



MODEL PROJECT REPORT



PROJECT REPORT ON BIO CNG PLANT UNIT

SWAVALAMBI BHARAT ABHIYAN

PROJECT AT GLANCE

1 Name of Proprietor/Director	XXXXXXXXXX
2 Firm Name	XXXXXXXXXX
3 Registered Address	XXXXXXXXXX
4 Nature of Activity	XXXXXXXXXX
5 Category of Applicant	XXXXXXXXXX
6 Location of Unit	XXXXXXXXXX
7 Cost of Project	21.79 Rs. In Lakhs
8 Means of Finance	
i) Own Contribution	2.18 Rs. In Lakhs
ii) Term Loan	12.60 Rs. In Lakhs
iii) Working Capital	7.01 Rs. In Lakhs
9 Debt Service Coverage Ratio	2.86
10 Break Even Point	0.48
11 Power Requirement	155 KW
12 Employment	11 Persons
13 Major Raw Materials	Crop waste,Animal waste,Municipal waste,Agro-Industry Waste and Forestry Waste etc.

14 Details of Cost of Project & Means of Finance

<u>Cost of Project</u>	<u>Amount in Laacs</u>
Particulars	Amount
Building & Civil Work	Owned/Leased
Plant & Machinery	12.5
Other Misc Assets	1.00
Furniture	0.50
Working Capital Requirement	7.79
Total	21.79

<u>Means of Finance</u>	
Particulars	Amount
Own Contribution	2.18
Term Loan	12.60
Working capital Loan	7.01
Total	21.79

1. INTRODUCTION



Biogas is the mixture of gases produced by the breakdown of organic matter in the absence of oxygen (anaerobically), primarily consisting of methane and carbon dioxide. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Biogas

is a renewable energy source. In India, it is also known as "Gobar Gas".

Biogas is produced by anaerobic digestion with methanogen or anaerobic organisms, which digest material inside a closed system, or fermentation of biodegradable materials. This closed system is called an anaerobic digester, biodigester or a bioreactor.

Biogas is primarily methane (CH_4) and carbon dioxide (CO_2) and may have small amounts of hydrogen sulfide (H_2S), moisture and siloxanes. The gases methane, hydrogen, and carbon monoxide (CO) can be combusted or oxidized with oxygen. This energy release allows biogas to be used as a fuel; it can be used for any heating purpose, such as cooking. It can also be used in a gas engine to convert the energy in the gas into electricity and heat.

Biogas can be compressed after removal of Carbon dioxide, the same way as natural gas is compressed to CNG, and used to power motor vehicles. In the United Kingdom, for example, biogas is estimated to have the potential to replace around 17% of vehicle fuel. It qualifies for renewable energy subsidies in some parts of the world. Biogas can be cleaned and upgraded to natural gas standards, when it becomes bio-methane. Biogas is considered to be a renewable resource because its production-and-use cycle is continuous, and it generates no net carbon dioxide. As the organic material grows, it is converted and used. It then regrows in a continually repeating cycle. From a carbon perspective, as much carbon dioxide is absorbed from the atmosphere in the growth of the primary bio-resource as is released, when the material is ultimately converted to energy.

Bio-CNG is produced from biogas, through a simple and convenient process involving desulphurisation, upgradation and compression. First, biogas is desulphurated if the hydrogen sulphide content is over 1,500 ppm. Then, the desulphurated biogas is upgraded to make its composition similar to CNG, followed by the compression and bottling of the resulting bio-CNG.

Composition of Biogas:

Component	Content [%]
Methane, CH ₄	50-75
Carbon Dioxide, CO ₂	25-50
Hydrogen Sulphide, H ₂ S	0-3
Other Gases	0-13

Composition of Bio-CNG:

Component	Content [%]
Methane, CH ₄	92-98
Carbon Dioxide, CO ₂	2-8
Nitrogen, N ₂	0-3

Calorific Value:

Gaseous Fuel	Calorific Value (MJ/Kg)
Biogas	31
CNG	50
Bio-CNG	52
LNG	54
LPG	55

Physical Properties of Bio-CNG:

- It is hydrocarbon component with methane as a major component.
- It is colorless and odorless.

