DETAILED PROJECT REPORT OF 40MTPD TORREFIED BIOMASS PELLET MANUFACTURING AT VILLAGE BHULAWAI TEH. CHANDAUSI, DISTT. SAMBHAL

DECEMBER, 2023

SUBMITTED BY: NATURAL GAS INDIA PVT LTD

Prepared By: ALMATIN ENERGY PVT LTD, Sector 135, Noida – Uttar Pradesh - 201034
E mail: info@almatinenergy.com Telephone:

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1. INTRODUCTION

Energy resources are required for the growth and development of the country. Till date, energy resources in the form of fossil fuels such as coal and crude oil have been used all over the world. These fossil fuel resources have been controlled by a cartel in the oil sector or by a few countries. They control the output and price of these fossil fuels. Countries in the rest of the world are the importer of crude oil & coal and hence are vulnerable to fluctuations in the price of fossil fuels. These countries not only lose valuable foreign exchange but also get terms dictated by countries supplying the fossil fuel. Hence their plans for growth and development have been at stake. Moreover, the usage of fossil fuels has contributed largely to climate change and several problems in the socio-economic sphere. Now, these resources are on the verge of extinction. Hence the world is moving towards the use of renewable energy for energy safety & security.

Biomass is one of such resources that can be used for the production of renewable energy. It is abundant in quantity & available across the globe in every country. Bioenergy can be produced from biomass. Its constituents are municipal waste, industrial use, solid biomass, biogas, and liquid biofuels. Biomass pellet can be produced from the different kind of biomass such as agriculture waste, energy crops and forestry waste etc.

Modern bioenergy is being recognized as an increasingly important low-carbon resource by policy-makers around the world to meet climate policy targets. In India also, there is a clear recognition of the significant role of bioenergy in electricity generation as well as in other applications. Surplus availability of biomass feedstock from agriculture and forestry/ wasteland sector is estimated at 242 million tonnes (Mt) for 2010–11 and is expected to rise to 281 Mt in 2030–31 due to increased crop production and associated waste/residue availability. In terms of related capacity, the potential of Biomass pellet projects is estimated at 35 GW for 2030–31. The associated carbon dioxide mitigation potential resulting from the substitution of coal is estimated at 205 Mt in 2030–31 if the entire biomass surplus is to be diverted for power generation. Additionally, Biomass Pellet projects will generate permanent employment in the construction phase and operational phase.

India's total geographic area is 328 million hectares (Mha), the net cropped area accounts for approximately 43%, and it appears that the net cropped area has stabilized at approximately 140 Mha since 1970 (CMIE 1997; Ravindranath et al. 2005). The gross cropped area, accounting for the cultivation of multiple crops per year, increased from 132 Mha in 1950–51 to approximately 195 Mha in 2008–09. There are two main cropping seasons in India, viz., Kharif (based on the southwest monsoon) and Rabi (based on the north-east monsoon). The gross cropped area includes land areas subjected to multiple cropping (normally double cropping), mainly in irrigated land. The net irrigated area increased substantially from 21 Mha in 1950–51 to approximately 64 Mha in 2013–14 (MoA 2014). Rice and wheat are the dominant crops, together accounting for 41% of the total cropped area, while pulses, oilseeds, and other commercial crops account for 13.8%, 15.9%, and 10.2% respectively. Cereals dominate the agricultural crops and account for 60% of the total cropped area, followed by pulses, cotton, and sugarcane. The specific ratios of residue-to-grain production of different crops are taken from (Tripathi et al. 1998b; Purohit and

Michaelowa 2007; Ravindranath et al. 2011; Purohit and Dhar 2015) and presented in Table 1. The use of crop residues varies from region to region and depends on the calorific values of individual crops, their lignin content, density, palatability by livestock, and nutritive value. The residues of most cereals and pulses have fodder value. However, the woody nature of the residues of some crops restricts their utilization to fuel use only.

Table 1 Area under different crops and their production

Economic produce/crop	Type of residue	Residue-to-grain ratio	Area (Mha)			Crop production (Mt)		
			2010/11	2020/21	2030/31	2010/11	2020/21	2030/31
Food grains								
Rice	Straw + husk	1.8	42.9	48.1	50.3	96.0	109.9	123.2
Wheat	Straw	1.6	29.1	33.7	36.6	87.0	108.2	121.1
Jowar	Stalk	2.0	7.4	5.2	3.4	7.0	6.0	5.7
Bajra	Straw	2.0	9.6	9.3	8.8	10.4	11.4	12.3
Maize	Stalk + cobs	2.5	8.6	8.4	9.0	21.7	24.8	28.3
Other cereals	Stalk	2.0	2.9	2.1	1.5	4.6	3.9	3.8
Gram	Waste	1.6	9.2	8.9	8.7	8.2	8.4	8.6
Tur (arhar)	Shell + waste	2.9	4.4	4.4	4.7	2.9	3.1	3.3
Lentil (masur)	Shell + waste	2.9	1.6	1.7	1.9	0.9	1.2	1.4
Other pulses	Shell + waste	2.9	11.2	12.8	13.2	6.2	6.3	6.8
Oilseeds								
Groundnut	Waste	2.3	5.9	6.0	6.1	8.3	8.9	9.6
Rapeseed and Mustard	Waste	2.0	6.9	7.2	7.9	8.2	9.6	11.0
Other oilseeds	Waste	2.0	14.5	16.7	18.6	16.0	19.3	22.4
Fiber								
Cotton	Seeds + waste	3.5	11.2	11.9	12.6	5.6	6.1	6.4
Jute and Mesta	Waste	1.6	0.9	1.0	1.0	1.9	2.3	2.5
Sugar								
Sugarcane	Bagasse + leaves	0.4	4.9	5.1	5.6	342.4	406.4	459.3
Total			171.0	182.4	190.1	627.3	735.9	825.8

Source: (Ravindranath et al. 2005; Purohit et al. 2006; MoA 2012)

Table 1 presents the area under cultivation and the production of different crops (MoA 2012). For 2020–21 and 2030–31, the area and crop productivity were projected based on the data from 1950–51 to 2011–12 (Figs. S1–S6) as shown in Section S1 of the supplementary section. Figure 3 presents the total residue production in India based on the production of different food grains, oilseeds, fibers, and sugarcane. For 2010–11, the area under cultivation and total crop production were 171 Mha and 627 Mt respectively. The gross residue availability is estimated at 680 Mt for 2010–11. Hiloidhari et al. (2014) reported a gross crop residue production of 686 Mt during 2010–11 by considering 39 residues from 26 crops as compared to the 16 principal crops examined in this study. Singh and Gu (2010) reported a gross potential of 1055 Mt/ year, including residues

from spices (ginger, cardamom, coriander, garlic, cumin, and dry chili) and plantation crops (such as rubber and coffee), while the present study and Hiloidhari et al. (2014) did not include these residues. The highest average densities of agricultural residues of more than 500 tonnes/ km2 were observed for Punjab and Haryana, where intensive wheat–rice systems are practiced on mostly irrigated land (Purohit and Dhar 2018). For 2010–11, agricultural residue availability for energy applications is estimated at approximately 150 Mt in 2010–113 with a collection efficiency of 80% (Purohit and Dhar 2015). In the base year, agricultural residue availability from select crops for biomass pellets is estimated at 123 Mt after adjusting moisture content for bagasse and residue used for biomass/bagasse-based power generation as shown in Table 2. The net residue availability for biomass pellets in 2020/21 and 2030/31 is estimated at 141 Mt and 157 Mt respectively.

