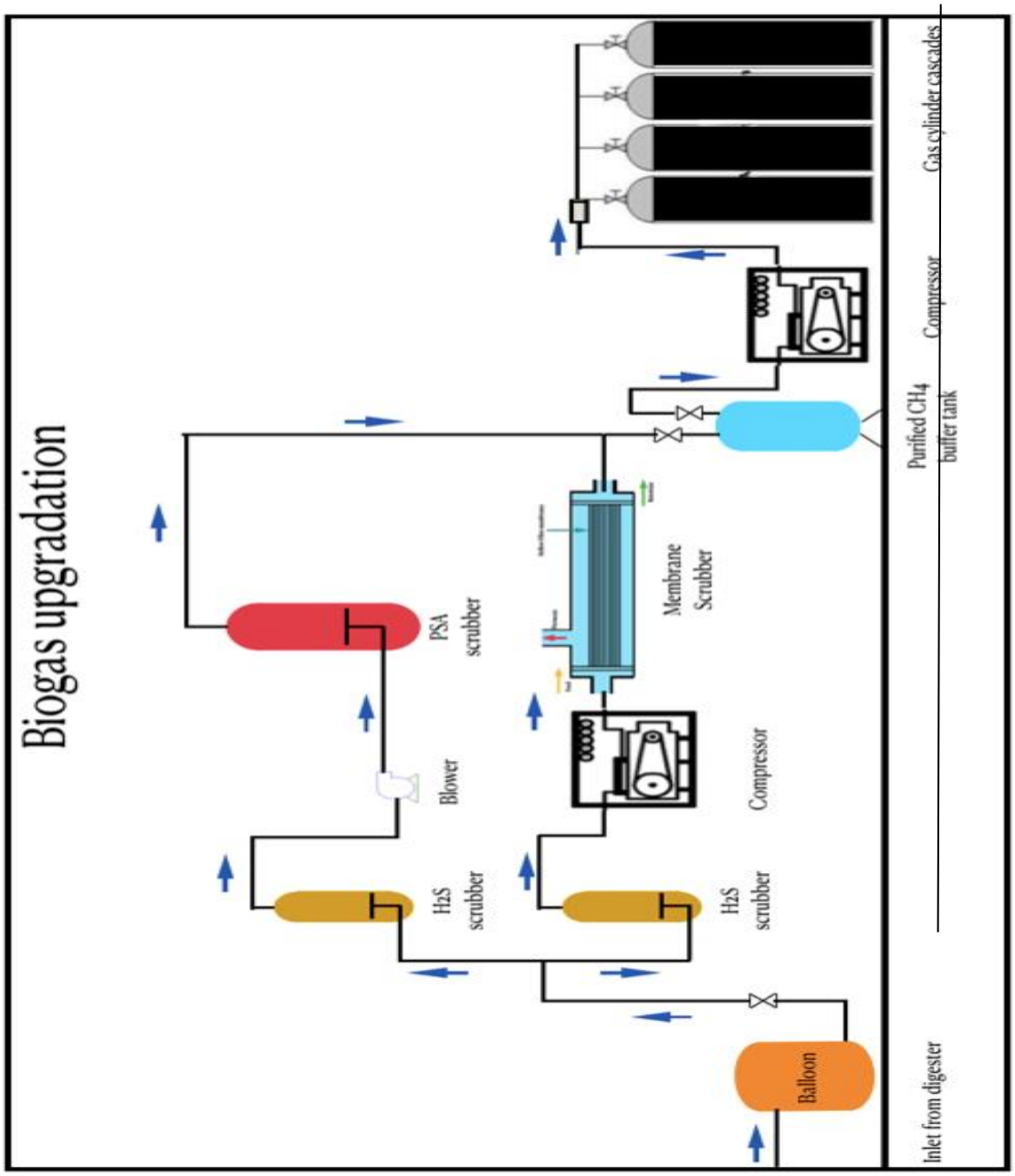
## 15.1 Conclusion and Recommendation:

