PANACEU
Engineering Beyond Thoughts

COMPRESSED BIOGAS & BIOMASS PELLETS PROJECT

Prepared By:

PANACEU SYSTEMS PRIVATE LIMITED

- PROJECT DETAILS
- STATUTORY REQUIREMENTS AND GOVT SUPPORT
- TECHNOLOGY
- PLANT AND MACHINERY
- PSPL PROFILE
- REPRESENTATIVE PROJECTS
- FEASIBILITY ANALYSIS REPORT

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

PROJECT DETAILS

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

COMPRESSED BIOGAS (CBG) & BIOMASS PELLETS IN INDIA

1. India is among the fastest-growing economy in the world and its energy consumption is slated to increase rapidly. According to the Ministry of Petroleum and Natural Gas (MoP&NG) estimates, India has a total reserve of 763 million Metric Ton (MMT) of crude oil and 1,488 billion Cubic meters (BCM) of natural gas. The country currently imports nearly 77% of its crude oil requirements and about 50% of the natural gas requirement, leading the Government of India to set a target of reducing this import by at least 10% by 2022. Further, it has set a target of increasing the contribution of gas in India's energy mix from the existing 6.5% (global average is 23.5%) to 15% by 2022.
2. Countries such as Germany, Italy, the UK, France, and Switzerland are promoting biogas usage promoted by supporting legal frameworks, education schemes, and the availability of technology. Biogas produced in European countries is mostly fed into local natural gas grids and used for power generation. Grid injection is most common in European states followed by vehicles fueled with biogas (either pure or in blend with natural gas) and biogas is also used for heating purposes either directly or blended with natural gas.
3. The number of biogas plants in Germany has doubled to nearly 9,000 plants from 4,136 plants in 2010. The total biogas production capacity of the plants is 8.98 Billion Cubic Meter (BCM) equivalent to 6.6 Million Metric Ton (MMT). They are primarily operated by farmer co-operatives and utilize crops like maize or turnips as feedstock in their plants.
4. Vide Gazette Notification no. 395 dated 16th June 2015, Ministry of Road Transport and Highways, Government of India had permitted usage of bio-compressed natural gas (bio-CNG) for motor vehicles as an alternate composition of the compressed natural gas (CNG).
5. Government of India has released the National Policy on Biofuels 2018 vide gazette notification no. 33004/99 dated 8.6.2018. The policy emphasizes on promotion of advanced Biofuels including CBG.
6. The Galvanizing Organic Bio-Agro Resources Dhan (GOBAR-DHAN) scheme was launched by Government of India to convert cattle dung and solid waste in farms to Bio-CNG (CBG) and compost. GOBAR-DHAN scheme proposes to cover 700 projects across the country in 2018-19.

To help tackle air pollution issues, the Ministry of Power has issued a policy that calls for using 5-10 percent of biomass pellets alongside coal for power generation in thermal power plants across the country. Responding to a query in the Lok Sabha, Union Minister of Power R.K. Singh informed the House that the Central Electricity Authority (CEA) has written to all states and union territories across the country and asked them to promote the use of biomass pellets at all of their thermal power plants, whether public or private.

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

BASIC DETAILS OF THE PROJECT

1. Waste / Bio-mass sources like agricultural residue, poultry waste, cattle dung, sugarcane press mud, municipal solid waste and sewage treatment plant waste, etc. produce biogas through the process of anaerobic decomposition. The main objective of the project is to set up a compressed biogas plant to sale the Bio CNG to the local vehicles at around Rs. 54 per kg. The plant also produces biomass pellets in large quantity which can be sold at about Rs. 7.5 per kg to NTPC.

   A standard biogas plant of capacity 6000 Cubic Meter per day can be used. We can set up to 5 units of 6000 CUM together as a single plant. We also know that 1 CUM raw biogas gives 400 Gram compressed biogas.

   The total Biogas and BIOMASS pellets produced per day as per the capacity are following:

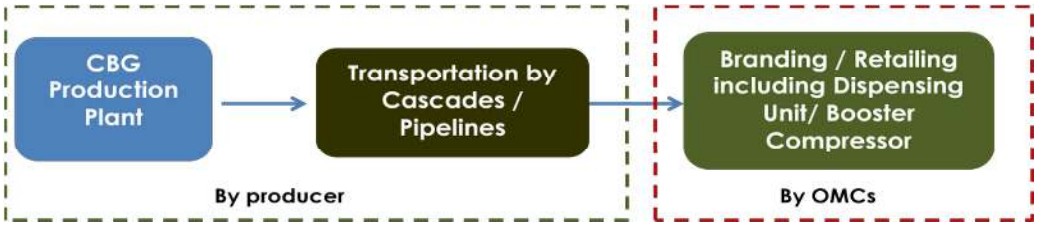
BIOGAS PLANT CAPACITY (CUM)	6000	12000	18000	24000	30000
ENRICHED BIOGAS CAPACITY (Nm^3 per day)	3300	6600	9900	13200	16500
ENRICHED BIOGAS CAPACITY (Kg per day)	2400	4800	7200	9600	12000
BIOMASS PELLETS (MT/day)	25	50	75	100	125

2. The biogas is purified to remove hydrogen sulfide (H_2S), carbon dioxide (CO_2), water vapor and compressed as Compressed Biogas (CBG), which has methane (CH_4) content of more than 90%. The CBG is to be compressed at 250 Bar and supplied through Cascades to the Retail Outlets. CBG has calorific value and other properties similar to CNG and hence can be utilized as green renewable automotive fuel. Thus, it can replace CNG in automotive, industrial and commercial areas, given the abundance biomass availability within the country.

3. Similarly, the Slurry obtained from a biogas plant can be dried and converted to Biomass pellets. This can replace the coal to a small extend in the thermal power plants.

4. SALE THROUGH GOVT. OIL MARKETING COMPANIES AND THERMAL POWER PLANTS: To be retailed through OMCS / fixed for three years from 1.10.2018 / the price will be reviewed at the end of 3 years: Producer shall deliver CBG (within 25 Km, an indicative maximum distance), at public sector Oil Marketing Companies' existing or new Retail Outlet / Stand-alone Selling Point, through the 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 Market 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 outlet flange of the Cascade / Inlet Flange of Compressor at the Retail Outlet shall be the Point of Sale for CBG. The cascade is to remain connected to the compressor at the 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 extra polated as per the above. If the RSP of CBG falls below Rs. 70/kg, there will be immediate revision in the procurement 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 a retail outlet, shall be provided to OMC or APPLICANT, as per whosoever sets up infrastructure at retail outlet.

Similarly, Biomass pellets can be sold to Govt. and private thermal power plants through tenders. They go into an agreement for 1 to 5 years. Power plants buy pellets based on their calorific value. Pellets sale in the range of Rs 6 to 10 per kg.

5. ANNUAL INPUT REQUIREMENT: The main raw material required for the plants is cow dung or poultry droppings Biomass waste or Press Mud. This will be procured from dairy and farms in

nearby areas. Water is required for the process. A tube well will be installed for meeting water requirements.

The supply of cow dung is available at Rs. 500 per ton delivered at the site and ready to use (for financial modeling, the same rate of Rs. 500 per ton has been taken). Poultry Litter will be available at Rs. 500 per ton. Biomass waste will be available at Rs. 1500 per ton. Press mud can be made at Rs. 300 per ton. We can always mix these wastes as per the availability.

Below we are giving approximate quantities of the requirements. A combination of any of these can also work in proportionate quantity.

PLANT CAPACITY, CUM	6000	12000	18000	24000	30000
DUNG REQUIRED DAILY (TON)	120	240	360	480	600
Or					
POULTRY DROPPINGS (TON)	50	100	150	200	250
Or					
BIOMASS WASTE (TON)	45	90	135	180	225
Or					
PRESS MUD (TON)	60	120	180	240	300
Biomass waste (for pellets production) (Ton)	5	10	15	20	25

PLANT CAPACITY, CUM	6000	12000	18000	24000	30000
Normal Water (Liters / day)	10,000	20,000	30,000	40,000	50,000
Recycled Water (Liters / day)	90,000	180,000	270,000	360,000	450,000
Electric Load (Maximum) kW	200	400	600	800	1000

6. PLANT AND MACHINERY: The entire plant and machinery is easily available from many different suppliers from India and abroad. The know-how is also available from very reliable sources from abroad. The plant for 365 days per year, using sophisticated and proven CSTR (Continually stirred tank reactor) technology. Anaerobic digestion is a renewable energy generation process in which microorganisms break down biodegradable material in the absence of oxygen. Anaerobic digestion technology was developed long back and commercialized in Europe and is technically considered a low-risk, high-output technology.

Biomass pellets making is a standard method for the production of high density, solid energy

carriers from biomass. Pellets are manufactured in several types and grades as fuels for electric power plants, homes, and other applications. Pellet-making equipment is available at a variety of sizes and scales, which allows manufacture at domestic as well industrial-scale production. Pellets have a cylindrical shape and are about 6-25 mm in diameter and 3-50 mm in length. There are European standards for biomass pellets and raw material classification (EN 14961-1, EN 14961-2 and EN 14961-6) and international ISO standards under development (ISO/DIS 17225-1, ISO/DIS 17225-2 and ISO/DIS 17225-6).

7. LAND AND BUILDING: The buildings for the project will consist of cylinder filling room, administrative office, security room, etc. The provision for tube well, foundations for equipment's, internal roads etc. have also to be made.

To ensure continuous supply of the waste, location of the plant has to be in rural background away from city limits. The land is needed for the planned biogas capacity, storage of cow dung & poultry droppings or other waste and biomass pellets produced.