Table 2 Surplus agricultural residue availability for biomass pellets in India

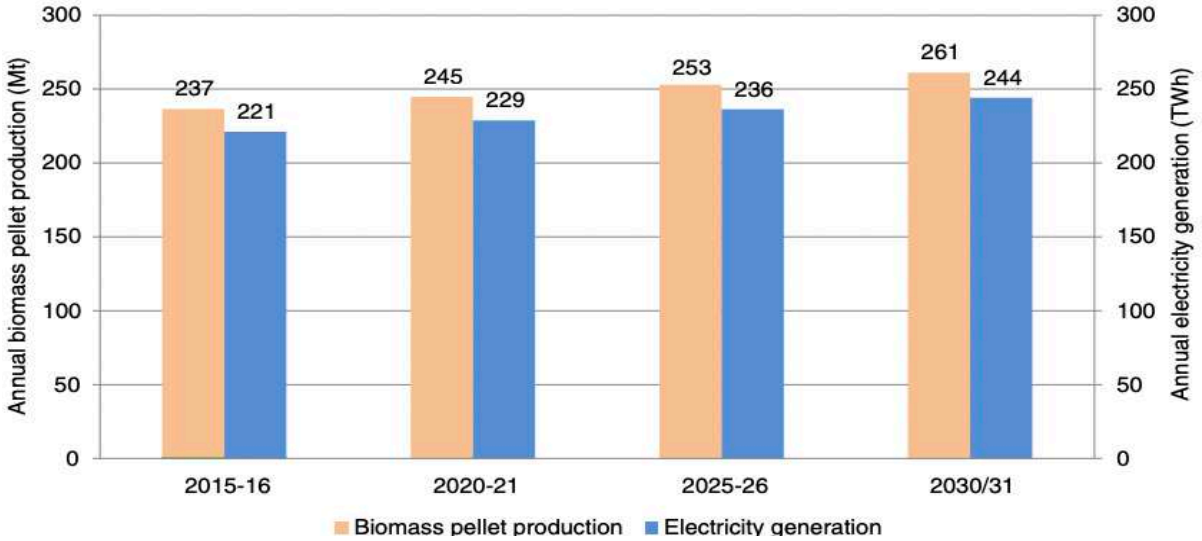
Crop residue	Total residue production (air dry*) – Mt			% of agricultural residue used for**			Net agricultural residue availability for biomass pellets***		
	2010/11	2020/21	2030/31	Fodder	Fuel	Other	2010/11	2020/21	2030/31
Rice straw and husk	172.8	197.9	221.8	80.8	11.1	8.0	13.8	15.8	17.8
Wheat straw	139.2	173.1	193.7	86.4	0.0	13.6	0.0	0.0	0.0
Jowar stalk	14.1	12.1	11.5	100.0	0.0	0.0	0.0	0.0	0.0
Bajra straw	20.7	22.8	24.7	89.8	0.0	10.2	0.0	0.0	0.0
Maize stalk and cobs	54.3	62.1	70.6	81.0	19.0	0.0	7.4	8.5	9.7
Other cereals stalk	9.1	7.8	7.6	100.0	0.0	0.0	0.0	0.0	0.0
Gram waste	13.2	13.5	13.8	0.0	100.0	0.0	9.5	9.7	10.0
Tur shell and waste	8.3	8.9	9.6	3.5	48.5	48.0	2.9	3.1	3.3
Lentil shell and waste	2.7	3.6	4.1	3.5	48.5	48.0	1.0	1.3	1.4
Other pulses shell/waste	18.0	18.4	19.8	3.5	48.5	48.0	6.3	6.4	6.9
Groundnut waste	19.0	20.6	22.0	0.0	13.2	86.8	1.8	1.9	2.1
Rape and Mustard waste	16.4	19.3	22.1	0.0	100.0	0.0	11.8	13.9	15.9
Other oilseeds waste	32.1	38.6	44.7	0.0	100.0	0.0	23.1	27.8	32.2
Cotton seeds and waste	19.6	21.2	22.5	0.0	100.0	0.0	14.1	15.3	16.2
Cotton gin trash	0.4	0.5	0.5	0.0	100.0	0.0	0.3	0.3	0.4
Jute and Mesta waste	3.1	3.6	3.9	0.0	100.0	0.0	2.2	2.6	2.8
Sugarcane bagasse/leaves	137.0	162.6	183.7	11.8	41.0	47.2	28.7	34.1	38.6
Total	679.9	786.3	876.6				123.0	140.8	157.2

* Moisture content (At harvest: 30%; at use: 10%)

** Source: (Ravindranath et al. 2005; Purohit 2009)

*** Apart from fodder and other applications, the net agricultural residue availability for biomass pellets also takes into account the residue used for biomass power/cogeneration projects

Annual biomass pellet production through biomass surplus and associated electricity generation



State-wise Total Cropped Area Production, Biomass Generation, Surplus Biomass Production and Biomass Power Potential in India (TE 2015-18)

States/UTs	Total Crop Area (Million Hectares)	Total Crop Production (Million Tonnes)	Total Biomass Generation (Million Tonnes)	Surplus Biomass Potential (Million Tonnes)	Biomass Utilization (Million Tonnes)	Biomass Power Potential (Mwe)	% Share in total Biomass Power Potential
Andhra Pradesh	7.36	28.62	40.01	17.09	22.92	1999.49	7.03
Arunachal Pradesh	0.33	0.58	0.75	0.17	0.58	18.46	0.06
Assam	3.40	8.93	12.57	2.54	10.03	321.89	1.13
Bihar	7.28	32.50	32.57	7.98	24.59	964.37	3.39
Chhattisgarh	5.47	8.71	12.99	2.65	10.34	353.68	1.24
Goa	0.14	0.24	0.45	0.23	0.22	32.97	0.12
Gujarat	9.67	32.27	50.24	21.74	28.50	2637.84	9.27
Haryana	6.60	27.17	36.24	10.91	25.33	1353.35	4.76
Himachal Pradesh	0.77	1.51	2.74	0.57	2.17	69.71	0.25
Jammu & Kashmir	0.96	1.77	3.24	0.65	2.59	82.82	0.29
Jharkhand	1.96	3.32	5.31	1.20	4.11	146.31	0.51
Karnataka	10.94	51.34	34.09	14.05	20.05	1793.88	6.31
Kerala	1.30	4.79	8.58	6.04	2.54	778.41	2.74
Madhya Pradesh	23.70	43.81	70.23	19.93	50.30	2516.42	8.85
Maharashtra	21.07	86.48	52.54	21.49	31.05	2629.55	9.24
Manipur	0.34	1.12	1.14	0.48	0.66	62.31	0.22
Meghalaya	0.25	0.91	1.37	0.56	0.81	68.54	0.24
Mizoram	0.05	0.13	0.13	0.02	0.11	2.90	0.01
Nagaland	0.44	1.37	1.37	0.44	0.94	53.90	0.19
Odisha	4.45	7.88	11.84	2.23	9.61	298.72	1.05
Punjab	7.17	37.88	53.00	22.25	30.75	3022.11	10.62
Rajasthan	31.93	32.11	59.50	10.21	49.29	1299.55	4.57
Sikkim	0.08	0.12	0.23	0.04	0.19	4.73	0.02

States/UTs	Total Crop Area (Million Hectares)	Total Crop Production (Million Tonnes)	Total Biomass Generation (Million Tonnes)	Surplus Biomass Potential (Million Tonnes)	Biomass Utilization (Million Tonnes)	Biomass Power Potential (Mwe)	% Share in total Biomass Power Potential
Tamil Nadu	8.96	47.92	52.14	12.22	39.92	1560.08	5.48
Telangana	9.38	18.57	33.62	13.76	19.86	1678.36	5.90
Tripura	0.35	0.97	1.41	0.25	1.16	34.35	0.12
Uttar Pradesh	24.19	246.66	124.69	21.60	103.09	2800.31	9.84
Uttarakhand	1.00	8.05	3.55	0.72	2.83	93.34	0.33
West Bengal	8.49	38.20	47.51	16.28	31.23	1741.74	6.12
Andaman & Nicobar	0.04	0.08	0.20	0.13	0.07	18.13	0.06
Chandigarh	0.00	0.00	0.00	0.00	0.00	0.15	0.00
Dadra & Nagar Haveli and Daman & Diu	0.02	0.10	0.07	0.02	0.06	2.16	0.01
Puducherry	0.02	0.27	0.12	0.04	0.08	5.00	0.02
Total	**198.11**	**774.37**	**754.50**	**228.53**	**525.98**	**28445.52**	**100**

Based on the above data it is quite evident that sufficient quantity of biomass is available across all the states specially in Uttar Pradesh and surrounding areas where we are planning to set up the plant. Therefore our proposed plant will not be having any raw material supply challenges.