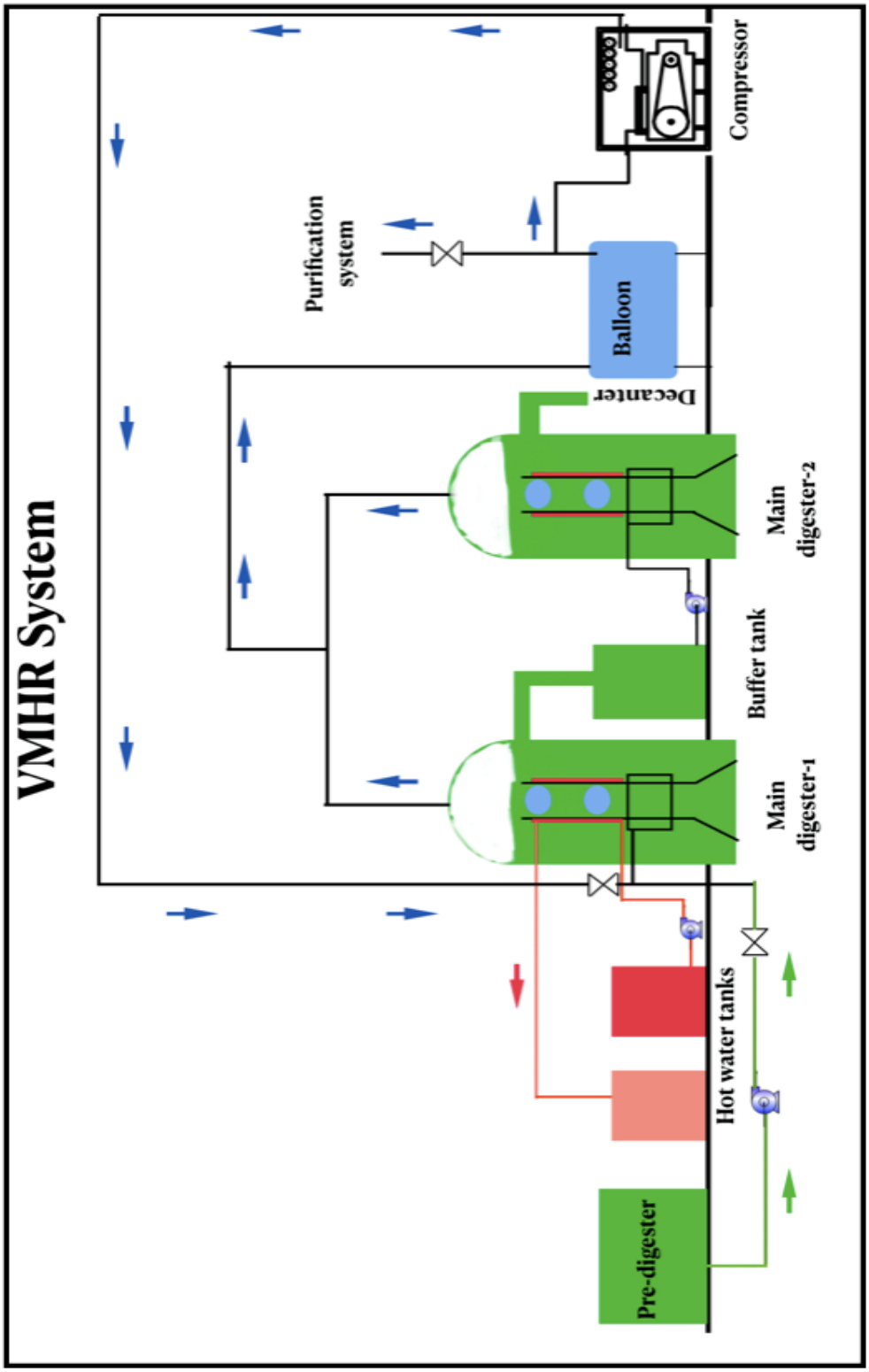
Financial Analysis clearly indicates that setting up of CBG plant of 450 Tons of feedstock is Environmentally friendly as well as techno economically a viable and profitable project. Keeping in mind the environmental impact and self-sustainability of the project, it is strongly recommended that the project should be executed in the right earnest at the earliest.