- For security during, transportation or processing, a commercial odorant is added to allow users to detect the gas for safety.
- It is lighter than air with a specific gravity of about 0.6-0.8. If leaks, it disperses upward and dissipates into the air quickly.
- It is inflamed during a range of 5-15% by volume of gas in air.
- The self-ignition temperature of natural gas is 537-540 degrees celsius.
- As it is a clean fuel with cleaner burning nature, natural gas has lower environmental impact when compared with other types of fuel.

Types of Biogas Plant:

Classification of biogas plants depends upon the plants design and mode of working.

- Batch Type Biogas Plant
- Continuous Type Plant
- Movable Type Drums Plant

Batch Type Biogas Plant- Salient Features-

- Gas production in batch type is uneven.
- Batch type plants may use several digesters for continuous supply of gas.
- This type of plants requires large volume of digester; therefore, initial cost becomes high.
- This plant needs addition of fermented slurry to start the digestion process.

Continuous Type Biogas Plant- Salient features

- Gas production is continuous
- Retention period is less
- Less problems as compared to batch type
- Small digestion chambers are required

Movable drum type Plants

- Constant Gas pressure
- No problem of gas leakage
- Higher gas production

- Scum problem is less.

Application of Biogas

- Automotive
- Locomotives
- IC Engine Power Generators

2. PRODUCT DESCRIPTION

2.1 PRODUCT USES

Bio-CNG is being utilised to replace CNG as an automobile fuel (for CNG buses and tractors) and LPG as a cooking fuel at Mahindra World City, as well as to power street lighting.

2.2 RAW MATERIAL REQUIREMENT

- Crop waste
- Animal waste
- Municipal waste
- Agro-Industry Waste
- Forestry Waste

Consumables:

- Membranes of Multi-Stage Membrane Purification System
- Media used in Scrubber for Absorption (Caustic Solution in most cases)

2.3 MANUFACTURING PROCESS

The manufacturing process of Bio-CNG is a two-stage process, first stage is generation of Biogas, while second stage is processing of Biogas into Bio-CNG. The details of same are mentioned below;

Biogas Production:

- The various food waste is procured from agro-industry & municipal bodies, while the Cow-dung is obtained from dairy farms & farmer groups. All these raw materials are stored in appropriate storage facilities composed of bins and appropriate enclosing structure.
- The food waste is sent to crusher which essentially crushes the various sizes food waste into an appropriate size & form to be used for making slurry. This crushed food waste, along with Cow-dung is added to slurry tank with water.
- The slurry tank has its own agitator to form a uniform slurry. The Slurry is then pumped into digester of biogas plant which essentially decomposes the organic waste, releasing mostly methane and other gases, which are collectively called as biogas.
- The gas deposits in dome or floating cover, from where it's extracted via flow control valve periodically.
- The used slurry or sludge is pumped out of digester into a sludge tank which can be used as manure.
- The biogas is collected in a large gas receiver from, where it's sucked in by compressor and collected in its receiver, which acts as a temporary holding tank. This gas is then either filled in large pressure vessels from where the supply is provided to Bio-CNG Processing Plant.

Bio-CNG Production from Biogas:

- The biogas is received from a storage vessel from biogas production plant, which is then fed to a dehumidifier which essentially removes water vapours from gas and the required refrigeration effect is generated by a refrigeration plant.
- The dehumidified biogas is then fed to a repeater which essentially raises the temperature of biogas slightly for Hydrogen sulphide absorption, for which the biogas after reheating is fed to a hydrogen sulphide scrubber, while in case of bigger plants nitrogen scrubbers are also installed which further purify the biogas.
- This partially purified biogas is then fed to a compressor, which compresses the biogas to necessary pressure for membrane purification system, this compressed biogas is collected in its receiver which also acts as a holding tank for membrane purification system.
- Three stage membrane purification system is most widely used in which, first stage of membrane purification system separates gas into carbon dioxide rich gas and methane

rich gas, the carbon dioxide rich gas is supplied to second stage of membrane purification system which further extracts most possible methane out of carbon dioxide rich gas and supplies it back to methane rich gas.