PLANT CAPACITY (CUM)	6000	12000	18000	24000	30000
AREA REQUIRED (Sq. Meter)	**10,000**	**20,000**	**30,000**	**40,000**	**50,000**
COVERED AREA REQUIRED (Sq. ft.)	**5,000**	**8,000**	**12,000**	**15,000**	**17,000**

IMPLEMENTATION SCHEDULE

PHASE	ACTIVITIES	TIME REQUIRED IN (MONTHS)
1.	**COMPANY FORMATION**	
	• Company name approval • Company incorporation • Issue of Certificate	**1.0**
	TOTAL TIME FOR THE PHASE	**1.0**
2.	**PROJECT DEVELOPMENT**	
	• Site selection	0.5
	• Application for Biogas sale to Indian Oil Corp.	0.5
	• Detailed Project Report	1.0
	• PESO license application	0.5
	• Application to State Govt. for approval	0.5
	• Land registration	1.0

	• Other state approvals and registrations and other small paper works	1.0
	TOTAL TIME FOR THE PHASE	**3.0**
3.	**LOAN FROM IREDA & BANK**	
	• Grading for Loan from India Ratings	2.0
	• Loan Application	0.5
	• Presentations to IREDA	1.0
	• Finalization with IREDA	1.0
	• Loan approval and allocation	1.0
	• BANK Loan approval and allocation	1.0
	• Civil Work at the site	3.0
	TOTAL TIME FOR THE PHASE	**3.0**

4.	**DESIGN AND ENGINEERING**	
	• Detailed design and engineering	1.0
	TOTAL TIME FOR THE PHASE	**1.0**
5.	**CONSTRUCTION AND COMMISSIONING**	
	• Order for the Plant and Machinery	1
	• Start of civil work	1
	• Completion of the civil work of the digester	3
	• Completion of the entire mechanical work of the digester and biogas holder	1
	• Fabrication and commissioning of purification unit	3
	• Commissioning of the compressor system	1
	• Completion of the slurry system	1
	• Commissioning of the complete system	3
	TOTAL TIME FOR THE PHASE	**9.0**

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

STATUTORY REQUIREMENTS
AND
GOVT. SUPPORT

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

STATUTORY REQUIREMENTS

APPROVAL FROM STATE NODAL AGENCY

We need to submit a Detailed Project Report to the state Govt. for approval. It helps in getting subsidy and other benefits offered by the Govt.

POLLUTION CONTROL APPROVALS:

We have to apply for obtaining following permissions from respective state pollution control boards:

- 'Consent to establish' (NOC) under the provisions of the Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981.
- 'Consent to operate' u/s 25/26 of the Water (Prevention & Control of Pollution) Act, 1974 and/or u/s 21 of the Air (Prevention & Control of Pollution) Act, 1981.
- Authorization under Rule 5 of the Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008.

CHANGE OF LAND USE PERMISSION

We also have to get clearances under change of land use from state housing and urban development department.

GAS CYLINDERS RULES, 2016.

There are regulatory requirements for filling of Compressed Biogas. We have to obtain a license to fill compressed biogas cylinders from Petroleum and Explosive Safety Organization, (PESO) (Govt. of India) under Gas Cylinders Rules, 2016. For this an online application has to be filled up. License requires payment of a fee.

License to dispense Compressed Biogas in vehicles in a station is also granted under it.

CANAL WATER/GROUND WATER USAGE APPROVAL

We have to submit an application to Central Ground water authority to get the approval.

NOC FROM FOREST DEPT.

We have to submit an application to Forest authority to get the approval.

NOC FROM VILLAGE PANCHAYAT

We have to get NOC from village Panchayat.

CLEARANCE FROM CHIEF ELECTRICAL INSPECTOR

We have to submit an application and get the approval.

NOC FROM DISTRICT FIRE OFFICER

We have to submit an application to Fire department and get the approval.

GOVERNMENT SUPPORT

NO INCOME TAX

Under Section 80JJA: Deduction in respect of profits and gains from business of collecting and processing of bio- degradable waste is allowed. Only MAT 18.5% has to be paid on the income.

NO FEES CHARGED FOR CHANGE OF LAND USE PERMISSION - NO CONVERSION CHARGES FOR SETTING UP OF RENEWABLE ENERGY PROJECTS IN AGRICULTURE ZONE.

We do not have to pay fees for application under change of land use from state housing and urban development department.

LONG TERM PURCHASE AGREEMENT SIGNED BY INDIAN OIL CORPORATION LIMITED AT THE CNG RATES

IOCL will sign long term agreement at the present rates declared of CNG.

CUSTOM DUTY CONCESSIONS

Equipment for the project can be imported without custom duty concessions. Ministry's Notification No. 33/2005 CE Dated: 08.09.2005.

INDUSTRY STATUS

Loan is available from institute and banks.

LOCAL AREA DEVELOPMENT TAX EXEMPTED.

OTHER FINANCIAL SUPPORT

GOLD STANDARD CARBON CREDITS

As per the prevailing practices any effort by an organization to reduce Green House Gas emissions, will be awarded with the carbon credits. These credits are sold in the advanced countries. This system is called the Gold voluntary carbon market.

The Gold Standard (GS) seeks to provide a credible but simple set of criteria that will provide integrity to the voluntary carbon market. In particular, the GS will ensure that all project-based voluntary emission reductions that are independently verified to meet its criteria – defined as Carbon credits - represent real, quantifiable, additional and permanent project-based emission reductions.

The Gold Standard was established in 2003 by WWF and other NGO to provide assurance of integrity, effective regulation and strong governance in carbon markets and, more broadly, to define, demonstrate and drive best practice in international compliance carbon markets. It is the only 'compliance grade' standard also operating in the voluntary market and is structured to operate as a genuine regulator on behalf of civil society in these markets.

A project of 6000 CU M capacity will receive about 25000 carbon credits per year for next 20 years. It will mean a gain of Rs 40 Lakh per year at the present market rates of carbon credits.

TECHNOLOGY

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

BIOGAS TECHNOLOGY

BIOMETHANATION

Bio-methanation process is one of the most essential processes for treating the Bio-degradable portion of Solid Waste. In this process the organic matter is converted into biogas that is a very useful form of energy. For the bio-methanation process, the bio-methanation process reactor, called Bio-digester are used in which the temperature and atmosphere is controlled for the process to occur. Anaerobic processing of organic material is a two-stage process, where large organic polymers are fermented into short-chain volatile fatty acids. These acids are then converted into methane and carbon dioxide. Both the organic polymers fermentation process and acid conversion occur at the same time, in a single-phase system. The separation of the acid-producing (acid- organic) bacteria from the methane producing (methano-genic) bacteria results in a two-phase system.

The main feature of anaerobic treatment is the concurrent waste stabilization and production of methane gas, which is an energy source. The retention time for solid material in an anaerobic process can range from a few days to several weeks, depending upon the chemical characteristics of solid material and the design of the bio- gasification system (e.g., single stage, two-stage, multi-stage, wet or dry, temperature and pH control). In the absence of oxygen, anaerobic bacteria decompose organic matter as follows:

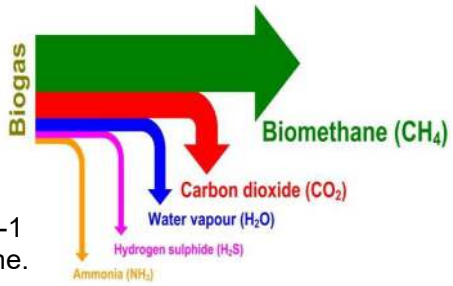
The conditions for bio-gasification need to be anaerobic, for which a totally enclosed process vessel is required. Although this necessitates a higher level of technology than compared to composting, it allows a greater control over the process itself and the emission of noxious odours. Greater process control, especially of temperature, allows a reduction in treatment time, when compared to composting. Since a biogas plant is usually vertical, it also required less area than a composting plant.

Biomethane, after installation of the requisite equipment, is essentially free, as opposed to buying natural gas. Bio-methane has similar qualities of methane and both are used in interchangeably, and each may be a substitute for the other.

Organic matter + anaerobic bacteria - CH_4 + CO_2 + H_2S+ NH_3 + other end products + energy

Biogas is a mixture of gases composed of following:

- Methane (CH_4) 40 - 70 % by volume,
- Carbon dioxide (CO_2) 30 – 60 % by volume,
- Other gases 1 – 5 % by volume including hydrogen (H_2) 0-1 % by volume and hydrogen sulphide (H_2S) 0 – 3 % by volume.



PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

KG OF WASTE REQUIRED FOR GENERATION OF PER CUBIC METER OF BIOGAS (APPOX.)

S.NO.	FEED MATERIAL	
1.	Cattle Dung	20
2.	Poultry Waste	8
3.	Horse dung/ mule dung/ elephant dung	10-15
4.	Food waste: Pre and post cooked leftover food from households, hotels and canteens.	10-12
5.	Green waste (vegetable market waste): Vegetable refuses from Vegetable Markets or kitchens.	10-12
6.	Paddy straw/ wheat straw/ mushroom spent waste: Lawn cuttings, leafy biomass, dried flowers, finely chopped and ground straw.	7-8
7.	Press Mud	10
8.	De-oiled rice bran	3-4
9.	De-oiled seed cake (Pongamia/ Jatropha)	3-4
10.	Segregated municipal solid waste (biodegradable)	10-15
11.	Slaughter house waste (blood, flesh and left over food in the gut of animal)	5-10
12.	Algae or plants material recovered from water bodies	
13.	ETP and STP grease and sludge.	
14.	Used vegetable oil	

BIO-METHANE FROM ANAEROBIC DIGESTERS

Anaerobic processes could either occur naturally or in a controlled environment such as a biogas plant. Organic waste such as livestock manure and various types of bacteria are put in an airtight container called digester so the process could occur. Depending on the waste feedstock and the system design, biogas is typically 55 to 75 percent pure methane. State-of-the-art systems report producing biogas that is more than 95 percent pure methane.

The primary component of an AD system is the anaerobic digester, a waste vessel containing bacteria that digest the organic matter in waste streams under controlled conditions to produce Biomethane. As an effluent, AD yields nearly all of the liquid that is fed to the digester. This remaining fluid consists of mostly water and is recycled to flush manure from the swine building to the digester.

HYDROGEN SULFIDE REMOVAL

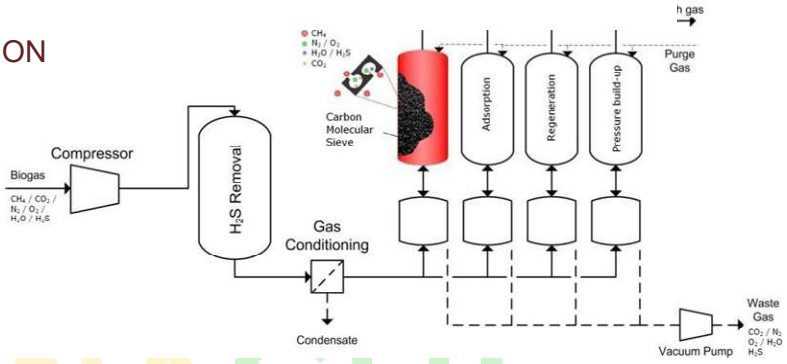
Hydrogen sulfide is a corrosive gas. Presence of carbon-dioxide in the bio-gas reduces its calorific value. Hence the bio-gas needs to be purified. Various technologies are used for removal of hydrogen sulfide, as detailed below:

COMPARATIVE ANALYSIS OF TECHNOLOGIES TO REMOVE HYDROGEN SULPHIDE

Method	Efficiency	Cap Cost	O&M	Complexity
Biological Fixation	Moderate	Moderate	Low	Moderate
Iron chloride dosing	Moderate	Low	Moderate	Low
Water scrubbing	High	High	Moderate	High
Activated Carbon	High	High	Moderate	Moderate
Iron Hydroxide or Oxide	High	Moderate	Moderate	Moderate
Sodium Hydroxide	High	Moderate	High	Moderate

CARBON DI OXIDE REMOVAL

- PRESSURE SWING ADSORPTION (PSA)



This technology is most prevalent for large bio-gas systems in India. With this technique, carbon dioxide is separated from the biogas by adsorption on a surface under elevated pressure. The adsorbing material, usually activated carbon or zeolites, is regenerated by a sequential decrease in pressure before the column is reloaded again, hence the name of the technique. Hydrogen sulphide and water needs to be removed before the PSA-column. There is significant loss of methane (20-30%) in this process.