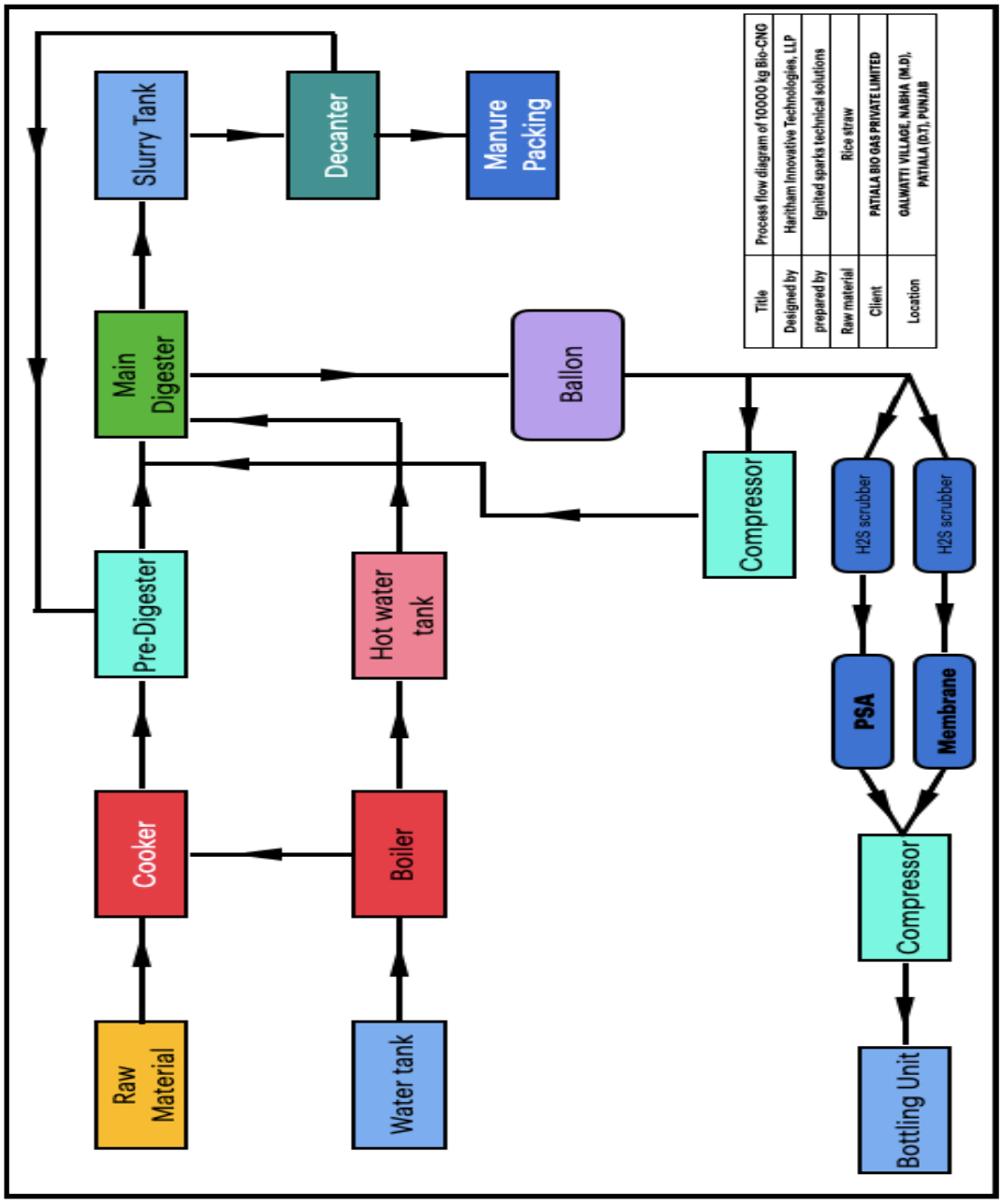
The internal rate of return of the project is very high with a payback period of 4 years including finance cost. Hence it is essential to execute the project as soon as possible.