- The methane rich gas is then supplied to third stage of membrane purification system, which essentially extracts most possible carbon dioxide out of methane rich gas, the methane rich gas at this point is called as Bio-NG which is supplied to THT Gas injector system.
- On the other hand, carbon dioxide from Three Stage Membrane Purification System is fed to a compressor which compresses the carbon dioxide and collects it, in its receiver, from where it's supplied to a storage pressure vessel.
- Appropriate gas pressure regulator & connectors are used to fill this stored carbon dioxide into gas cylinder which are then sold as by-product. The Bio-NG which is fed to THT Gas Injector is injected with THT (Tetrahydrothiophene) Gas and due to injection of THT Gas into stream of Bio-NG they get mixed properly.
- THT Gas is basically an odorant used in LPG and CNG to detect leakage by smell. The Bio-NG is then fed to a High-Pressure Compressor which simply compresses the Bio-NG in order to obtain Bio-CNG, this Bio-CNG is then collected in a receiver vessel of the compressor, from where the Bio-CNG is supplied to a high-pressure storage vessel.
- Appropriate gas pressure regulator, hoses, connectors, control valves etc, are used to fill this stored Bio-CNG into large gas cylinders or cylinder cascades which are then sold in market or in many plants this stored Bio-CNG is directly filled into pressure vessel mounted on the truck which carry it to gas stations.

3. PROJECT COMPONENTS

3.1 Land/Civil Work

Approximately total area required for **500 Nm³/hr** capacity fully automatic plant is close to **8000 Sq.ft** including all warehouses and infrastructure like loading and unloading stations in a generalized sense. While for the production of **5-ton capacity 5-6 Acre** land would be required. For this particular report, we have assumed the cost of Land/ Civil Work as follows:

3.2 Plant & Machinery

The process involved are crushing, slurry preparation, anaerobic digestion (fermentation), Biogas Purification, Bio-NG Compression & Cylinder or Cascade Gas Filling thus machine required are:

- Biogas Plant: There are several types of biogas plants some are constructed by excavating land and constructing the required infrastructure within excavation, while some utilize large tanks to carry out same operation above ground; but irrespective of type they are designed for anaerobic decomposition of organic waste to generate biogas. The main components of biogas plant include slurry tank, digester, dome or floating cover, sludge tank, sledge pump and slurry pumps.



- Slurry Storage Tank: A slurry tank is usually a specially designed steel tank capable of storing a wide range of farm waste and slurry.



- Slurry Pump: It an operational term defining pumps that are used to pump slurries, in most cases centrifugal pumps are used for this purpose.



- Sledge Pump: It an operational term defining pumps that are used to pump sledges, the appropriate positive displacement pumps are used for this purpose.



- Organic Waste Crusher Machine: It a crusher class machine which utilizes appropriate crushing arrangement to crush the organic waste like waste food products into required size.



- Refrigeration Plant: It's a plant designed to generate appropriate refrigeration effect to perform given set of cooling operations. The main component of the refrigeration plant includes multistage compressor, condenser, expansion device, evaporator, cooling tower and pumping station.



- Gas Dehumidifier: It's a simple device which utilizes appropriate refrigeration effect from refrigeration system to effectively condense and thus remove water from given gas.



- Gas Reheater: The device is a simple heat exchanger, designed to reheat gaseous fluid in various application ranging from thermal power plant to biogas upgradation system.



- Boiler: It's a steam generating device used to produce steam of appropriate pressure and temperature, but as steam is only required for reheating in biogas upgradation plant, relatively small boilers are used.



- RO Plant: They are used to process water to obtain required dissolved salt value in water. They are used in variety of application but in this case, they are used to process water into appropriate boiler feed water.