- WATER SCRUBBING

Carbon dioxide has a higher solubility in water than methane. Carbon dioxide will therefore be dissolved to a higher extent than methane, particularly at lower temperatures. In the scrubber column carbon dioxide is dissolved in the water, while the methane concentration in the gas phase. There are technologies available through which 97% purity of methane can be achieved with minimal (<%) methane loss.

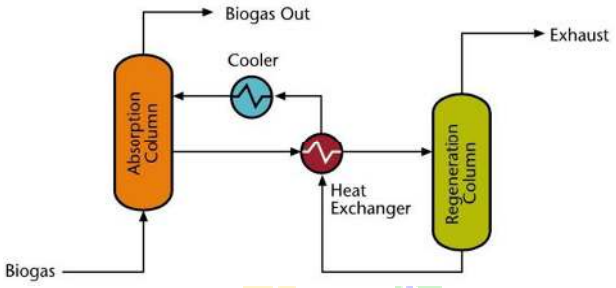
PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

- MEMBRANE SEPARATION

Dry membranes for biogas upgrading are made of materials that are permeable to carbon dioxide, water and ammonia. Hydrogen sulphide, and oxygen permeate through the membrane to some extent while nitrogen and methane only pass to a very low extent. Usually membranes are in the form of hollow fibers bundled together.

- CHEMICAL SCRUBBING - MONOETHYLAMMINE (MEA) SYSTEM

This is one of the best systems for bio-gas purification achieving 99.9% purity with negligible loss of methane. The systems are being extensively used in Germany for purification of bio-gas. Carbon dioxide is not only absorbed in the liquid, but also reacts chemically with the amine in the liquid. Since the chemical reaction is strongly selective, the methane loss might be as low as <0.1%.



COMPARATIVE ANALYSIS OF TECHNOLOGIES TO REMOVE CARBON DIOXIDE

Parameer	PSA	Water Scrubber	Mono-ethylammine (MEA) system
Pre- H_2S removal required	Yes	No	Yes
Working pressure (bar)	04-Jul	04-Jul	No pressure
Methane loss	20-30%	5-10%	<0.1%
Methane content in upgraded gas	>96%	>97%	>99%
Electricity consumption (kWh/m^3)	0.25	<0.25	<0.15

COMPRESSED BIOGAS STANDARD

Compressed Bio Gas (CBG) to be supplied shall meet IS 16087:2016 specifications of BIS (detailed below) and any other further revisions in the said specifications.

Table: Composition of CBG

IS 16087 : 2016 Standard		
S No.	**Characteristic**	**Requirement**
1	Methane percentage (CH_4), minimum	90.0 %
2	Only Carbon Dioxide percentage (CO_2),, maximum	4%
3	Carbon Dioxide (CO_2)+ Nitrogen (N_2)+ Oxygen (O_2) percentage maximum	10%
4	Oxygen (O_2) percentage maximum	0.5%
5	Total sulphur (including H_2S) mg/m^3, maximum	20 mg/m^3
6	Moisture mg/m^3, maximum	5 mg/m^3

Also as per the IS 16087:2016 specifications, the following shall also be met

i. CBG shall be free from liquids over the entire range of temperature and pressure encountered in storage and dispensing system
ii. The CBG shall be free from particulate matter such as dirt, dust, etc.
iii. CBG delivered shall be odorized similar to a level found in local distribution (ref. IS 15319)

COMPARISON WITH OTHER FUELS

Fuel	Calorific Value	Tariff/Rate/Cost
CNG	**52000 kJ/kg**	**Rs. 80.0/kg**
Purified Biogas (CBG)	**52000 kJ/kg**	**Rs. 60.0/kg**
LPG (Commercial)	**46000 kJ/kg**	**Rs. 65.7/kg**
Auto LPG	**46000 kJ/kg**	**Rs. 74.0/kg**
LPG (Domestic)	**46000 kJ/kg**	**Rs. 40/kg**
Petrol	**48000 kJ/kg**	**Rs. 107/ltr**
Diesel	**44800 kJ/kg**	**Rs. 100/ltr**

BENEFITS OF BIOGAS PLANTS

A non-polluting and renewable source of energy is created in biogas plants. Under the process organic waste is converted to useful fuel. It is an excellent way of energy conversion. Compressed biogas or electrical power can be used in Industries, Canteens, Restaurant, Hotels, Hostels, Sweet shop, Dhabas, etc.
It leads to energy security via conservation of natural resources (LPG, wood, kerosene, coal, etc.).

Many types of raw material (other than dung) can be used in the plant: Kitchen Waste, Vegetable & Fruit Market Waste, Agro & Farm Waste, Food Processing Waste and other Bio Degradable Waste.

- It destroys Methane, which is a potent greenhouse gas with a heat trapping capacity of approximately 21 times that of carbon-di-oxide. It thus leads to reduction of global warming.

- Biogas plants also produce enriched organic manure. This can be used as fertilizers. Liquid slurry is rich in micro & macro nutrients along with NPK and can be directly applied in fields. It leads to soil improvement due to high nitrogen contents.
- Biogas as a gas provides improvement in the environment, sanitation and hygiene by proper management of waste.
- It improves ground water quality as anaerobic digestion provides several water quality benefits. Biogas digesters can destroy more than 90% of disease causing bacteria that can otherwise enter surface water. Thus it reduces risk to human and animal health.

BIOMASS PELLETS TECHNOLOGY

The biomass pelletization process consists of multiple steps including raw material pre-treatment, pelletization and post-treatment. The first step in the pelletization process is the preparation of feedstock which includes selecting a feedstock suitable for this process, its filtration, storage and protection. Raw materials used are sawdust, wood shavings, wood wastes, agricultural residues like straw, switchgrass etc. Filtration is done to remove unwanted materials like stone, metal, etc. The feedstock should be stored in such a manner that it is away from impurities and moisture. In cases where there are different types of feedstock, a blending process is used to achieve consistency.

The moisture content in biomass can be considerably high and are usually up to 50% – 60% which should be reduced to 10 to 15%. Rotary drum dryer is the most common equipment used for this purpose. Superheated steam dryers, flash dryers, spouted bed dryers and belt dryers can also be used. Drying increases the efficiency of biomass and it produces almost no smoke on combustion. It should be noted that the feedstock should not be over dried, as a small amount of moisture helps in binding the biomass particles. The drying process is the most energy intensive process and accounts for about 70% of the total energy used in the pelletization process.

Before feeding biomass to pellet mills, the biomass should be reduced to small particles of the order of not more than 3mm. If the pellet size is too large or too small, it affects the quality of pellet and in turn increases the energy consumption. Therefore the particles should have proper size and should be consistent. Size reduction is done by grinding using a hammer mill equipped with a screen of size 3.2 to 6.4 mm. If the feedstock is quite large, it goes through a chipper before grinding.

The next and the most important step is pelletization where biomass is compressed against a heated metal plate (known as die) using a roller. The die consists of holes of fixed diameter through which the biomass passes under high pressure. Due to the high pressure, frictional forces increase, leading to a considerable rise in temperature. High temperature causes the lignin and resins present in biomass to soften which acts as a binding agent between the biomass fibers. This way the biomass particles fuse to form pellets.

The rate of production and electrical energy used in the pelletization of biomass are strongly correlated to the raw material type and processing conditions such as moisture content and feed size. The The average energy required to pelletize biomass is roughly between 16 kWh/t and 49kWh/t. During pelletization, a large fraction of the process energy is used to make the biomass flow into the inlets of the press channels.

Binders or lubricants may be added in some cases to produce higher quality pellets. Binders increase the pellet density and durability. Wood contains natural resins which act as a binder. Similarly, sawdust contains lignin which holds the pellet together. However, agricultural residues do not contain much resins or lignin, and so a stabilizing agent needs to be added in this case. Distillers dry grains or potato starch is some commonly used binders. The use of natural additives depends on biomass composition and the mass proportion between cellulose, hemicelluloses, lignin and inorganics.
Due to the friction generated in the die, excess heat is developed. Thus, the pellets are very soft and hot (about 70 to 90^{o}C). It needs to be cooled and dried before its storage or packaging. The pellets may then be passed through a vibrating screen to remove fine materials. This ensures that the fuel source is clean and dust free.