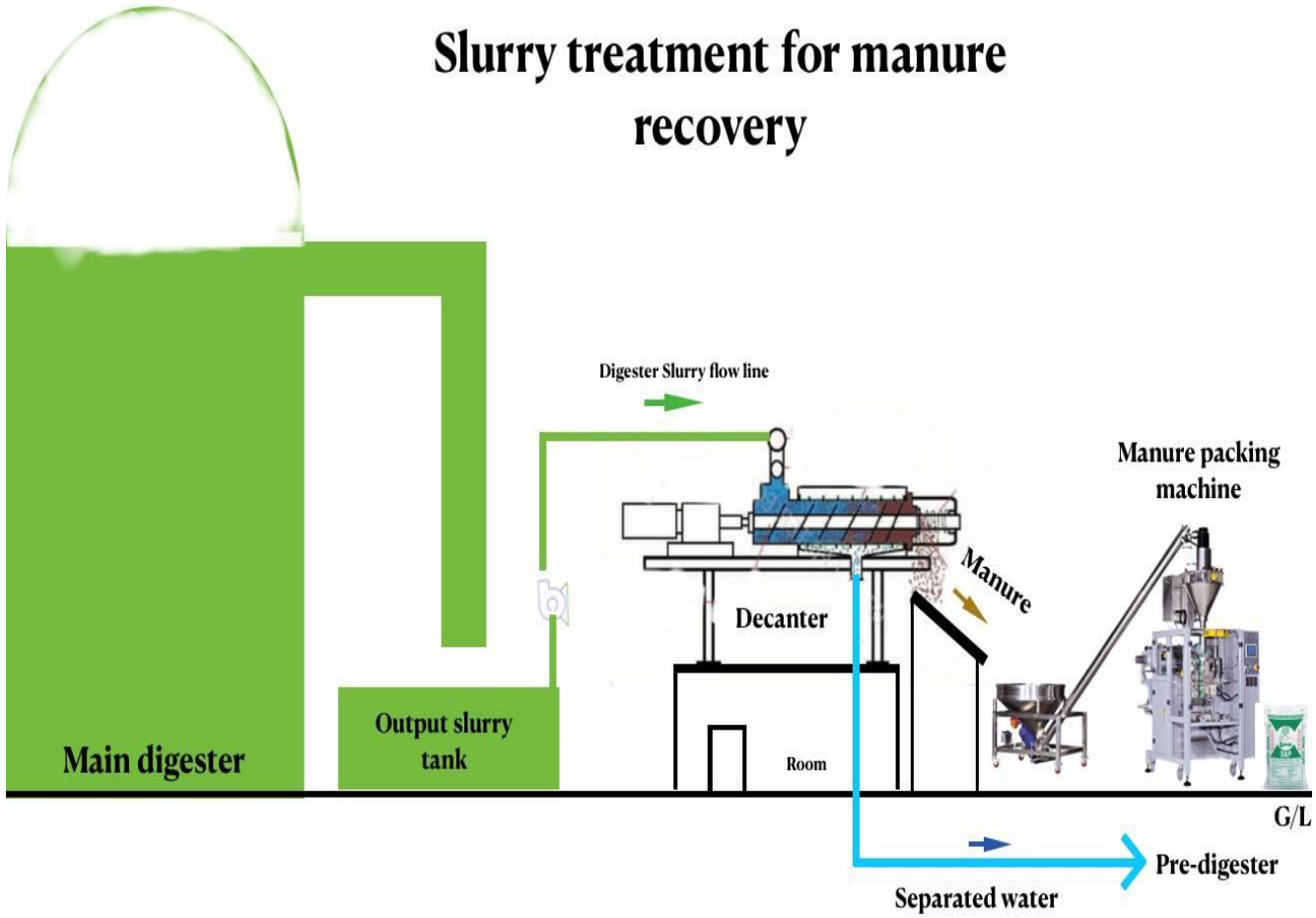
# 16 Appendix: FLOW DIAGRAMS AND ENGINEERING DRAWINGS OF PLANTS & MACHINARY