- Hydrogen Sulphide Scrubber: It's a device designed to absorb Hydrogen Sulphide from the given gaseous fluid, there are several varieties available using different technologies but usually a simple caustic solution and aeration plate arrangement is used.



- Compressor: It's a device used to increase pressure of a gaseous fluid by converting mechanical energy supplied to it to pressure energy of fluid.



- Three Stage Membrane Purification System: It's a multistage-selective membrane-based purification system which is specifically designed to purify biogas into Bio-CNG.



- THT Gas Injector: It's a simple gas injection system designed to inject small quantities of THT gas into odorless flammable gases for leakage detection purpose.



- High Pressure Compressor: It's a heavy-duty compressor designed to achieve high compression ratio, which in this case is for compression of Bio-NG into Bio-CNG.



- **Storage Pressure Vessels:** They are vessels or tanks designed to store a fluid under pressure, the range of operating temperature & pressure and nature of fluid to be stored determines constructional requirement of pressure vessel.



- **Other Machine & Equipment's-** A range of small machine & equipment are required to keep plant functioning and maintain it in working condition like, control panels, trays, valves, pumps etc.



4. LICENSE AND APPROVALS

- Factory License
- UDYAM online registration.
- GST
- NOC from Fire and Pollution control board
- NOC from Petroleum and Explosives safety organisation
- Labour Registration.(PF& ESI)

PROJECTED BALANCE SHEET					
(in Lacs)					
PARTICULARS	1st year	2nd year	3rd year	4th year	5th year
<u>Liabilities</u>					
Capital					
Opening Balance		3.17	5.16	8.90	13.63
Add:- Own Capital	2.18				
Add:- Retained Profit	2.74	4.34	7.24	9.43	11.25
Less:- Drawings	1.75	2.35	3.50	4.70	6.00
Closing Balance	<u>3.17</u>	<u>5.16</u>	<u>8.90</u>	<u>13.63</u>	<u>18.89</u>
Term Loan	11.20	8.40	5.60	2.80	-
Working Capital Limit	7.01	7.01	7.01	7.01	7.01
Sundry Creditors	0.49	0.62	0.69	0.81	0.88
Provisions & Other Liabilities	0.50	0.75	0.90	1.08	1.30
TOTAL :	22.37	21.95	23.11	25.34	28.08
<u>Assets</u>					
Fixed Assets (Gross)	14.00	14.00	14.00	14.00	14.00
Gross Depreciation	2.08	3.84	5.34	6.62	7.71
Net Fixed Assets	11.93	10.16	8.66	7.38	6.29
Current Assets					
Sundry Debtors	1.61	1.64	2.15	3.44	3.82
Stock in Hand	6.67	7.09	7.77	8.52	9.33
Cash and Bank	1.67	2.06	2.52	3.00	3.64
Loans and advances/other current assets	0.50	1.00	2.00	3.00	5.00
TOTAL :	22.37	21.95	23.11	25.34	28.08

<u>PROJECTED PROFITABILITY STATEMENT</u>					(in Lacs)
PARTICULARS	1st year	2nd year	3rd year	4th year	5th year
Capacity Utilisation %	55%	60%	65%	70%	75%
<u>SALES</u>					
BIO CNG	68.97	82.02	92.32	103.17	114.57
Total	68.97	82.02	92.32	103.17	114.57
<u>COST OF SALES</u>					
Raw material cost	11.22	12.48	13.80	15.15	16.56
Electricity Expenses	29.76	32.74	36.01	39.61	43.57
Depreciation	2.08	1.77	1.50	1.28	1.09
Wages & labour	10.80	11.88	13.07	14.37	15.81
Repair & maintenance	1.38	1.64	1.85	2.06	2.29
Consumables	3.45	1.23	1.38	1.55	1.72
Packaging cost	2.41	2.87	3.23	3.61	4.01
Cost of Production	61.10	64.61	70.84	77.64	85.05
Add: Opening Stock	-	6.11	6.46	7.08	7.76
Less: Closing Stock	6.11	6.46	7.08	7.76	8.51
Cost of Sales	54.99	64.26	70.22	76.96	84.31
GROSS PROFIT	13.98	17.77	22.11	26.21	30.26
GROSS PROFIT RATIO	20.27%	21.66%	23.94%	25.40%	26.41%
Salary to Staff	3.96	4.55	5.24	6.02	6.93
Interest on Term Loan	1.24	2.00	0.78	0.47	0.17
Interest on working Capital	0.77	0.77	0.77	0.77	0.77
Rent	3.60	3.96	4.36	4.79	5.27
Selling & Administration Expenses	1.66	2.05	3.00	3.35	3.72
TOTAL	11.23	13.34	14.15	15.41	16.86
NET PROFIT	2.76	4.43	7.96	10.79	13.40
Taxation	0.01	0.10	0.72	1.36	2.14
PROFIT (After Tax)	2.74	4.34	7.24	9.43	11.25
NET PROFIT RATIO	4.00%	5.40%	8.62%	10.46%	11.69%