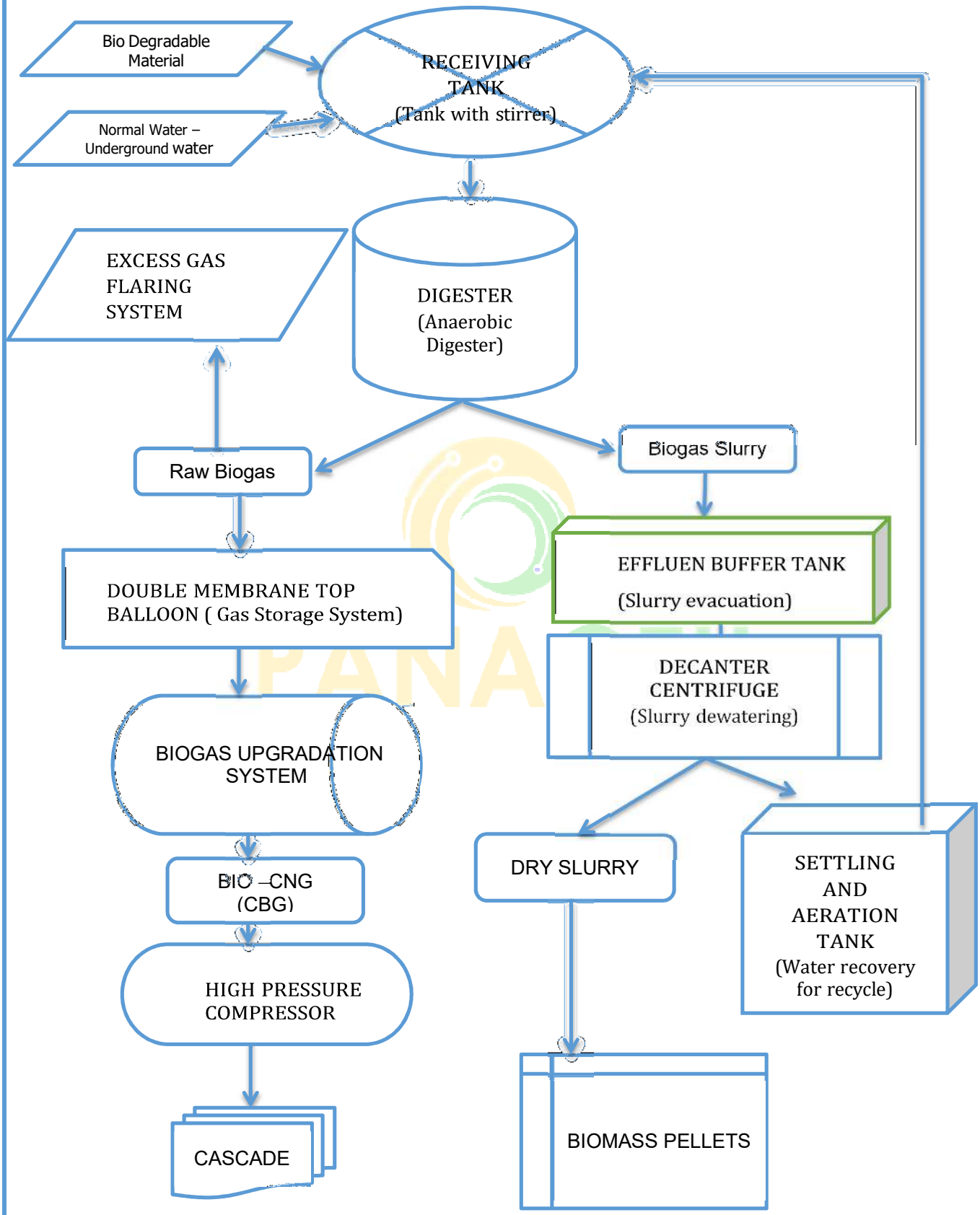
The pellets are packed into bags using an overhead hopper and a conveyor belt. Pellets are stored in elevated storage bins or ground level silos. The packaging should be such that the pellets are protected from moisture and pollutants. Commercial pellet mills and other pelletizing equipment are widely available across the globe.

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

PLANT
AND
MACHINERY

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

COMPRESSED BIOGAS SYSTEM PROCESS FLOW DIAGRAM



PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

1. BIOGAS PRODUCTION PLANT:

It deals in generation of biogas from Cow Dung or Poultry droppings. Biogas is produced in an anaerobic digester
i.e. a Biogas plant. Biogas in its natural self consists of Methane gas, Carbon dioxide, Hydrogen sulphide, Moisture and traces of other gases. These are the components of the section:

I. RECEIVING TANK: The Dung is mixed with water in the receiving tank with the help of mechanical stirrer. The ratio of the mixing of water and waste depends upon quality of material. The material is thoroughly mixed till homogeneous slurry is formed.

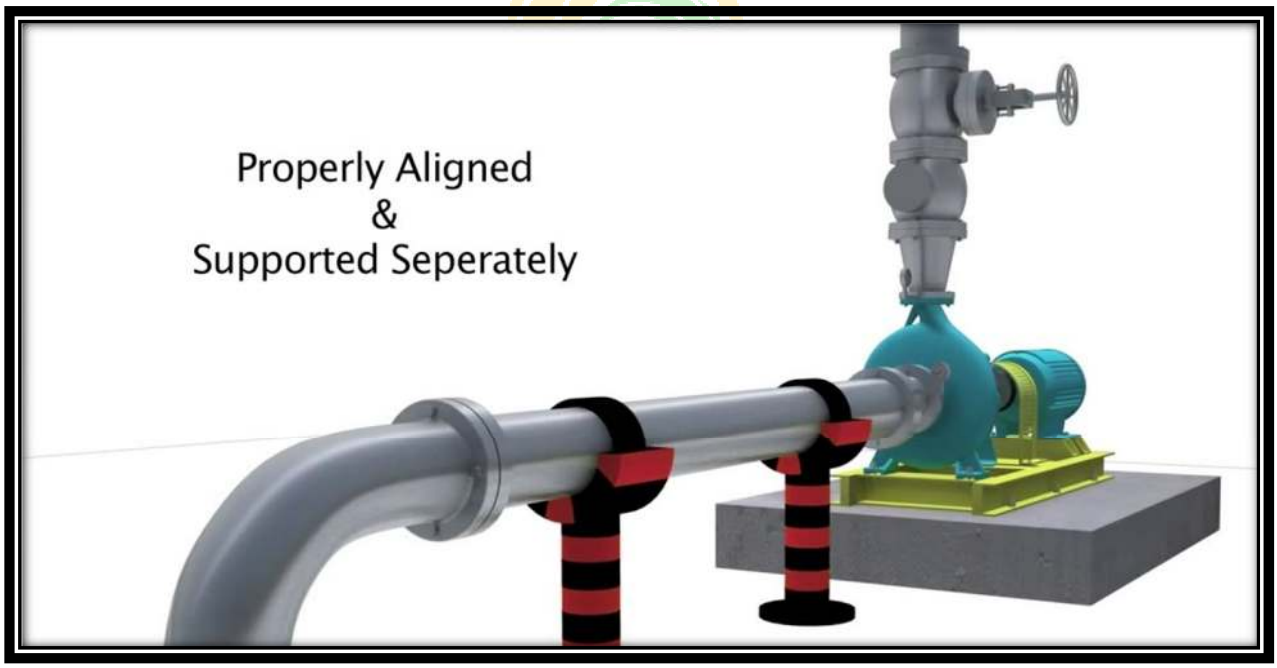
II. INLET PIPE: The slurry is moved into the digester through the inlet pipe.

III. DIGESTER: The mixed slurry is then fed to the anaerobic digester for production of biogas. It is equipped with a stirrer and heating system. Inside the digester, the slurry is fermented. Biogas is produced through bacterial action. Temperature is maintained around 35°C.

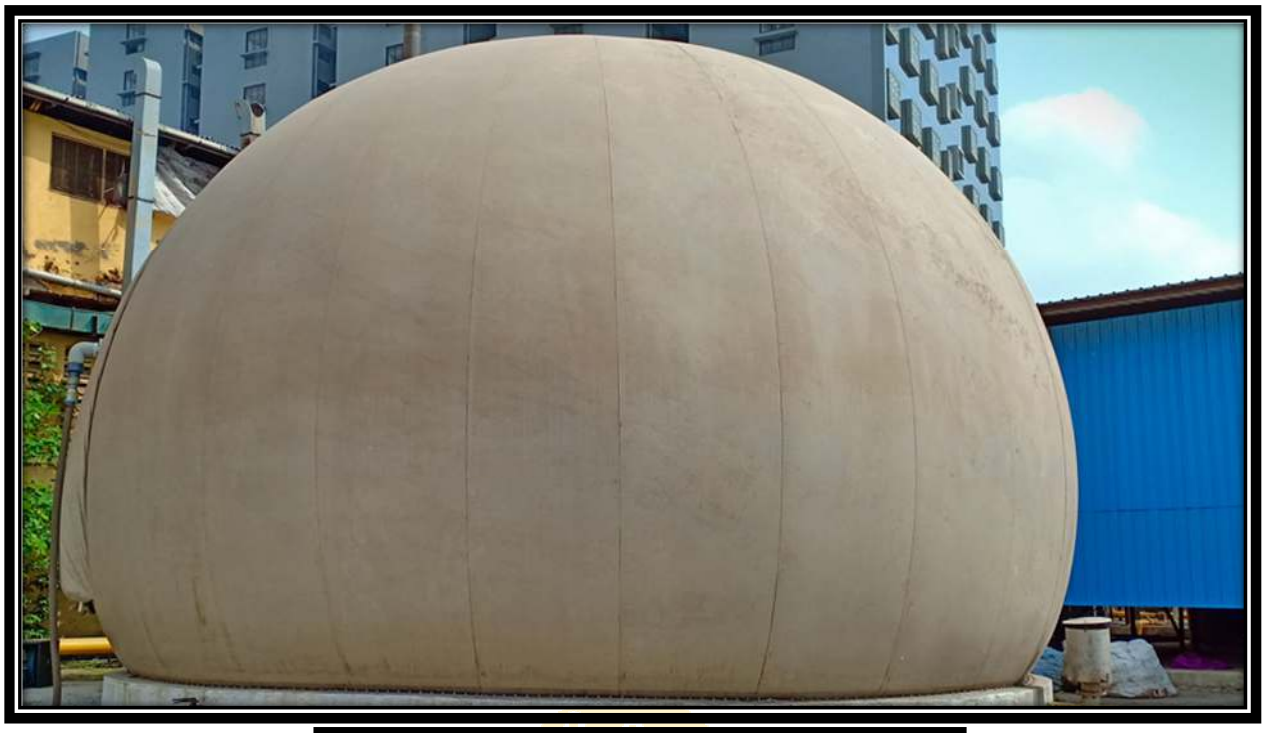
IV. DOUBLE MEMBRANE TOP BALLOON: The biogas thus formed gets collected in the gas holder. It holds the gas till the time it is transported for purification. A separate biogas balloon can work as gas holder.

V. EFFLUENT BUFFER TANK: The slurry is discharged into the outlet tank. This is done through the outlet pipe or the opening in the digester.

VI. EXCESS GAS FLARING SYSTEM: The excess gas flaring system is provided to flare the bio gas when the engine generator set is under maintenance & storage is full. As methane is a greenhouse gas and highly flammable, it cannot be allowed to evacuate freely in to atmosphere.



PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com



PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

2. PURIFICATION PLANT:

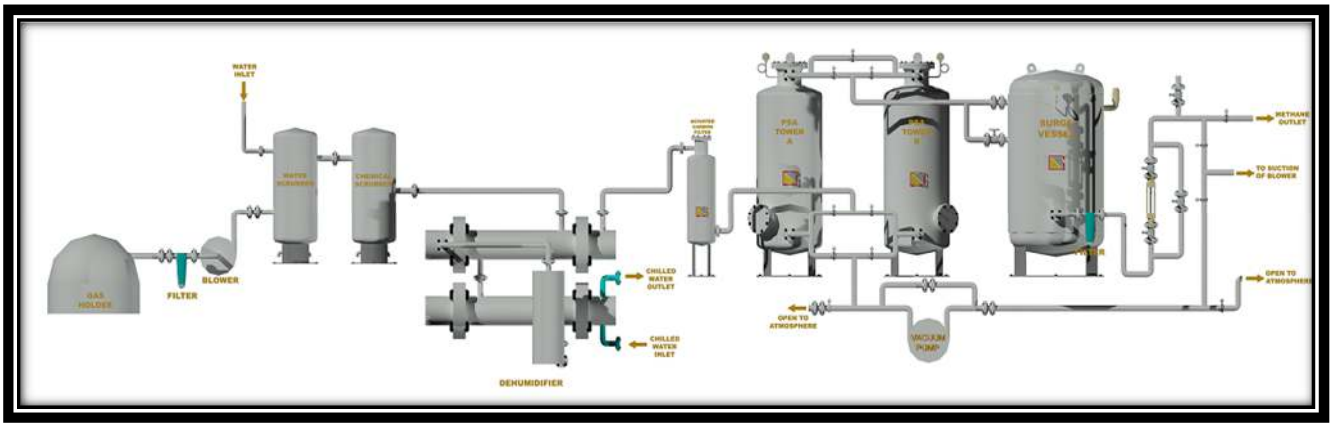
Biogas is an economical, renewable and an eco-friendly fuel. Biogas produced in anaerobic digester consists of Moisture, Carbon dioxide, Hydrogen sulfide and Methane gas. Methane has a high calorific value in its pure stage. Due to the presence of impurities Biogas becomes a very low calorific value fuel and hence finds a very limited application even though it is cheap and easily available.

We have to extract pure and high calorific value fuel methane from low calorific fuel Biogas to make it suitable for compression. Once pure Methane is available in suitable quality and quantity it finds a wide range of applications from Motor car Engine, as cooking fuel and to operating a Gas Turbine for rural power generation. Main components of the section:

I. WET SCRUBBER: Biogas generated from the digester is allowed to flow through moisture traps. This process drains out the water droplets present in the gas. Raw Biogas is compressed by the Low Pressure Compressor and fed to the bottom of Packed Tower and from the top water is sprayed through water Rota pump. Gas and water interact inside the tower in counter current; as a result, carbon dioxide and hydrogen sulphide dissolve in water. Water with dissolved gases exits from the bottom of tower and releases dissolved gases in the cooling tower at atmospheric pressure. The Physical Absorption Device is a specially designed modern high pressure combined directional flow device for cleaning Biogas of its high impurities.

II. PSA DRIER: Enriched gas exiting from top of tower contains moisture which is removed by PSA at scrubber pressure.

III. BIOGAS ONLINE MONITORING: A monitoring device is fitted after the filters to gauge the quantum of different gases H_2S, CO_2, CH_4 and Moisture present in the gas.



3. BOTTLING AND DISTRIBUTION SYSTEM:

It deals in compressing and filling Methane in a Gas Bottle:

IV. HIGH PRESSURE COMPRESSOR: The gas is compressed at 200 bar pressure and distributed through Biogas cylinders to users. This pressure is considered suitable to fill up a Cascade of Biogas cylinders. This Bottle Rack can then be connected to a standard CNG Dispenser unit. Now this purified Biogas is ready to be used as Fuel, it is renamed as CBG - **COMPRESSED BIOGAS.**

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

4. CONTROL SYSTEM:

5. SLURRY DEWATER AND BAGGING SYSTEM:

I. SCREW PRESS: Slurry from effluent buffer tank is passed through screw press for Separation of coarse solids from fine & liquid matter.

II. SETTLING AND AERATION TANK: Residual Slurry is made to pass through settling tank, aeration tank & secondary clarifier for recycling to process again.

III. BAGGING MACHINE: Solid waste created in decanter centrifuge and Clarifier is passed through drying yard and bagged.

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

BIOMASS PELLETS MAKING PLANT

1. **WOOD CHIPPER**
   Chipping of the woods using the drum chipper. This entails processing of the used to ensure they have required sizes that is considered to be less than 6mm. Turn raw materials from big size into small chips. (thickness<3mm and length 10-30 mm)

2. **HAMMER MILL**
   Crush the raw material chips into powder. (Size<3mm)

3. **SCREENING**
   You should screen the raw materials to ensure they have no impurities such as metals, stones, and other impurities.

4. **DRYER**
   Dry the moisture percentage of the powder material to 12% to 18%. You should dry the raw materials using the drum dryer when you have a standard wood pellet plant. This is essential in ensuring the raw materials have the required moisture content for the working of the pellet mill.

5. **PELLET MILL**
   Make the well prepared biomass material powder into density, smooth biomass pellets. The diameter of final pellets is adjustable. There are flat die pellet mill and ring die pellet mill. Choose the right one depending on your needs. You will then be expected to force the pellets with the required moisture content and the proper size through the die hole of the pellet mills with great pressure. The high pressure is essential in extruding hot and softer pellets.

6. **COOLER**
   The pellets will get high temperature during the pelletizing process. They are hot and easy to loosen. This equipment will help cool the finished wood pellets and make them smooth and solid.) You should cool the hot pellets to ensure that they get hardened and strengthened using air cooling.

7. **PACKAGING**
   Weigh and pack the wood pellets automatically. Then they are ready for sale. The hardened and strengthened pellets can then be packaged for protection and to ensure convenience during distribution.

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

PANACEU SYSTEMS PRIVATE LIMITED

HEAD. OFFICE:

- Panaceu Systems Private Limited:
- Khushnuma Complex, 7-Meera Bai Marg, Hazratganj, Lucknow, Uttar Pradesh India. -226001

Phone: +91-8808488084, +91-8808488082,

- Mail: panaceu@gmail.com, info@panaceu.com
- Web: www.panaceu.com

INTRODUCTION

PANACEU SYSTEMS PVT LTD is an organization based in LUCKNOW, UTTAR PRADESH providing Consulting, Technology, Outsourcing, and Industrial project services. It takes a multi-disciplinary approach and provides a complete range of services from concept development to commissioning for projects in the Energy area.

MANAGEMENT

PSPL is a professionally managed company with its strong intellectual capital of well-qualified result-oriented managers with vast experience in the industry. In the last few years of operation, the company has developed its expertise and now has its team of experienced accredited electrical & mechanical engineers, technicians and researchers, social scientists, environmentalists, marketing, and financial managers.

In the management of the projects, the company depends a good deal on short-term consultants working on a full-time or part-time basis. PSPL has been fortunate enough to get the co-operation of some of the best experts in their fields. The company employs modern techniques of project management to ensure timely and speedy execution of the projects.

WORKING PROFESSIONALS AND FACILITIES

PSPL team is drawn from various disciplines, like civil, electrical & mechanical engineering, infrastructure, economics, science, planning, management, etc. All the personnel have wide experience in their field and are from good universities and institutions. The company has an adequate working place with working staff, communication, and computational facilities and is strategically located in the capital city of UTTAR PRADESH.

COLLABORATIONS AND CO-OPERATIONS

The Company maintains regular contact with leading industrial, research, and academic organizations, working in the energy sector. A formal collaboration agreement is signed with these organizations for accessing their expertise either for an individual project or for working in specific areas.

BUSINESS VERTICALS

PSPL'S portfolio of services encompasses a broad domain. Following are the strategic & technical projects areas of Energy where PSPL is rendering its services:

- **Biogas Plants.**
- **Biomass Gasifier Plants.**
- **Biomass Thermal Plants.**

OUR VISION

PANACEU SYSTEMS PVT LTD is a professionally managed company regarded by its customer, employees, and vendors as dedicated to creating values by complete excellence.

OUR MISSION

PANACEU SYSTEMS PVT LTD is committed to delivering innovative solutions through teamwork with sincerity to total customer satisfaction and contributing to the success of its customers.

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

ENERGY PLANT SERVICES

PANACEU SYSTEMS PVT LTD takes a multi-disciplinary approach and provides a complete range of services from concept development to commissioning of the Energy Plants. Below given are the exact details of the supplies & services made by us:

SUPPLIES & SERVICES:

1. **PROJECT PROFILE:**
   The project profile will provide details on project system requirements, techno-economic feasibility, technical specifications, analysis of investment, production costs, cash flow, and profitability. Every relevant aspect of the project has been included in the profile. All relevant snaps of the projects, plants, and equipment are also included.

2. **FEASIBILITY ANALYSIS:**
   Based on the results of the following analysis, the feasibility report shall be prepared to ascertain the technical feasibility and commercial viability of the project.

   Project Background: To describe the project idea and major project parameters. To identify project promoters, financial possibilities, and their role within the project.

   Market and Plant capacity: To prepare the possible user's industries' supply and demand projections on an international, zonal, and country basis with special reference to major consumption zones. To assess the growth rate in demand and supply over a period of the next 10 years and the consequent picture of surplus/shortage.

   To determine a production program based on anticipated sales. To determine plant capacity based on demand and market analysis.
   Materials and Inputs: To study the available data on all the raw materials like tapes etc., their

   sources of supply, mode of transportation, and economics of procurement and to give material and energy balances of the project to assess the requirement of raw materials and utilities.

   Location and site: To study the suitability of any proposed sites for the plant keeping in view the economic viability of raw materials, land, power, water, and fuel, manpower, transport facilities, social infrastructure facilities, financial incentives, market, environment conditions, communication channels, etc.

   Process: To evaluate the suitability of the process for different products. To select the most optimized process for processing after due consideration of factors such as the available raw materials, equipment availability, capacity range, capital cost, energy requirements and To give a detailed description of the process adopted.

   Technology: To identify the sources of technology and to make complete arrangements of the foreign collaboration and agreements.

   Technical concept: To recommend broad sizing of the major equipment and storage. To prepare a general layout of the plant and preliminary flow sheet based on the technical concept outlined above.

   Plant organization and overhead costs: To assess the requirement of staff and workers at various levels for the efficient running of the plant. To suggest a suitable organizational structure for the

proposed plant. To determine overhead costs

Project implementation schedule: To prepare a bar chart for the project implementation. To enumerate the critical activities which would have a bearing on the realization of the schedule described above.