Flow diagrams & plans will be shared within the 3 weeks before the ground breaking of the project. **(Note: Drawings are just for references)**




VMHR System
Compressor
Purification system
Balloon
Decanter
Main digester-2
Buffer tank
Main digester-1
Hot water tanks
Pre-digester


Slurry Tank
Decanter
Manure Packing
Main Digester
Ballon
Compressor
H2S scrubber
H2S scrubber
Pre-Digester
Hot water tank
PSA
Membrane
Cooker
Boiler
Compressor
Raw Material
Water tank
Bottling Unit
Title
Process flow diagram of 10000 kg Bio-CNG
Designed by
Haritham Innovative Technologies, LLP
prepared by
Ignited sparks technical solutions
Raw material
Rice straw
Client
PATIALA BIO GAS PRIVATE LIMITED
Location
GALWATTI VILLAGE, NABHA (M.D), PATIALA (D.T), PUNJAB


Slurry treatment for manure recovery
Digester Slurry flow line
Manure packing machine
Manure
Decanter
Main digester
Output slurry tank
Room
G/L
Pre-digester
Separated water


After weight measurement, dung is unloaded in the cow dung unloading Tank.



Compressed purified gas is store in the Cylinder Cascade system

Storage Pressure: 250 Bar

Liquid fertilizer is collected in the tank and sold to the farmers though tankers

This fertilizer shall also serve the purpose of manure and help retain the moister content of the soil

## 17. CONTRACTOR DETAILS & EXPERIENCES

Finsen Ritter Technologies Private Limited have expertise in OXYGEN, NITROGEN, BIO-CNG, HYDROGEN, ANA, UVGI Equipment, Water Treatment, BREWING Equipment, SOLAR Power Plant, MILK CHILLER Plants, CHLORINATION Plant, BIOGAS Plant, BIO-CNG Plant, NOISE

MONITORING Devices, RAIN WATER HARVESTING Set-up and many more. Finsen Ritter have successfully commissioned 100+ plants all over India.

Finsen Ritter was founded in 2020 by Mr. Aniket Awasthi (B. Tech. Mechanical & M Tech) from IIT Kharagpur. Now Finsen Ritter have a team of more than 25 employees of young & qualified Mechanical engineers, design engineers, project engineers & many more.

PRODUCTS & SERVICES OFFERED BY FINSEN RITTER:

CLIENTS:

## ABOUT THE COMPANY

WE SPECIALISE IN INDUSTRIAL TURNKEY SOLUTIONS. WE HAVE DEVELOPED OUR IN-HOUSE TECHNOLOGIES IN THE DESIGN, SUPPLY, INSTALLATION AND TESTING OF CHEMICAL AND GAS PLANTS.

WE HAVE BUSINESSES IN EUROPE AND INDIA. OUR DESIGN CENTRE IS IN AMSTERDAM, THE NETHERLANDS AND THE MANUFACTURING CENTRE IN INDIA.

WE HAVE EXPERTISE IN OXYGEN, NITROGEN, HYDROGEN, ANA, UVGI EQUIPMENT, WATER TREATMENT, BREWING EQUIPMENT, SOLAR POWER PLANT, MILK CHILLER PLANTS, CHLORINATION PLANT, BIOGAS PLANT, BIO CNG PLANT, NOISE MONITORING DEVICES ETC

WE FOLLOW THE STATE OF THE ART INDUSTRY 4.0 STANDARDS ACROSS ALL OUR EQUIPMENT AND PLANTS DELIVERING THE BEST OF EQUIPMENT TO OUR CLIENTS.

## OUR CORPORATE CLIENTS

GRASIM
AVANTHA
IMPETUS
JAYPEE GROUP
BHARAT OMAN REFINERIES LIMITED
AJAY DEEP Electro Medical
CHARTERED
Bengaluru International Airport
LOGOMAN
awfis where work meets life
PM PROJECTS
SAIMS
NAVODAYA MEDICAL COLLEGE
murugappa

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