1.1 SAMARTH Scheme from Ministry Of Power – G.O.I

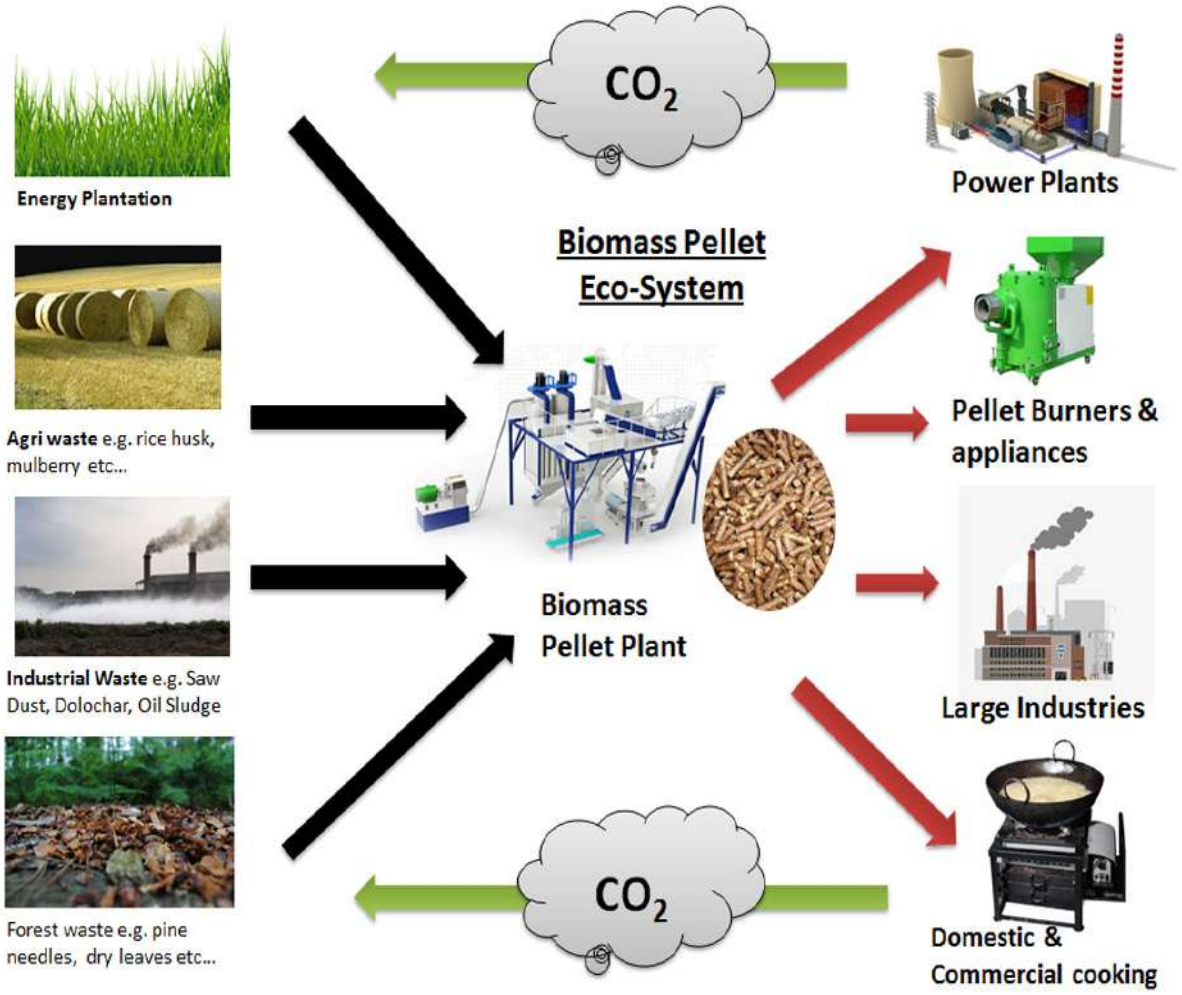
As a step towards usage of biomass for pellet manufacturing, Government of India through ministry of power has released National scheme called SAMARTH (Sustainable Agrarian Mission on use of Agro Residue in Thermal Power Plants) scheme to replace coal with biomass pellets in thermal power plant through replacement of 5% coal by biomass pellet

- It was created to address the issue of air pollution from stubble burning in farms and reduce the carbon footprint generated by thermal power plants which work on coal.
- It is a government initiative to use Agro-residue, which was earlier regarded as waste.
- It is also regarded as National Mission on Use of Biomass in Thermal Power Plants

As per the SMARTH scheme of Ministry of Power, Biomass Pellets are targeted to co-fire with coal to replace 5% of coal. The scheme called - SAMARTH (Sustainable Agrarian Mission on use of Agro Residue in Thermal Power Plants) and the policy for the co firing would be in force for 25 years or till the useful life of power plant whichever earlier. The blending of biomass with coal will reduce coal dependence in thermal power plants and reduce the import bill of coal. Every year, most of the farmers specially in the states of Punjab, Haryana, and Uttar Pradesh set fire the crop residues/agriculture waste. After the paddy harvesting, they must prepare the crop fields quickly for wheat and other Rabi season crops. This cropping pattern leads to the burning of paddy straw (stubble) which emits large amounts of gases including smog-forming carbon monoxide, carbon dioxide, nitrogen dioxide, etc. The thick smoke which spread out because of setting fields on fire

leads to serious health hazards. Burning fields also affect the quality of the soil and steal its vital nutrients. The generated toxic smoke causes respiratory problems and other diseases. The only sustainable solution to this problem is to produce / manufacture biomass pellets/briquettes which will replace fossil fuel i.e., coal. This project shall not only reduce the air pollution caused by rampant stubble burning in India but will also contribute towards the SAMARTH scheme to replace coal with biomass pellets in thermal power plant. The policy for co-firing will be valid for 25 years or until the useful life of a power plant, whichever is earlier, the ministry said. The biomass pellets must be primarily made up of agricultural residue and the policy encourages local sourcing.

BIOMASS PELLET ECOSYSTEM



PROJECT IN DETAIL

2. EXECUTIVE SUMMARY

Establishment of **Biomass Based Pellets (BBP)** projects in India is need of the hour from the point of view of savings in foreign exchange, protection of environment, energy safety and security, commitment to cut in GHG emissions, employment generation, retaining fertility of the soil and food security. These projects can be established at various locations throughout the country depending on the availability of feedstock such as agriculture waste, forestry waste, Industrial waste based on agriculture waste like corrugated packaging waste, furniture etc.

Crop residue burning in northern India has been known, but nowadays it's spreading more frequently in other parts of the country. A study estimates that crop residue burning releases, every year, 149.24 million tonnes of carbon dioxide (CO2), over 9 million tonnes of carbon monoxide (CO), 0.25 million tonnes of oxides of sulphur (SOX), 1.28 million tonnes of particulate matter and 0.07 million tonnes of black carbon. According to a report, one-ton stubble burning leads to a loss of 5.5-kilogram nitrogen, 2.3 kg phosphorus, 25 kg potassium and more than 1 kg of sulphur — all soil nutrients, besides organic carbon. Based on the above, it is evident that the burning of crop residues, including Paddy Stubble, is a huge menace/problem, especially in Northern India, however, the practice is also being observed in other parts of the country. Our proposed projects are targeting to eliminate the problem, at hand, of stubble burning by providing the farmers with an alternative route wherein the crop residue shall be processed and converted to Biochar /torrefied pellets/briquettes. So, in a nutshell, these projects will not only reduce the pollution level but also increase the earnings of the farmers and replace fossil coal usage in the ecosystem.

GOVERNMENT PUSH:

To reduce the pollution caused by burning of biomass, Ministry of power has launched a scheme called **SAMARTH** in which "Biomass Based Pellets utilization for Power Generation through Co-firing in Thermal Power Plants" has been mandated for plant operators across the country to use it along with the coal. All coal based Thermal Power Plants with –

- Bowl Mills shall mandatorily use minimum 5% of Biomass Pellets
- Ball & Race Mills shall mandatorily use minimum 5% of Torrefied Biomass Pellets
- Ball & Tube Mills shall mandatorily use minimum 5% of Torrefied Biomass Pellets with volatile content below 22%

Pellets use is to increase from 5% to 7% w.e.f. FY 2025-26

Based on the market information and previously awarded tenders the average price of biomass pellet (non-Torrefied) was 8-9 Rs / Kg including transportation upto site, excluding tax.

To address issues like pollution and doubling farmer income, **NATURAL GAS INDIA PRIVATE LIMITED (NGIPL),** a Company registered under the Companies Act 2013, having its registered office at 36, Model Town West, Ghaziabad, Uttar Pradesh – 201002. decided to install the biomass pellet manufacturing plant under national mission for biomass called SAMARTH and the final product, biomass pellets shall be sold to thermal power plant operators

like NTPC, state owned power plants, Industrial units running boiler for their process and other applications.