Financial and economic evaluation: To assess the total capital cost for the project through budgetary quotations and based on the technical concept discussed above.

To recommend a suitable financing pattern based on the understanding reached with the client.

To assess the total cost of production based on:

- Cost of raw materials and consumable
- Cost of utilities
- Cost of wages/salaries and plant overheads.
- Contribution to R & D fund and administrative expenses.
- Contingency provisions

To ascertain the project profitability based on the cost of production as arrived at earlier and the sales realization occurring from the project. To assess the financial viability of the project based on the internal rate of return on investment/equity, pay-back period, break-even point, and liquidity limit.

To prepare cash flow statements including working capital estimates, pre-operative cost, source and application of funds, and other financial resources. To conduct a sensitivity analysis on the break-even point.

3. DETAILED PROJECT REPORT:

A detailed report has to be prepared to contain the following details on the project:

General: Name, the form of organization, and other details; brief particulars of the project.

Promoters: Bio-data of the main promoters, brief write-up on other companies promoted by the promoters.

Particulars of the industrial concern: Brief history; list of subsidiaries; particulars of holding company; details of directors.

Particulars of the project: Details of the project in terms of the following:

Capacity: Specification of major products and by-products section-wise capacities for the major sections of the plant.

Process: Details of technical process, the reason for choosing the particular process, copy of process flow charts with material balance, utilities, and process parameters.

Technical arrangements: Technical arrangements made, write-up on the collaborator, copy of collaboration agreement, particulars of consultants.

Management: Proposed arrangements for executive management; particulars of proposed key technical, administrative, and accounting personnel; proposed organization chart.

Location and land: Location of the plant, land requirement and the arrangements thereof, location advantages, particulars in respect of the land acquired/proposed to be acquired, location map,

site plan.

Buildings: Arrangements for constructing the buildings, master plan, plan of buildings, particulars of the architect.

Plant and machinery: Basis of the selection of equipment, list of imported and indigenous plant and machinery along with detailed specifications, layout of the plant and machinery indicating the flow of material.

Raw materials: Requirement of raw materials, components, chemicals, arrangements made for obtaining the raw materials/chemicals.

Utilities: Details about power, details about water, layout for the water system, details for steam, the layout of the steam system, details for compressed air, fuel, etc., details for the transport.

Effluents: Details of the nature of the atmosphere, soil and water pollution, and measures proposed for control of pollution.

Labour: Estimates of total requirements and availability of skilled and unskilled labor, plans for training of personnel, manpower development program.

Schedule of implementation: Schedule of the implementation showing the commencement and completion of the following: acquisition of land, development of land, civil works, placement of order and delivery at the site of plant and machinery (imported and indigenous), power arrangements, arrangements for water, erection of equipment, commissioning, procurement of raw material and chemicals, training of personnel, trail runs, and commercial production; PERT chart.

Cost of project: an estimate of the cost of the project under the following heads:
- Land and site development
- Buildings
- Plant and machinery
- Technical know-how fees
- Expenses of foreign technicians and training of Indians technicians abroad.
- Miscellaneous fixed assets
- Preliminary and preoperative expenses
- Provision for contingencies
- Margin money for working capital

Means of financing: Means of financing envisaged divided as follows: Share capital, rupee loans, foreign currency loans.

Marketing and selling arrangements: Brief notes on the products, their major uses, scope of the market, possible competition from substitute products, existing and future demand and supply of products, list of principal customers, selling arrangements made, proposed selling organization for direct sales, proposed selling agreements.

Profitability and cash flow: Estimates of the cost of production and working results for the first ten years of operation, cash flow statement for company as whole for ten operating years, projected balance sheet for ten operating years, brake even capacity level.

4. ALL CLEARANCES INCLUDING SUBSIDY, POLLUTION CONTROL, AND LICENSE:

All necessary documentation for clearances/approvals necessary for the project and all other applications, write-ups, clarifications, etc., required by various authorities, at various stages of the project.

5. POWER PURCHASE AGREEMENT

We can identify potential customers and obtain short term / long term Power Purchase Agreements, wheeling arrangements, or long term selling agreements. We facilitate investors to enter into MoU / PPA.

6. PROJECT FINANCE:

Project Feasibility:

We take up pre-feasibility studies, techno-economic study, size study, and detailed feasibility study. We do project formulation, cost-benefit analysis, and sensitivity analysis of projects concerning variations in the capital and operating cost, time and cost-overruns, changes in interest rates or exchange rates, escalation of material cost or product prices, or overhead costs.

Financial Structure:

We work and plan meticulously every detail in the financial structure including business valuation, risk analysis, investor and capital sourcing, debt financing and equity financing, equipment, and raw material financing, etc. We work to suggest the most appropriate financial structure and matching financial institutions/agencies as per business needs and can negotiate with international development agencies, commercial banks, FII's, and others.

Financial Closure:

We prepare the applications for equity and debt financing, including preparation of project appraisal report, project pitch, due-diligence, the formation of a syndicate, preparation/review of responses to queries of financial institutions, preparation, and conclusion of the preliminary term sheet, appraisal formalities, negotiation of terms and conditions of pre-commitment and sanction, review of common loan and securitization agreement and fulfillment of pre-disbursement conditions.

7. BASIC KNOW-HOW AND DETAILED ENGINEERING & DESIGNING SERVICE

The Contractor shall be responsible for the development of the Executive Design for the Plants, in compliance with the Project Documents, the Technical Specifications, and Prudent Industry Practices, and shall also be responsible for:

(a) Complete civil and structural design of the biogas plant with all relevant drawings.

(b) Electrical schemes.

(c) Lists and specifications for equipment, materials, Spare Parts, and accessories.

(d) Operations and Maintenance Manuals and training;

(e) Major Equipment warranties up to the Facility Acceptance Date and O&M Terms;

(f) Quality control plan, (henceforth, "**Quality Assurance Plan**" or "**QAP**");

(g) Any other document or certificate necessary to comply with the rules and requirements set forth under the Project Documents and as may be directed by the Competent Authority from time to time.

(h) The Contractor, while designing the power project, shall ensure that the Plants deliver the rated capacity.

We manage the basic development of P & I diagrams, plant layouts, equipment sizing, hazard studies, and optimization. We supply Basic Engineering, know-how, and Plant and machinery by

following: Process Engineering, mechanical engineering, architecture, civil and structural engineering, utility engineering, Electrical engineering, Instrumentation engineering, piping engineering services, etc.

8. CIVIL CONSTRUCTION AND PLANT AND MACHINERY SUPPLY AND ERECTION

With emphasis laid on single-point responsibility, the company uses modern techniques for total construction management including selection of contractors, the material used and handling, store management, supervision, and monitoring of site progress till mechanical completion and pre-commissioning checks.

9. PLANT OPERATION

We draw up an organizational plan, management structure, functional demarcation, and select & allocate proficient candidates for different jobs. We take up all types of services for efficiency improvement of operation of industrial assets: Marketing, Operational, Personnel, Technical & Purchasing Services.

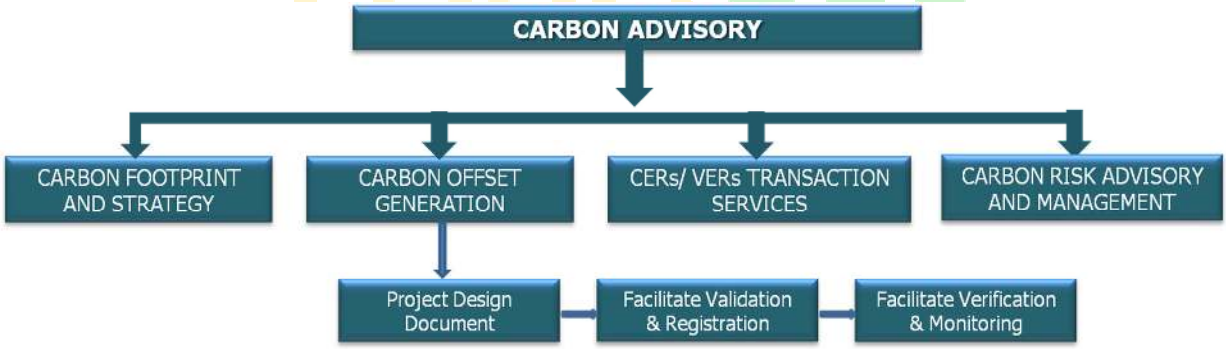
10. ORGANIZATIONAL PLANNING AND PLACEMENT:

In terms of the project report and proposed implementation schedule, Consulting Engineers will assist the client in drawing up an organizational plan, management structure, and functional demarcation areas.

Besides, Consulting Engineers will assist the client in sourcing, interviewing, evaluating, and selecting candidates to man the various positions in terms of manpower requirements envisaged in the Project Report.

This part of Consulting Engineers' work will be completed before the plant commences commercial production.

11. CARBON ACCOUNTING



Carbon Footprint & Strategy:

PSPL helps to draw up strategies to measure and manage GHG emissions and use this intelligence to cut down your carbon footprint. The team focuses on the potential of integration to meet current challenges and future opportunities.

Carbon Offset Generation:

In CDM / VCS, we undertake projects in various disciplines including but not limited to: Renewable Energy (Bio Mass, Hydro Power, Wind Energy, Solar Energy), Waste Heat recovery, Cogeneration & Captive Power Projects, Fuel Switch Scenario, Captive Power Projects, and Energy Efficiency Projects.

Our team offers a full range of services, from strategy to solution implementation. We assist in project screening, due diligence, project origination & identification, preparation of Project Design Document (PDD, PCN/PIN). Under PDD preparation we will carry out the following tasks: establishing a baseline, conduct an environmental impact study, conduct the Monitoring & Verification Protocol, Conduct Stakeholder Consultation & address the comments thereupon. Host Country Approval (HCA from MoEF); facilitate Validation by a designated operational entity (DOE).

Offset Transaction Services:
Contracting for selling of CERs and VERs etc. Analysis and consulting to facilitate the creation of carbon credits from valid projects, aiding organizations to maximize commercial opportunities. Exclusive advisor to manage carbon assets; obtaining price bids, facilitating Emission Reduction Purchase Agreements (ERPAs).

12. MECHANICAL, ELECTRICAL AND PLUMBING DESIGN

We provide mechanical, electrical, and plumbing (MEP) engineering design services all under one roof. With our technical expertise and multidisciplinary approach to building services design we can bridge the gap between the requirements of the client and efficiency of planning.