<u>PROJECTED CASH FLOW STATEMENT</u>					(in Lacs)
PARTICULARS	1st year	2nd year	3rd year	4th year	5th year
<u>SOURCES OF FUND</u>					
Own Margin	2.18				
Net Profit	2.76	4.43	7.96	10.79	13.40
Depriciation & Exp. W/off	2.08	1.77	1.50	1.28	1.09
Increase in Cash Credit	7.01	-	-	-	-
Increase In Term Loan	12.60	-	-	-	-
Increase in Creditors	0.49	0.14	0.07	0.12	0.08
Increase in Provisions & Other liabilities	0.50	0.25	0.15	0.18	0.22
TOTAL :	27.61	6.59	9.68	12.37	14.78
<u>APPLICATION OF FUND</u>					
Increase in Fixed Assets	14.00				
Increase in Stock	6.67	0.41	0.69	0.75	0.81
Increase in Debtors	1.61	0.03	0.51	1.28	0.38
Increase in loans and advances	0.50	0.50	1.00	1.00	2.00
Repayment of Term Loan	1.40	2.80	2.80	2.80	2.80
Drawings	1.75	2.35	3.50	4.70	6.00
Taxation	0.01	0.10	0.72	1.36	2.14
TOTAL :	25.94	6.19	9.22	11.90	14.14
Opening Cash & Bank Balance	-	1.67	2.06	2.52	3.00
Add : Surplus	1.67	0.39	0.46	0.48	0.64
Closing Cash & Bank Balance	1.67	2.06	2.52	3.00	3.64

CALCULATION OF D.S.C.R

PARTICULARS	1st year	2nd year	3rd year	4th year	5th year
CASH ACCRUALS	4.82	6.10	8.75	10.71	12.34
Interest on Term Loan	1.24	2.00	0.78	0.47	0.17
Total	6.06	8.10	9.53	11.19	12.51
<u>REPAYMENT</u>					
Instalment of Term Loan	1.40	2.80	2.80	2.80	2.80
Interest on Term Loan	1.24	2.00	0.78	0.47	0.17
Total	2.64	4.80	3.58	3.27	2.97
DEBT SERVICE COVERAGE RATIO	2.30	1.69	2.66	3.42	4.22
AVERAGE D.S.C.R.	2.86				