Natural Gas India Pvt Ltd (NGIPL) is a dynamic company with a mission of providing innovative renewable energy solutions to individuals and businesses for sustainable future. Founded in 2020, our team comprises of experienced professionals from energy and agriculture background.

"NGIPL" is dedicated to revolutionizing the agriculture sector by utilizing agriculture waste and creating wealth for rural sector of the country. We believe that our biomass pellets, torrefied and non-torrefied shall contribute to the circular economy, and we are committed to the holistic growth of every stakeholder. NGIPL constantly striving to achieve this goal through a combination of cutting-edge technology, with R&D, and a commitment to excellence in everything we do.

NGIPL, has appointed **ALMATIN ENERGY PVT LTD** (AEPL) as an **EPCM** (Engineering Procurement Construction and Management) Partner for the proposed 60 TPD biomass pellet manufacturing plant. AEPL has sufficient experience in the field of renewable energy especially in the field of biomass and biogas. Having trained and experience manpower to provide comprehensive EPCM services to end user like us.

KEY PERSON PROFILES:

Subodh Kumar: Director, Mr. Subodh Kumar, served as Executive Director in India's largest Oil Marketing Company, Indian Oil Corporation Ltd, and has 35 years' experience in the field of Petroleum Marketing, Alternate Energy and Sustainable Development. He was actively involved in increasing the portfolio of IOCL in the areas of Solar, Wind, Nuclear, Bio-fuels, waste to fuel etc. along with planning and monitoring sustainable development and climate change mitigation & adaptation activities. He has been instrumental in IOCL's foray in alternative fuels like production of ethanol from lignocellulosic Bio-mass sources, production of Bio-CNG from various waste streams.

Babar Shah, Director, is an engineering graduate from Faculty Of technology – Jamia Millia Islamia University and MBA in Marketing from Welingkar Institute of Management, Mumbai. He is 38 years old and has over 15 years of experience in handling small to mid-size business with specialization in Business Management, Operation management and execution of Techno-Commercial Operations. Before promoting NGIPL, he has worked with multinational companies like QUIPPO ENERGY, JAKSON GROUP, and CLARKE ENERGY in the key role position. He takes care of overall administration and execution of the company's projects.

2.1 PROJECT DETAILS

NGIPL wishes to contribute to a sustainable rural economy by establishing a 60MTPD biomass-based pellet manufacturing plant in the village of Bhulawai, District Sambhal, Uttar Pradesh.

The identified location has been selected based on several factors like raw material availability, consumer / demand centre and quality manpower availability. Our selected location is near to agriculture belt of Sambhal district therefore availability of paddy straw is in abundance moreover DADRI Thermal Power Station, where we intend to sell the pellets, is also near to our location and we can sell our produce easily. The power plant is one of the coal based power plants of NTPC.

Approximately 60 MTPD raw material will be utilized to produce 40MTPD biomass pellets. Approximately 0.5 acre of land would be required to install the plant machinery for the pellet manufacturing and the same has been taken on registered mortgageable lease and to store the raw material we shall lease the additional 4 Acre land.

2.2 Raw Material Overview

Thorough working has been done on the location and raw material where we are planning to install the plant. Based on the study lot of agriculture residue i.e. paddy straw is available for us to manufacture the biomass pellets. These waste generators has been identified and agreement for raw material tie-up for the plant can easily be done.

We have identified four district which are within the 100KM range to the proposed location to support the manufacturing unit for the raw material, Badaun, Moradabad, Bareilly and Rampur. Approximately 1 million tons of biomass waste is being generated every year in these four districts whereas to fulfil the requirement of our manufacturing plant we will need only 19000 Tons per year which is approximately 2% of the waste generated therefore it is safe to install the plant in this region and we can maintain continuous availability of raw material for the proposed plant and for the expansion in future.

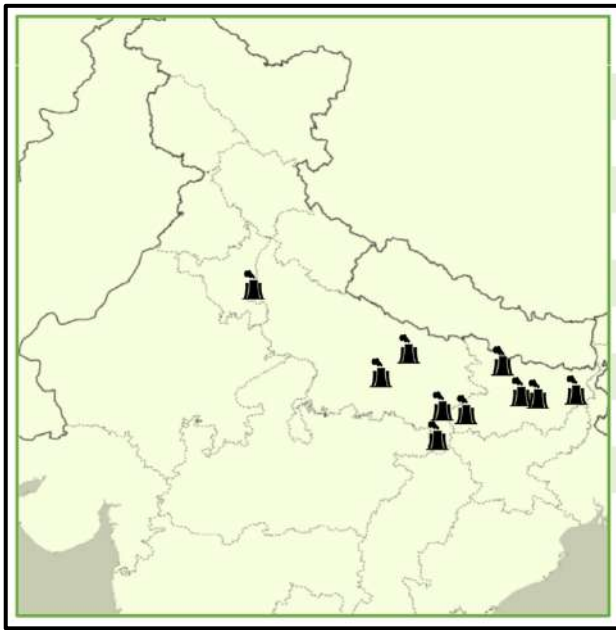
Table: 1

Availability of biomass waste in Badaun Tons / Year	2,70,000.00
Availability of biomass waste in Moradabad Tons/ Year	2,24,000.00
Availability of biomass waste in Bareilly in Tons/Year	1,58,000.00
Availability of biomass waste in Rampur in Tons/Year	2,67,500.00
Total waste availability in Tons/Year	9,19,000.00
Requirement of waste in our Proposed plant in Tons/Year	19000.00

From the data it is quite obvious that availability of raw material is much higher than our requirement.

DEMAND & SUPPLY:

Based on a 5% coal replacement with biomass pellets, the demand for the closest NTPC power plant in Dadri is 1835 TPD which is around 150KM. Our proposed plant's production capacity is 60 TPD and requirement in Dadri power plant is 1835 TPD, there is enormous room for us to supply. We have 9 additional plants in U.P. and Bihar where these biomass pellets can be sold in addition to the Dadri power plant. Therefore, we can conclude that project capacity can be used and that scalability is possible due to high demand.



S No	Location	Capacity (MW)	Biomass Reqt (MTPD)
1	Dadri, UP	1,820	1,835
2	Unchahar, UP	1,550	1,562
3	Tanda, UP	1,760	1,774
4	Rihand, UP	3,000	3,024
5	Singrauli, UP	2,000	2,016
6	Nabinagar, Bihar	1,980	1,996
7	Kanti, Bihar	390	393
8	Barh, Bihar	1,980	1,996
9	Barauni, Bihar	720	726
10	Kahalgaon, Bihar	2,340	2,359
		19,640 MW	**19,798 MTPD**

SWOT ANALYSIS:

Strength	**Weakness**
• Feedstock availability like agriculture waste specially paddy straw are easily available within 100 km radius of the proposed location of the plant. • There are plenty of feedstock aggregators which are ready to supply agriculture waste, saw dust and mustard straw • Biomass pellet production is a visible technology to reduce agricultural and municipal organic waste. • Plant and Machinery is capable of handling various feedstock without any changes.	• Even though, feedstock for the plant is readily available but the exact quantum of waste used by other industries are not known. As such estimation for the availability of feedstock is based on government data and feedstock suppliers. • No establish raw material suppliers.
Opportunity	**Threat**
• Due to rice belt of Northern India huge Agriculture waste is being generated every year and our plant need is only 3% of the total waste available	• Farmers may substitute another crop for rice. It is extremely unlikely, but even if it does occur, our requirement is only 3%, and not every farmer will switch crops.