Our team is equipped to handle project of all sizes. We have a varied platter of project, from Hospitality, Malls, IT Parks, Commercial Towers, High Rise Residential Towers, Residential Townships, Sports Complex and Mixed use buildings. Our scope included concept, feasibility study, master planning, design services, contract preparation, site visits and implementation up to commissioning. For “Indoor Air Quality” we work on air purifying methods in offices and buildings for best production/output and on CO_2 and O_2 level requirements. We provide complete technology consulting on sewage treatment methods, new innovative drinking water treatment methods & potable water requirements, various methods of water recycling, retrofitting technologies for existing buildings, water saving methods for existing and new industries. Our scope also includes uses of rain water, water recycling and reducing water consumption.

Our Services are offered for following systems:

MECHANICAL: Air conditioning (Cooling / Heating / Humidity Control), Ventilation System (Natural / Mechanical / Combination), Staircase Pressurization, Building Management System.

ELECTRICAL: HT / LT Power Distribution, Lighting & Raw Power Design, Public Address / Audio Visual System**,** Security & Access System, Building Management System, Fire Alarm System.

INFRASTRUCTURE ELECTRICAL REQUIREMENTS: Sub-Station, Captive Power Generation, Street Lighting, HT / LT Cabling, Tele-Communication & Net Work System.

PLUMBING HEALTH ENGINEERING: Internal & External Plumbing, Infrastructure / Public Utilities**,** Rain Water Harvesting / Drainage System, STP / UG Tank / OH Tank System**,** Fire Fighting System (Hydrants, Sprinklers & Fire Pumps).

FIRE SAFETY & SECURITY: Fire Fighting Solutions, Fire Alarm System, Security & Access System, CCTV & PA system.

COMMERCIAL APPLICATIONS OF ENERGY PLANTS

- CAPTIVE BIOGAS POWER PLANT
- COMPRESSED BIOGAS PLANT
- LARGE SIZE BIOGAS POWER PLANT
- FOOD WASTE BIOGAS DIGESTER
- BIOMASS GASIFIER POWER PLANT

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

- ## CAPTIVE BIOGAS POWER PLANT

A dairy farm owner, Poultry farm owner, Gaushala can set up a biogas-based power plant with 12 kW to 100 kW capacity. The plant will have to be installed as a captive power plant. A Biogas plant will have to be installed to produce 100 CUM to 1000 CUM biogas per day.

- ## COMPRESSED BIOGAS PLANT

Thermal application is done by filling the compressed biogas in cylinders and then taking those cylinders to the application site. The main objective of the project is to set up a compressed biogas plant to sell the Bio CNG to the local users or as an automotive fuel. The plant also produces organic manure in large quantity which can be sold in the open market. Bio CNG is in good demand. Similarly, organic manure is always in short supply. It is needed for fruits and vegetables and horticulture. The plant can be set up in a place where cow dung and Poultry droppings or Press Mud or Biomass waste or Napier Grass is available in large quantities.

- ## LARGE SIZE BIOGAS POWER PLANT

Electrical power is generated at the biogas generation site. The plant size can have a capacity of a few MW. The main objective of the project is to set up a biogas based power plant to sell the power to the grid via a long term PPA. The power produced from biogas and fed to the grid gets preferential rates. Biogas plant also produces organic manure in large quantity which can be sold in the open market. Any amount of power can be fed to the grid. Similarly, organic manure is always in short supply. It is needed for fruits and vegetables and horticulture. The plant can be set up in a place where cow dung and Poultry droppings or Press Mud or Biomass waste is available in large quantities.

- ## FOOD WASTE BIOGAS DIGESTER

Food waste or kitchen waste can be fed to this plant. This plant will be fitted in a container that will be lifted to the site. The biogas can be used on the site or can be used for electricity generation. The main objective of the project is to take care of the food waste on-site. The plant also produces organic manure in large quantity which can be used on site. The plant can be set up in a building or open space as per the requirement. The entire unit is placed in a container and is very compact.

- ## BIOMASS GASIFIER POWER PLANT

Electrical power is generated at the Gasifier power plant site. The plant size can be from a few kW to a few MW. The main objective of the project is to set up a Biomass-based Gasifier based power plant to sell the power to the grid via a long term PPA or use it under captive conditions. The power produced from biogas and fed to the grid gets preferential rates. The plant can be set up in a place where the biomass of any type is available in a large quantity.

CASE STUDY

M/s. Bhadauria Natural Gas and Products set up a compressed biogas plant of 6000 CU M capacity. The plant is in a rural area. The Gas produced will be sold to IOCL and the dry Bio-fertilizer will be used in the farms. The total finance expenditure for the project will be Rs. 1200.00 Lakh consisting primarily of capital expenditure. We have obtained the Grading of the project and has obtained the loan from Punjab National Bank. PSPL has obtained different approvals for the project and has signed a long term CBG purchase agreement with Indian Oil Corporation Ltd.

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com












PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

FINANCIAL ANALYSIS

INSTALLED CAPACITY: 6000 CUM				
COW DUNG, BIOMASS WASTE AS RAW MATERIAL				
A	**CAPITAL COST ESTIMATE**	**RS. IN LAKH**		
1	Land & Development	75.00		
2	Civil works & Building	75.00		
3	Complete plant and machinery	1311.00		
4	Other fixed assets	60.00		
5	Pre-operative expenses	145.00		
6	Contingencies	15.00		
7	Margin money for working capital	25.00		
	TOTAL	**1706.00**		
B	**MEANS OF FINANCE**	**RS. IN LAKH**		
1	Equity of the promoters, 30%	511.80		
2	Term loan, 70%	1194.20		
	TOTAL	**1706.00**		
	Subsidy	200.00		
	Term loan	**994.20**		
C	**BASIS**	**OPERATING YEARS**		
		1ST	2ND	3RD
	No. of working days	365	365	365
	BIO CNG Production in TON	788.4	788.4	788.4
	Biomas Pellets production in Ton	8212.5	8212.5	8212.5
	% Utilization of the capacity	90%	90%	90%
	No. of shifts	3	3	3
D	**COST OF OPERATION**	**RS. IN LAKH**		
	PLANT EXPENSES			
	Raw Material	262.80	262.80	262.80
	Salary and wages	75.00	75.00	75.00
	Utilities (Power)	65.00	65.00	65.00
	Misc. plant expenses	16.00	16.00	16.00
	Repairs and Maintenance	11.00	22.00	25.00
	Insurance	10.00	10.00	10.00
	OFFICE EXPENSES			
	Sales expenses	58.21	58.21	58.21
	Professional fees	3.00	3.00	3.00
	Administrative expenses	5.00	5.00	5.00
	ESTIMATED COST OF OPERATION	**506.01**	**517.01**	**520.01**

E	TOTAL SALES AS CALCULATED	RS. IN LAKH		
	BIO CNG SALE @ RS. 70 / kg	551.88	551.88	551.88
	PELLET SALE PRICE OF RS. 7.0 PER KG	574.88	574.88	574.88
	CARBON CREDITS 25,000 @ 150 PER UNIT	37.50	37.50	37.50
	TOTAL SALES AS CALCULATED	**1164.26**	**1164.26**	**1164.26**

F	PROFITABILITY	RS. IN LAKH		
	Gross profit before interest (E-D)	658.24	647.24	644.24
	Depreciation @ 10% WDV	144.60	130.14	117.13
	Interest on term loan and WC at 11%	117.61	106.68	95.74
	Total Financial expenses (Depr., Interest)	262.21	236.82	212.87
	NET OPERATING PROFIT	**396.03**	**410.43**	**431.38**

G	CASH FLOW	RS. IN LAKH		
	MAT Tax (@18.5)	73.27	75.93	79.80
	Retained profits	322.76	334.50	351.57
	Term loan payment (Loan return in 10 years)	99.42	99.42	99.42
	Include depreciation	144.60	130.14	117.13
	Net cash accruals	367.94	365.22	369.28
	CUMULATIVE CASH ACCRUALS	**367.94**	**733.16**	**1102.44**

INSTALLED CAPACITY: 12000 CUM

COW DUNG, POULTRY DROPPINGS AS RAW MATERIAL

A	CAPITAL COST ESTIMATE	RS. IN LAKH
1	Land & Development	175.00
2	Civil works & Building	150.00
3	Complete plant and machinery	2476.00
4	Other fixed assets	90.00
5	Pre-operative expenses	100.00
6	Contingencies	25.00
7	Margin money for working capital	50.00
	TOTAL	**3066.00**

B	MEANS OF FINANCE	RS. IN LAKH
1	Equity of the promoters, 30%	919.80
2	Term loan, 70%	2146.20
	TOTAL	**3066.00**
	Subsidy	400.00
	Term loan after subsidy	**1746.20**

C	BASIS	OPERATING YEARS		
		1ST	2ND	3RD
	No. of working days	365	365	365
	BIO CNG Production in TON	1576.8	1576.8	1576.8

	Biomas Pellets production in Ton	16425	16425	16425
	% Utilization of the capacity	90%	90%	90%
	No. of shifts	3	3	3
D	**COST OF OPERATION**	**RS. IN LAKH**		
	PLANT EXPENSES			
	Raw Material	341.64	341.64	341.64
	Salary and wages	132.00	132.00	132.00
	Utilities (Power)	113.00	113.00	113.00
	Misc. plant expenses	32.00	32.00	32.00
	Repairs and Maintenance	21.00	42.00	42.00
	Insurance	20.00	20.00	20.00
	OFFICE EXPENSES			
	Sales expenses	116.43	116.43	116.43
	Professional fees	5.00	5.00	5.00
	Administrative expenses	5.00	5.00	5.00
	ESTIMATED COST OF OPERATION	**786.07**	**807.07**	**807.07**
E	**TOTAL SALES AS CALCULATED**	**RS. IN LAKH**		
	BIO CNG SALE @ RS. 70 / kg	1103.76	1103.76	1103.76
	PELLET SALE PRICE OF RS. 7.0 PER KG	1149.75	1149.75	1149.75
	CARBON CREDITS 50,000 @ 150 PER UNIT	75.00	75.00	75.00
	TOTAL SALES AS CALCULATED	**2328.51**	**2328.51**	**2328.51**
F	**PROFITABILITY**	**RS. IN LAKH**		
	Gross profit before interest (E-D)	1542.44	1521.44	1521.44
	Depreciation @ 10% WDV	271.60	244.44	220.00
	Interest on term loan and WC at 11%	208.58	189.37	170.17
	Financial expenses (Depr., Interest)	480.18	433.81	390.16
	NET OPERATING PROFIT	**1062.26**	**1087.63**	**1131.28**
G	**CASH FLOW**	**RS. IN LAKH**		
	MAT Tax (@18.5)	196.52	201.21	209.29
	Retained profits	865.74	886.42	922.00
	Term loan payment (Loan return in 10 years)	174.62	174.62	174.62
	Include depreciation	271.60	244.44	220.00
	Net cash accruals	962.72	956.24	967.37
	CUMULATIVE CASH ACCRUALS	**962.72**	**1918.96**	**2886.33**