REPAYMENT SCHEDULE OF TERM LOAN							
						Interest	11.00%
Year	Particulars	Amount	Addition	Total	Interest	Repayment	Closing Balance
1st	Opening Balance	-					
	1st month		12.60	12.60	-	-	12.60
	2nd month	12.60	-	12.60	0.12	-	12.60
	3rd month	12.60	-	12.60	0.12	-	12.60
	4th month	12.60	-	12.60	0.12	-	12.60
	5th month	12.60	-	12.60	0.12	-	12.60
	6th month	12.60	-	12.60	0.12	-	12.60
	7th month	12.60	-	12.60	0.12	0.23	12.37
	8th month	12.37	-	12.37	0.11	0.23	12.13
	9th month	12.13	-	12.13	0.11	0.23	11.90
	10th month	11.90	-	11.90	0.11	0.23	11.67
	11th month	11.67	-	11.67	0.11	0.23	11.43
	12th month	11.43	-	11.43	0.10	0.23	11.20
						1.24	1.40
2nd	Opening Balance						
	1st month	11.20	-	11.20	0.10	0.23	10.97
	2nd month	10.97	-	10.97	0.10	0.23	10.73
	3rd month	10.73	-	10.73	0.10	0.23	10.50
	4th month	10.50	-	10.50	0.10	0.23	10.27
	5th month	10.27	-	10.27	0.09	0.23	10.03
	6th month	10.03	-	10.03	1.00	0.23	9.80
	7th month	9.80	-	9.80	0.09	0.23	9.57
	8th month	9.57	-	9.57	0.09	0.23	9.33
	9th month	9.33	-	9.33	0.09	0.23	9.10
	10th month	9.10	-	9.10	0.08	0.23	8.87
	11th month	8.87	-	8.87	0.08	0.23	8.63
	12th month	8.63	-	8.63	0.08	0.23	8.40
						2.00	2.80
3rd	Opening Balance						
	1st month	8.40	-	8.40	0.08	0.23	8.17
	2nd month	8.17	-	8.17	0.07	0.23	7.93
	3rd month	7.93	-	7.93	0.07	0.23	7.70
	4th month	7.70	-	7.70	0.07	0.23	7.47
	5th month	7.47	-	7.47	0.07	0.23	7.23
	6th month	7.23	-	7.23	0.07	0.23	7.00
	7th month	7.00	-	7.00	0.06	0.23	6.77
	8th month	6.77	-	6.77	0.06	0.23	6.53
	9th month	6.53	-	6.53	0.06	0.23	6.30
	10th month	6.30	-	6.30	0.06	0.23	6.07
	11th month	6.07	-	6.07	0.06	0.23	5.83
	12th month	5.83	-	5.83	0.05	0.23	5.60
						0.78	2.80

4th	Opening Balance						
	1st month	5.60	-	5.60	0.05	0.23	5.37
	2nd month	5.37	-	5.37	0.05	0.23	5.13
	3rd month	5.13	-	5.13	0.05	0.23	4.90
	4th month	4.90	-	4.90	0.04	0.23	4.67
	5th month	4.67	-	4.67	0.04	0.23	4.43
	6th month	4.43	-	4.43	0.04	0.23	4.20
	7th month	4.20	-	4.20	0.04	0.23	3.97
	8th month	3.97	-	3.97	0.04	0.23	3.73
	9th month	3.73	-	3.73	0.03	0.23	3.50
	10th month	3.50	-	3.50	0.03	0.23	3.27
	11th month	3.27	-	3.27	0.03	0.23	3.03
	12th month	3.03	-	3.03	0.03	0.23	2.80
					0.47	2.80	
5th	Opening Balance						
	1st month	2.80	-	2.80	0.03	0.23	2.57
	2nd month	2.57	-	2.57	0.02	0.23	2.33
	3rd month	2.33	-	2.33	0.02	0.23	2.10
	4th month	2.10	-	2.10	0.02	0.23	1.87
	5th month	1.87	-	1.87	0.02	0.23	1.63
	6th month	1.63	-	1.63	0.01	0.23	1.40
	7th month	1.40	-	1.40	0.01	0.23	1.17
	8th month	1.17	-	1.17	0.01	0.23	0.93
	9th month	0.93	-	0.93	0.01	0.23	0.70
	10th month	0.70	-	0.70	0.01	0.23	0.47
	11th month	0.47	-	0.47	0.00	0.23	0.23
	12th month	0.23	-	0.23	0.00	0.23	-
					0.17	2.80	
DOOR TO DOOR		60	MONTHS				
MORATORIUM PERIOD		6	MONTHS				
REPAYMENT PERIOD		54	MONTHS				