2.3 Details of agriculture residue based biomass pellet manufacturing project:

Sl. No.	DESCRIPTION	40 MTPD Biomass Pellet Plant
01	Location	Village Bhulawai, District Sambhal. U.P
02	Capacity	40,000 Kg/ day
05	Power requirement	300 KWh
06	Land requirement	0.5 Acre
07	Water requirement	10 m3 / day
08	Completion time	4-6 Months
09	Investment	8.73 Cr
10	Project IRR	30.7 %
11	Return on Investment	3.3 Yrs.
12	DSCR	2.06
13	Project Life	10

2.4 TECHNOLOGY

NGIPL, shall run the plant for 330 days per year, using sophisticated and proven technology. A typical description of Pelletisation process for Agro/ crop residue based biomass is indicated as below:

Biomass pellets are a type of solid biofuel that is produced by compressing and shaping biomass feedstock such as agricultural waste, sawdust, wood chips, and energy crops. Here are the steps involved in the biomass pellet manufacturing process:

1. Feedstock preparation: The first step is to collect and prepare the biomass feedstock. This includes collecting, sorting, and processing the feedstock to remove contaminants and prepare it for further processing. The feedstock is typically dried to a low moisture content to improve its handling and pelletizing properties.
2. Grinding: The feedstock is then ground into a fine powder using a hammer mill or similar equipment. The goal is to create a uniform and consistent feedstock that can be easily processed into pellets.
3. Pelletizing: The ground feedstock is then fed into a pellet mill where it is compressed and shaped into pellets. The pellet mill uses a combination of heat, pressure, and friction to force the feedstock through a die with small holes, forming the pellets. Binders or lubricants may be added to improve the pelletizing process or the quality of the pellets.
4. Cooling: The newly formed pellets are then cooled to room temperature, typically using a counter-flow cooler. The cooler removes excess moisture and prevents the pellets from sticking together.
5. Screening: The cooled pellets are then screened to remove fines and ensure that the pellets are of uniform size and shape.
6. Packaging: The final step is to package the pellets in bags or bulk containers for storage and transportation.

Overall, the biomass pellet manufacturing process is relatively simple and can be carried out using well established equipment's. The process can be easily scaled up to meet increasing demand for biomass pellets as a renewable energy source.

2.5 SUBSIDY ON BIOMASS PELLET PLANT

The Indian government has implemented a subsidy program for the production and use of biomass pellets in the country. The scheme is known as the "Scheme for Promotion of Biomass Pellets/Cross-cutting Technologies for Efficient Cookstoves" and is aimed at promoting the use of biomass pellets as a clean and renewable source of energy.

The scheme is open to entrepreneurs, individuals, and organizations engaged in the production, sale, and distribution of biomass pellets. To be eligible for the subsidy, the applicant must meet certain criteria related to the quality and standards of the biomass pellets and the efficiency of the biomass-based cooking systems.

The scheme is a part of the Indian government's larger effort to promote the use of renewable energy and reduce the country's dependence on fossil fuels. The use of biomass pellets as a source of energy has several benefits, including reducing greenhouse gas emissions, improving indoor air quality, and promoting rural livelihoods.

Overall, the subsidy program for biomass pellets in India provides a significant opportunity for businesses and entrepreneurs to participate in the growth of the renewable energy sector while also contributing to the country's sustainable development goals.

Under this scheme, the government provides financial assistance on Briquette/ Pellet Manufacturing plants: Rs. 9 Lakh per MTPH (metric ton/hour) manufacturing capacity (maximum CFA of Rs 45 Lakhs per plant). In addition, the government of Uttar Pradesh is also providing subsidy on torrefied pellet production at the rate of Rs 75,000/- per ton per day.

Our proposed plant is eligible for both central as well as state government subsidy which is 36 Lacs and 30 lacs respectively for 60 TPD plant. However, in our financial calculation we have not considered the subsidy amount. If we consider the subsidy, then the overall return on the project will be improved.

3. FEEDSTOCK, ITS TYPE & PROCUREMENT PROCEDURE

Biomass pellets can be produced from a variety of feedstock types, each with its own characteristics and suitability for Pelletization. The choice of feedstock depends on factors such as availability, cost, energy content, and environmental considerations.

For our proposed plant, paddy straw (agriculture waste of rice crop) is best suitable due to its availability, cost, and energy content. We have finalized our supplier based on the below mention procurement procedure.

Feedstock has been selected based on its sustainability, environmental impact, and compatibility with the Pelletization process. Proper care has been considered regarding feedstock preparation, including drying and size reduction, which is crucial to achieving high-quality pellets with consistent properties.

Biomass procurement procedures involve the systematic process of acquiring biomass feedstock for pellet production. Typical steps involved in biomass procurement:

a. **Assessment and Planning:** Identify the type of biomass feedstock needed and determine the quantity required and the preferred characteristics of the biomass, such as moisture content, calorific value, and chemical composition.

b. **Supplier Identification:** Identify potential biomass suppliers, which could include local farmers, Aggregators, waste management facilities, and other sources. We have considered factors like proximity to your facility, the sustainability of their practices, and their ability to provide consistent supply.

c. **Supplier Evaluation and Selection:** Evaluate the received proposals or quotations based on factors such as price, quality, reliability, sustainability, and the supplier's ability to meet your requirements. We have selected suppliers that align best with our needs and objectives.

d. **Contract Negotiation:** Negotiate the terms and conditions of the biomass supply contract. Clearly define responsibilities, pricing, payment terms, quality assurance measures, delivery schedules, dispute resolution mechanisms, and any other relevant details.

e. **Quality Assurance and Testing:** Implement quality control measures to ensure that the delivered biomass meets your specified standards. Regularly test samples for factors like moisture content, energy content, and impurities.

f. **Delivery and Logistics:** Coordinate the logistics for the transportation of biomass feedstock from the supplier to your facility. Ensure that transportation arrangements are efficient, timely, and compliant with relevant regulations.

g. **Monitoring and Performance Evaluation:** Monitor the performance of the biomass suppliers based on factors like delivery reliability, quality consistency, and adherence to contractual terms. Address any issues promptly and maintain open communication.

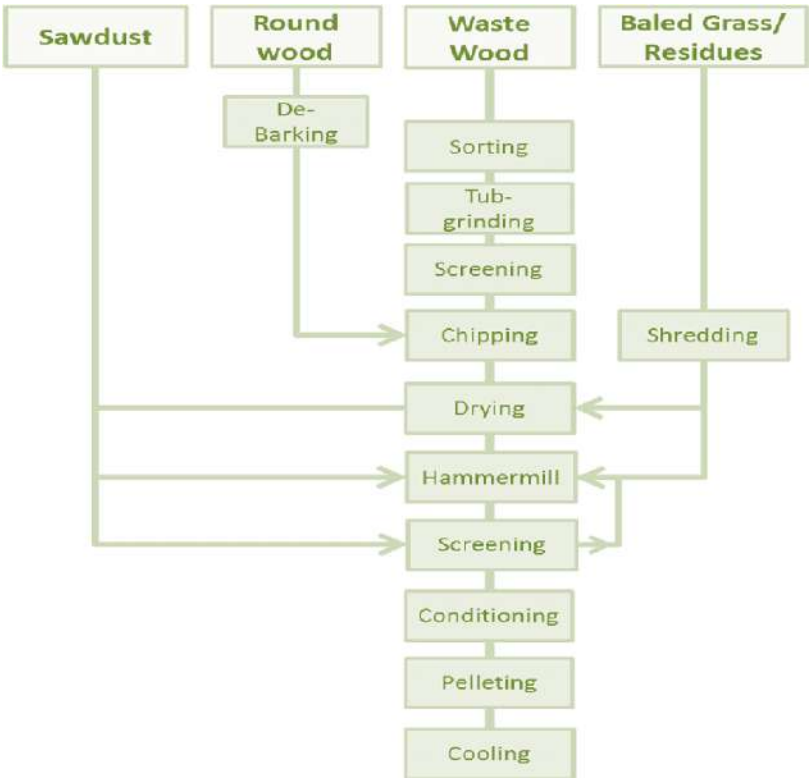
h. **Supplier Relationship Management:** Build strong relationships with your biomass suppliers. Regularly engage with them to discuss challenges, opportunities, and potential improvements in the procurement process.

i. **Sustainability Considerations:** Consider the sustainability of biomass procurement, including factors like the environmental impact of feedstock production, land-use practices, and the potential for regeneration or recycling.

Efficient biomass procurement procedures are essential to ensure a reliable and consistent supply of feedstock for pellet plant.

4. SCHEMATIC OF PELLET PLANT:

The process flow of biomass pellet manufacturing involves converting biomass materials, such as wood, agricultural residues, and other organic matter, into compressed pellets that can be used as a renewable energy source. Here's an outline of the key steps in the biomass pellet manufacturing process:



1. Raw Material Preparation: Collect and prepare biomass feedstock, which can include wood chips, sawdust, agricultural residues (corn stover, straw, etc.), and other organic materials. The feedstock should be dried to reduce moisture content, which is crucial for pellet quality and combustion efficiency.

2. Size Reduction: If the raw material is not already in a suitable size, use equipment like hammer mills or chippers to reduce it to smaller particles. The size reduction enhances the efficiency of the pelletization process.