Our Consultancy Services

SERVICE COVERAGE

Our services cover all stages in project cycle, from identification, development (preparation, appraisal, evaluation and presentation), to the implementation and monitoring of energy related projects. We can provide a full range on consultancy in different stages of project cycle:

a. Project development stage Planning documents
b. Project development support Studies and analyses
c. Conceptual design documents
d. Preliminary design documents
e. Detailed design documents
f. Pre-feasibility and feasibility studies
g. Strategic and action planning Institutional support and technical capacity building
h. Permit management and project monitoring
i. Tendering stage, Procurement documentation preparation and bid evaluation
j. Contract negotiations
k. Implementation stage Supervision of works, commissioning and trial operation
l. Cost and project control
m. Quality assurance and Reporting

SCOPE OF SERVICES

a. To technically inspect all the construction works to ensure compliance with contract provisions
b. To monitor contractions' performance, certification of work and issue of payment certificates
c. To prepare reports on the progress of the works indicating any difficulties affecting its efficient and timely execution
d. To witness testing and commissioning of all the works
e. To issue certificates of completion to the contractors upon completion of construction and installation works
f. To prepare a completion report, user manual and to do list within two months after the date of the issue of a certificate of practical completion

PAYMENT SCHEDULE

S.No.	Stage	% Price
1	Pre-Feasibility Study	150000.00
2	Project Signing Amount	25%
3	Stage 1	25%
4	Stage 2	25%
5	Stage 3	25%

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

STAGE 1 – Design, Drawing, Architectural, Structural & Services Consultancy

Sl. No.	Details	Submission Time Limit	Fee % of Quoted Amount
1	Submission of conceptual drawings in line with elevations, sections and key plan/site plan and finalization of drawing	D + 15 Days	20%
2	Submission of all drawings related to grant of statutory approvals	D + 30 Days	20%
3	Submission of all drawings and technical works related to grant of NOC from PESO	D + 40 Days	15%
4	Submission of Structural Working Drawings	D + 75 Days	20%
5	Submission of detail working drawing in line with architectural, structural feature/members of building/project and submission of services working drawing (plumbing, electrical and firefighting and all ancillary services as required for the project)	D + 90 Days	15%
6	Submission of detailed estimates and specifications, bill of quantities for civil, electrical, sanitary, water supply works and all other services including firefighting, D G Set installation.	D + 120 Days	5%
7	Balance will be released on submission of as built drawing after completion of work for the purpose of completion of Stage 1	On Completion of Stage 1	5%

STAGE 2 – Civil, Mechanical & Machinery Works

Sl. No.	Details	Submission Time Limit	Fee % of Quoted Amount
1	Stage 2 Advance	D+130	5%
2	Sizing and Supervision of the Excavation of the project site	D + 165 Days	5%
3	Engineering Support, Procurement Support, Technical Supervision of the Digester Base construction	D + 230 Days	20%
4	Engineering Support, Procurement Support, Technical Supervision of the Digesters & Ancillary Structure construction (1/3rd Completion)	D + 290 Days	15%
5	Engineering Support, Procurement Support, Technical Supervision of the Digesters & Ancillary Structure construction (2/3rd Completion)	D + 245 Days	15%
6	Engineering Support, Procurement Support, Technical Supervision of the Digesters & Ancillary Structure construction (Completion)	D + 290 Days	15%
7	Engineering Support, Procurement Support, Technical Supervision during mechanical structure erecting related to digesters (Parallel Activity)	D + 290 Days	15%
8	Engineering Support, Procurement Support, Technical Supervision during shed construction for biogas up gradation and cylinder filling as per PESO norms Parallel Activity)	D + 290	5%
9	Balance will be released on submission of as built drawing after completion of work for the purpose of completion of Stage 2	On Completion of Stage 2	5%

NOTE: ***TimeLine subject to cash flow***

STAGE 3 – Machinery Installation till Project Commissioning

Sl. No.	Details	Submission Time Limit	Fee % of Quoted Amount
1	Stage 3 Advance	D+300	5%
2	Engineering Support, Procurement Support, Technical Supervision of the Installation of Digester Mixing Arrangement and Feeding Arrangements & approval of workability	D + 330 Days	10%
3	Engineering Support, Procurement Support, Technical Supervision of the Installation of Digester Roof Installation & approval of workability	D + 330 Days	10%
4	Engineering Support, Procurement Support, Technical Supervision of the Installation of Digester Heating System Installation & approval of workability	D + 330 Days	10%
5	Engineering Support, Procurement Support, Technical Supervision of the Installation of Biogas Up gradation & Monitoring System & approval of workability	D + 330 Days	10%
6	Engineering Support, Procurement Support, Technical Supervision of the Installation of CBG filling & Monitoring System & approval of workability	D + 360 Days	10%
7	Engineering Support, Procurement Support, Technical Supervision of the Installation of Firefighting & Safety & Monitoring System & approval of workability	D + 410 Days	10%
8	Engineering Support, Procurement Support, Technical Supervision of the Installation of Piping works and electrical works & approval of workability	D + 410	15%
9	Project Commissioning	D + 475	15%
10	Balance will be released on submission of as built drawing after completion of work for the purpose of completion of Stage 2	On Completion of Stage 3	5%

NOTE: ***Time Line subject to cash flow***

ROLE OF PSPL (For Internal Usage Only)

What PSPL has to do in STAGE I

- Prepare Project Brief
- Select and manage Design team
- Prepare Consultants' contracts
- Mobilize Project Management and Professional teams
- Attend project coordination meetings with the Client, Consultants and project stakeholders
- Prepare detailed Project program
- Identify all project stakeholders
- Prepare communication protocols, including project specific web site
- Provide input on issues of constructability and construction related issues
- Prepare detailed Project budget
- Provide and maintain project cash flow for work packages
- Review the client's master schedule and provide comments ƒ
- Prepare a cost estimate during the design stage
- Identify construction packages
- Identify long delivery items
- Participate in value engineering sessions and provide comments and recommendations
- Set criteria to prequalify contractors
- Liaison and communicate with Authorities having Jurisdiction
- Issue monthly reports
- Participate in partnering sessions
- Establish cost control program and cash flow for construction stage
- Commence Government Applications Process
- Negotiate works contracts
- Provide recommendations regarding Project Insurance
- Review construction documents for constructability, bid ability, and coordination ƒ Prepare and update project schedule
- Provide advice on alternatives to systems and procedures to improve schedule or reduce budget
- Provide advice and identify long delivery items that may require pre-tendering
- Review consultant cost estimates
- Prepare independent cost estimates at project milestones including detailed work sheets
- Advise and assist the client on developing pre-qualification criteria
- Identify required permits, licenses and approvals

PANACEU SYSTEMS PRIVATE LIMITED
Khushnuma Complex, 7- Meera Bai Marg, Hazratganj, Lucknow, UP, India - 226001.
E-Mail: info@panaceu.com, Phone +91-88084 88082 / 88084 88084, www.panaceu.com

- Provide comments and advice on the tender schedule and tender packages
- Review final tender documents and make recommendations on bid-ability
- Provide advice, assistance and recommendation on the pre-qualification criteria
- Attend tender briefings and assist the Consultants in the preparation of addenda
- Assist the client as requested in bid analysis
- Provide the client with cost information, as requested, prior to negotiations with any bidders
- Liaise and communicate with authorities having jurisdiction
- File for notice of project with appropriate Local Government Authorities
- Provide advice on any packages that are required to be re-tendered
- Liaise and communicate with Authorities

What PSPL has to do in Stage 2

- Maintain a daily log
- Submit monthly written reports including budget and scheduling information
- Provide ongoing administration support
- Maintain complete and updated project files, drawing and specifications
- Provide construction supervision to perform defined activities
- Conduct ongoing site safety orientation sessions for all persons entering the site
- Chair joint health and safety committee meetings
- Evaluate trade contractors for compliance with health and safety policies
- Monitor and inspect all General Contractor's work
- Assign a health and Safety Supervisor
- Provide a monthly Health & Safety performance report
- Identify and report project risks
- Plan and manage site security
- Establish procedures for tracking shop drawing and samples
- Review change notices and forward independent estimates to the Client
- Maintain detailed log of changes
- Review regulations to identify and monitor permits, licenses and approvals
- Recommend payment of Contractor invoices
- Monitor requests for information from Contractors and responses from Consultant team
- Inspect and determine that all shop drawings, site instructions, and samples are complete
- Maintain daily site reports
- Assist in the resolution of disputes
- Manage and maintain record of changes and anticipated changes to the project
- Produce monthly progress reports

- Participate in partnering sessions
- Project record keeping

What PSPL will do in Stage 3

- Provide advice and recommendations on all aspects of commissioning
- Manage record drawings and specifications
- Assist in the interim and final inspections
- Expedite the completion of deficiencies
- Confirm accuracy of warranties and transfer to the Client prior to final certificate
- Continue with the implementation and management of the Commissioning Plan
- Manage all maintenance manuals, operating instructions and turn over to the Client
- Prepare post construction evaluation and cost analysis report
- Establish the certification of total performance
- Arrange for the issuing of substantial completion certificates and holdback releases
- Produce a final report on the project

What PSPL will do in Risk Management Area

- Identification of Risks Potential issues or occurrences that can have a negative impact on a project's cost, schedule, quality, safety, environment, communication, insurance and bonding are identified. Occurring at the very outset of a project, the identification of risks continues throughout the duration of a project.
- Evaluation of Risks Potential and risks identified are evaluated in terms of their size and scale and probability of impact. This step includes the ranking of the potential risks so that risk management effort can be focused on the most threatening.
- Mitigation and Containment of Risks Risk mitigation strategies are put in place to reduce the probability of an occurrence, and containment strategies are put in place to minimize the impact of an occurrence.
- Follow-up of Risks Involves periodic review of a given risk to evaluate the effectiveness of the reduction and containment strategies. If the risk management measures appear to be deteriorating in their effectiveness, the action strategies are reviewed, modified and corrected.