3. Drying: Reduce the moisture content of the biomass to the desired level, typically around 10-15%. This is essential for efficient pelletization and preventing deterioration during storage.

4. Pelletization: Feed the dried biomass particles into a pellet mill. The pellet mill uses heat, pressure, and mechanical force to compress the material into dense pellets. Dies with specific hole diameters and shapes are used to shape the pellets.

5. Cooling: Cool the newly formed pellets to room temperature using cooling equipment. This helps stabilize the pellets and reduces the risk of moisture reabsorption.

6. Screening and Grading: Screen the pellets to remove any fines or oversized particles. This step ensures that the final product meets quality and size specifications.

7. Pellet Quality Testing: Conduct tests to assess the quality of the pellets, including moisture content, density, durability, and calorific value. Quality testing ensures the pellets meet industry standards.

8. Packaging: Package the pellets in bags, totes, or bulk containers, depending on the intended market. Proper packaging helps maintain pellet quality during storage and transportation.

9. Storage and Distribution: Store the packaged pellets in a dry and well-ventilated area to prevent moisture absorption. Distribute the pellets to customers, retailers, or energy facilities.

10. Combustion or Use: End-users can utilize the biomass pellets as a renewable energy source for heating, electricity generation, or other industrial applications.

Throughout the process, quality control measures, including moisture monitoring, particle size analysis, and durability testing, ensure that the produced pellets meet the required specifications. Proper equipment maintenance, calibration, and adherence to safety guidelines are critical to a successful biomass pellet manufacturing operation.

4.1 STAGES OF THE PROJECT:

A. Civil Work

- Levelling of ground, trenches etc
- Building and shed
- Foundations for machinery

B. Equipment and installation

- Chipper Grinder Machine
- Hammer Machine
- Dryer
- screener
- Pellet Mill
- Pellets Cooler
- Packaging Machine
- Instrumentation, online monitoring system
- Electrical panels, cables & cable trays, and switchgears

5. Biomass Pelletisation Process

Biomass pellets are a popular type of biomass fuel, generally made from wood wastes, agricultural biomass, commercial grasses and forestry residues. In addition to savings in transportation and storage, biomass facilitates easy and cost effective handling. Dense cubes pellets have the flowability characteristics similar to those of cereal grains. The regular geometry and small size of biomass pellets allow automatic feeding with very fine calibration. High density of pellets also permits compact storage and rational transport over long distance. Pellets are extremely dense and can be produced with a low moisture content that allows them to be burned with very high combustion efficiency.

Biomass palettization 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.

Process Description

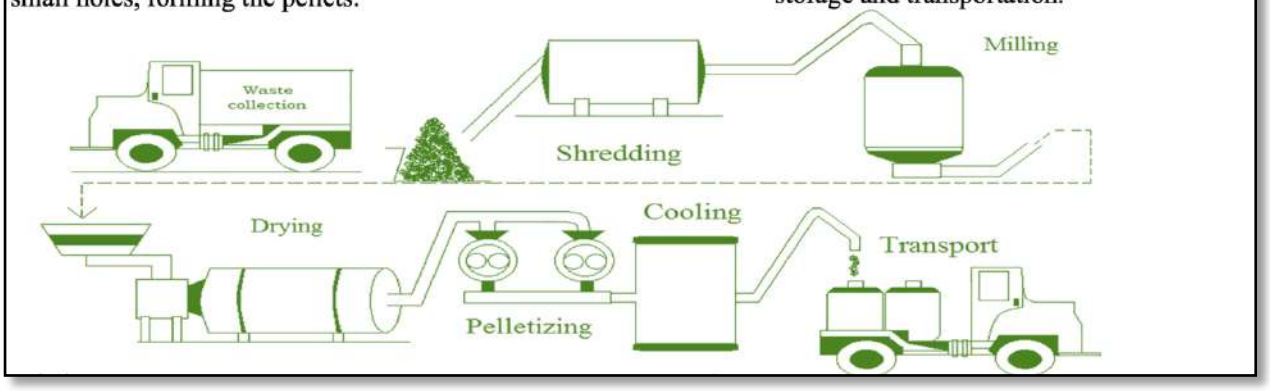
The biomass palletisation process consists of multiple steps including raw material pre-treatment, palletisation and post-treatment. The first step in the Pelletisation process is the preparation of feedstock which includes selecting a feedstock suitable for this process, its filtration, storage and 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 feedstocks, 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 palletisation 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.

PELLETIZATION PROCESS

1. **Feedstock preparation:** The first step is to collect and prepare the biomass feedstock like shredding and drying.
2. **Grinding / Milling:** The main goal of this step is to create a uniform and consistent feedstock that can be easily processed into pellets.
3. **Pelletizing:** The pellet mill uses a combination of heat, pressure, and friction to force the feedstock through a die with small holes, forming the pellets.
4. **Cooling:** The newly formed pellets are then cooled to room temperature, typically using a counter-flow cooler. The cooler removes excess moisture and prevents the pellets from sticking together.
5. **Packaging:** The final step is to package the pellets in bags or bulk containers for storage and transportation.



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 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 90oC). 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.

6. PLANT AND MACHINERY

Biomass Pellet Manufacturing unit shall have two prime units as mention below and both will have separate machineries.

6.1 Machinery for Collection of Crop residue – This process is in the scope of raw material supplier / feedstock aggregators.

6.2 Machinery for Manufacturing process of Pellet from crop residue / Paddy Straw – This will be in the scope of Project developer.

6.1 Collection of crop residue involve the following process:

a. Cutting the paddy straw / crop residue
b. Segregation of the paddy straw / crop residue
c. Bailing of paddy straw / crop residue
d. Transport the bails to manufacturing plant.

NOTE: This process is in the scope of raw material supplier.

EQUIPMENTS & MACHINERY REQUIRED FOR PADDY STRAW COLLECTION & TRANSPORTATION :-

a) Paddy Straw Cutter

Paddy straw cutter is used for cutting the paddy straw which is the first step of the crop residue collection process.

b) Paddy Straw Hay Rack

The Rotary Hay Rake is a proper machine meeting all the requirements of rapid and careful swathing. It meets the forage delicately without much of twisting/entangling thereby making subsequent harvesting (by a baler) easy. It works seamlessly on flat and hilly terrains. Its light yet sturdy construction ensure optimized harvesting by raking greater quantity of hay at once.

c) Paddy Straw Baler

Straw Baler are used for baling of straw into bales of rectangular or circular cross section. The tractor operated machine consists of reel type straw pick up assembly, and straw compaction and tying units. It automatically picks up the residue straw from field with the help of reel which is transferred into bale chamber with the help of feeder and then straw is compressed with the reciprocating ram into a compact variable length size. It also automatically ties the knots using metal wire or nylon rope.

d) Tractor

A tractor is a farm vehicle that is used to pull farm machinery and to provide the energy needed for the machinery to work.

e) Trolley

Agricultural Trolley is used in fields and farms to carry seeds, crops, fertilizers and other required material utilized during farming.

6.2 EQUIPMENTS FOR BIOMASS PELLET: (NGIPL SCOPE)

a) SHREDDING

DUAL SHAFT SHREDDER

Dual shaft shredder is a two shaft shredder with multiple shredding blades, spacers equipped with cleaning fingers to clean the blades and give raw-material a precise cut. The Shredder is a Robust design machine made for heavy duty functioning. The In-feed & outlet conveyors can be purchased as an optional item for easy operation. The extra wide feed opening in-feed chamber is provided for trouble free operation. Shredder is equipped with Programmed Control Panel which ensures smooth function and fully automatic operation with auto reverse and forward function in case of over feeding.

Process: The raw-material can be fed directly into an in-feed chamber with the help of lifting loaders or in-feed conveyors. Further, the material enters into an in-feed chamber and shredder blades cut the material into required size as per specification. The cleaning fingers help to keep the blades clean for smooth functioning of the machine and proper cutting of the raw-material. The shredded material is discharged at the discharged end and is ready to be used for further processing.

Specification:

- Production Capacity: 2,000 - 3000 KG/HR.
- Raw Material: Paddy straw or forest waste or any other agriculture
- Power Required: 80 HP

USP:

1. ***Cutting system: The shredders use different cutting systems, such as rotary knives, fixed knives, and multiple blades.***
2. ***Safety features: Shredders are equipped with various safety features such as emergency stop buttons, safety locks, and overload protection to prevent accidents and protect the operator.***
3. ***Noise level: Shredders are designed to operate at low noise levels to minimize the impact on the environment and the safety of the operator.***

b) CHIPPER GRINDER

CHIPPER GRINDER

Process: Chipper Grinder is drum type chipper, the material is fed into chipper via help of in-feed belt conveyor, through which the material goes into chipper drum where it gets cut into smaller pieces with the help of moving chipper blades. The chipped material is screened out through perforated screen to ensure the appropriate output size of the material.

Specification:

- Production Capacity Up to: 2,000 KG/HR.
- Input Size of Raw Material Up-to: 25 mm Diameter
- Power Required: 65 HP

Our selected Chipper & Grinder machinery has the following USP:

1) ***The blades of the chipper are made of stainless steel with German engineering.***
2) ***The machinery housing is very robust with MOC of mild steel suitable for the chipper grinder operation.***
3) ***All the electrical equipment's in the machinery like wire sensors, motor, control panel are of reputed make.***
4) ***All the mechanical items like conveyer belt, structure, blades are suitable for heavy duty / continuous operation.***
5) ***Chipper grinder machine is designed with safety features to protect the operator from potential hazards. For example, many machines have automatic shut-off switches that activate when the hopper lid is opened or when there is a blockage in the chipping mechanism.***
6) ***Selected chipper grinder machine designed for easy maintenance and operation.***

c) HAMMER

HAMMER MILL

Hammer Mill Working Process: The dried agricultural and forest waste in chipped form is fed and conveyed into the hammer mill with the help of in-feed screw conveyor. The material is clashed by the hammer batten and is thereby shredded and expelled through perforated screen of a selected size which is pneumatically conveyed into cyclone with the help of ID Fan(s). The grinded material in granulated form is discharged by the airlock(s) at the discharge end.

Specification:

- Production Capacity Up-to: 2,000 KG/HR.
- Input Size of Raw Material Up-to: Dia 20 mm x 4 inches long
- Input Raw Material Moisture Content Up-to: 12%
- Power Required: 65 HP

Our selected hammer mill has the following USP's:

1) ***The machine is designed to reduce the size of raw material to less than 5mm.***

2) ***All the electrical motors in the system are of reputed make having thermal insulation for the heavy duty / continuous long hours operation.***

3) ***The machine is forged with the sophisticated forging technology for robust design.***

d) TORREFACTION FURNACE:

TORREFACTION FURNACE

A torrefaction furnace is a type of reactor used to perform the torrefaction process on biomass. The process involves heating biomass in a low-oxygen environment at temperatures typically between 200-300°C (392-572°F) for a period of time ranging from 30 minutes to several hours. The working principle of a torrefaction furnace involves several steps. First, the biomass is loaded into the furnace, typically in a conveyor or hopper system. The furnace is then sealed to create a low-oxygen environment.

We shall be using an inclined type of rotary drum reactor for the torrefaction process which shall be unique of its kind in India. Inside the reactor the biomass will be fed at the higher high end of the drum. The drum will rotate at a constant low speed with the help of electric motors for uniform heating. As the drum rotates, the biomass progresses by gravity down the slope of the rotating drum.

After the torrefaction process is complete, the furnace is cooled, and the torrefied biomass is removed from the reactor. The torrefied biomass will be used for pellet manufacturing.

USP:

1. ***High energy density:*** *The torrefaction process removes moisture and volatile organic compounds from biomass, leaving behind a dry, energy-dense fuel with a higher heating value than raw biomass. This makes torrefied biomass an attractive alternative to fossil fuels in many applications.*

2. ***Reduced emissions:*** *The torrefaction process reduces the emissions of harmful pollutants such as greenhouse gases, particulate matter, and volatile organic compounds, making it a more environmentally friendly option compared to raw biomass.*

e) PELLET

PELLET MACHINE

Process: The torrefied and granulated raw-material is fed into the machine with the help of in-feed screw conveyor. Further, the material enters into the machine keep, the keep worm pushes the material into the briquetting chamber. The biofuel briquettes are formed in the briquetting chamber without the need of any binder with high pressure mechanical punch. Next, the briquettes come out from the cooling line and are ready to use.

SPECIFICATION:

- Production on Briquettes Up-to: 2,300 KG/HR.
- Production on Pellets Up-to: 1,400 KG/HR.
- Input Raw Material Moisture: 8-12%
- Input Raw Material Size: Granulated • Power Required: 92 HP

USP:

1. ***Efficiency:*** *Pellet machines are designed for high efficiency and can process large volumes of biomass waste in a short amount of time. This can result in cost savings and improved productivity for businesses that generate a lot of waste.*
2. ***Uniformity:*** *Pellet machines produce uniform-sized pellets that are consistent in shape and density, which is important for their performance in combustion and heating systems. This consistency also makes it easier to transport and store the pellets.*
3. ***Ease of use:*** *Pellet machines are designed for ease of use, with user-friendly controls and simple maintenance requirements. They can be operated by a single operator and require minimal training.*

Note: Plant and machinery pictures for reference only may differ from actual machinery.

7 ELECTRICAL, INSTRUMENTATION AND CONTROL SYSTEM

The electrical system of a manufacturing plant is a complex network that provides power, control, and safety mechanisms for various equipment, processes, and operations. Here's an overview of the key components and considerations involved in designing a manufacturing plant electrical system of biomass pellet manufacturing plant:

7.1 **Power Supply and Distribution:**

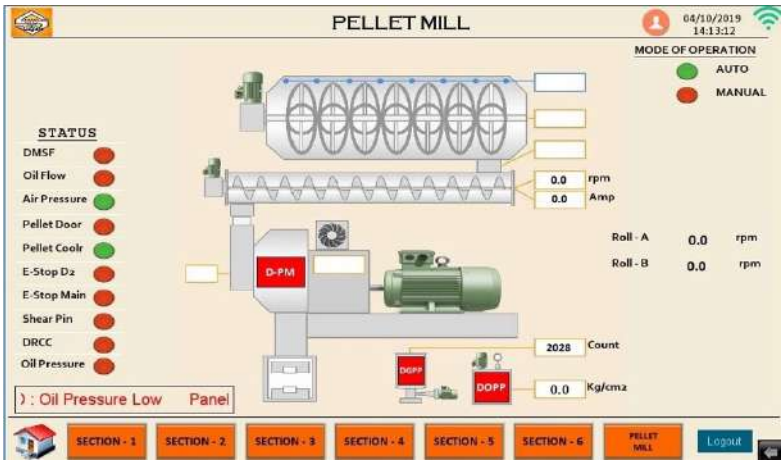
- Main Power Source: Connection to the local power grid for a reliable power supply.
- Electrical Panels: Distribution panels strategically located to route power to different areas of the plant like grinder, chipper, pellet mill etc.
- Circuit Breakers: Provide protection against overloads and short circuits.

7.2. **Motor Control and Drives:**

- Motor Starters: Control the start and stop functions of motors powering equipment.
- Variable Frequency Drives (VFDs): Control motor speed for energy efficiency and process optimization.

7.3. **Process Control and Automation:**

- Programmable Logic Controllers (PLCs): Automate and control various processes and equipment.
- Human-Machine Interfaces (HMIs): Touchscreen interfaces for operators to monitor and control equipment.
- Sensors and Instruments: Measure parameters such as temperature, pressure, flow, and level for process control.



7.4. **Lighting:**

- General Lighting: Adequate lighting for safe and efficient plant operations.
- Emergency Lighting: Backup lighting in case of power failures for safe evacuation.

7.5. **Safety Systems:**

- Emergency Stop Buttons: Easily accessible buttons to halt equipment in emergencies.

- Fire and Smoke Detection: Sensors that detect fires or smoke and trigger alarms and safety actions.
- Safety Interlocks: Mechanisms that prevent operation if certain conditions are not met.

7.6. **Communication and Networking:**

- Ethernet and Communication Cables: Wiring for data exchange between control systems, sensors, and devices.
- Network Infrastructure: Network switches and routers for communication between equipment and systems.

7.7. **Uninterruptible Power Supply (UPS):**

- Provides temporary power during outages to allow for safe equipment shutdown and data retention. Only for the lighting load and data acquisition system.

7.8. **Grounding and Earthing:**

- Grounding System: Ensures safety by providing a path for electrical fault currents to dissipate.

7.9. **Maintenance and Safety:**

- Cable Management: Organized routing and labeling of cables for easy maintenance and troubleshooting.
- Lockout-Tagout (LOTO): Procedures to isolate energy sources during maintenance and repairs.

7.9. **Backup and Redundancy:**

- Redundant Systems: Duplicate critical systems for continuity and reliability.
- Backup Generators: On-site generators for extended power supply during extended outages.

The electrical system of a manufacturing plant is designed to provide power, control, and safety to the entire operation. We have planned to design the electrical system by experienced electrical engineers who adhere to safety standards, and regularly maintained to ensure smooth and safe plant operations.

8 PROJECT IMPLEMENTATION:

ACTIVITIES							
	1	2	3	4	5	6	7
Approvals from government departments and institutions (DIC, PSB etc.)							
Application to MNRE for CFA and further process (Submission of progress report etc.)							
Test reports for substrate, soil, and water							
Agreements for raw material and land							
Arrangements for sale of pellet,							
Approval of Design of the system							
Preparation of the project report							
Floating of EOI and award of contracts							
Placement of order along with advance for equipment							
Arrangement of utilities such as power, water etc. at the site							
Arrangement of equipment (crane etc.) for installation and commissioning							

Civil work at the site (levelling of site, construction							
Ordering of Equipment & Delivery of equipment at the site, payment against proforma Invoice before dispatch							
Commissioning of equipment							
Pellet Production							
Arrangement of service support and storage of critical spares							

8.1 Execution and management plan: A biomass pellet plant involves outlining the steps, resources, and strategies needed to successfully establish, operate, and maintain the plant. Here's a comprehensive plan that covers various aspects of executing and managing a biomass pellet plant:

Project Initiation:

- Conduct a feasibility study to assess the viability of the project based on market demand, feedstock availability, regulatory requirements, and financial projections.
- Develop a detailed project plan that outlines the project scope, objectives, timeline, budget, and key stakeholders.

Design and Engineering:

- Engage engineering firms to design the plant layout, equipment specifications, and process flow.
- Obtain necessary permits and approvals from regulatory authorities for construction and operation.

Procurement and Construction:

- Procure necessary equipment, machinery, and materials based on the engineering design.
- Award contracts to construction and installation contractors for building the plant infrastructure.
- Monitor construction progress to ensure adherence to design specifications and timelines.

Commissioning and Testing:

- Conduct thorough testing and commissioning of equipment, systems, and safety protocols.
- Fine-tune processes and address any issues identified during testing.

Operations and Management:

- Hire and train operational staff, including operators, technicians, and administrative personnel.
- Develop standard operating procedures (SOPs) for various plant processes and equipment.
- Implement a comprehensive maintenance program to ensure equipment reliability and longevity.

Feedstock Procurement and Quality Control:

- Establish relationships with reliable suppliers of biomass feedstock.
- Implement quality control measures to ensure consistent feedstock quality for optimal pellet production.

Pellet Production:

- Set up the pelletization process, including feedstock preparation, drying, pelletizing, cooling, screening, and packaging.
- Implement process control and automation systems to ensure consistent and efficient production.

Marketing and Sales:

- Develop a marketing strategy to target potential customers, including power plants, heating facilities, and industrial users.
- Establish distribution channels and partnerships for selling and delivering biomass pellets.

Environmental and Safety Compliance:

- Implement environmental management practices to minimize emissions and ensure compliance with regulations.
- Develop and enforce safety protocols to protect employees and assets.

Performance Monitoring and Optimization:

- Implement monitoring systems to track key performance indicators (KPIs) related to production, quality, energy consumption, and emissions.
- Continuously analyze data to identify areas for improvement and optimize processes.

Financial Management:

- Monitor financial performance against the budget and adjust strategies as needed.
- Maintain accurate financial records and ensure proper cost management.

Sustainability Initiatives:

- Explore opportunities for waste reduction, energy efficiency, and renewable energy integration within the plant.

Continual Improvement:

- Regularly review and update processes, technologies, and strategies based on industry advancements and feedback.

Creating and managing a biomass pellet plant involves careful planning, collaboration, and continuous improvement. Having a well-defined execution and management plan helps ensure the successful establishment and operation of the plant while considering factors such as technical, financial, environmental, and operational aspects.

8.2 Engineering procurement and construction plan:

An Engineering, Procurement, and Construction (EPC) plan for a biomass pellet plant outlines the step-by-step approach for designing, procuring equipment, and constructing the plant. It ensures that the project is executed efficiently, on time, and within budget. Here's a breakdown of the EPC plan for a biomass pellet plant:

Preliminary Phase:

- Project Feasibility Study: Assess the project's technical and financial viability, including feedstock availability, market demand, and regulatory requirements.
- Site Selection: Identify a suitable location for the plant considering logistical factors, access to feedstock, utilities, and transportation.

Engineering Phase:

- Detailed Engineering: Develop detailed engineering plans, layouts, and process flow diagrams for the entire plant.
- Equipment Specifications: Define the technical specifications for all major equipment, machinery, and systems required for pellet production.
- Permitting and Approvals: Obtain necessary permits and approvals from regulatory authorities.

Procurement Phase:

- Vendor Selection: Identify and select suppliers based on their expertise, reputation, and equipment quality.
- Request for Proposals (RFPs): Issue RFPs to potential vendors, detailing equipment requirements, specifications, and evaluation criteria.
- Vendor Contracts: Negotiate and finalize contracts with selected vendors, specifying terms, delivery schedules, and warranty agreements.

Construction Phase:

- Site Preparation: Clear the site, lay foundations, and establish infrastructure such as utilities, roads, and buildings.
- Equipment Installation: Install purchased equipment following manufacturer's guidelines and engineering plans.
- Construction Management: Supervise contractors, manage schedules, and ensure compliance with safety and quality standards.
- Commissioning and Testing: Test and commission each equipment and system to ensure proper functioning and integration.

Quality Control and Assurance:

- Implement quality control procedures to ensure that equipment meets specified standards.
- Perform quality inspections at different stages of construction and commissioning.

Health, Safety, and Environment:

- Implement strict safety protocols to protect workers and the environment during construction.
- Adhere to environmental regulations and implement measures to minimize impacts.

Project Management:

- Appoint a dedicated project manager to oversee the entire EPC process.
- Monitor progress, manage schedules, and address any deviations from the plan.

Documentation and Reporting:

- Maintain detailed records of project milestones, expenditures, and construction activities.
- Generate regular progress reports for stakeholders, highlighting achievements and potential risks.

Training and Handover:

- Train operational staff on equipment operation, maintenance, and safety procedures.

- Prepare for the transition from construction to plant operation through a systematic handover process.

Post-Construction Phase:

- Address any outstanding punch list items and ensure all equipment is fully operational.
- Begin the transition to plant operation, focusing on optimization and ramping up production.

Creating a well-structured EPC plan is crucial for the successful establishment of a biomass pellet plant. It helps ensure that the plant is designed, constructed, and commissioned in a systematic and organized manner, meeting quality, safety, and budgetary requirements.

9 OPERATION AND MAINTENANCE:

Setting up an effective operation and maintenance (O&M) setup for a biomass pellet plant is crucial to ensure smooth, efficient, and safe plant operations while maximizing the plant's lifespan. O&M setup for your biomass pellet plant:

9.1. **Operations Setup:**

- **Staffing:** Hire skilled operators, technicians, supervisors, and administrative personnel based on the plant's size and complexity.
- **Training:** Provide thorough training to all employees, covering safety protocols, equipment operation, troubleshooting, and emergency response.
- **Shift Scheduling:** Establish a rotating shift schedule to ensure round-the-clock plant operations.
- **Standard Operating Procedures (SOPs):** Develop detailed SOPs for each process, outlining step-by-step guidelines for safe and efficient operations.
- **Process Control and Automation**: Implement advanced process control systems, such as PLCs and HMIs, to monitor and regulate various plant processes.

9.2. **Maintenance Setup:**

- **Maintenance Team:** Employ a skilled maintenance team comprising mechanical, electrical, and instrumentation technicians.
- **Preventive Maintenance:** Develop a preventive maintenance plan that includes regular inspections, lubrication, and replacement of critical components like die, roller etc.
- **Predictive Maintenance:** Utilize condition monitoring techniques (vibration analysis, thermography, oil analysis, etc.) to predict equipment failures and schedule maintenance accordingly.
- **Spare Parts Inventory:** Maintain an inventory of critical spare parts to minimize downtime during equipment breakdowns.
- **Emergency Maintenance:** Establish an emergency response team capable of addressing urgent maintenance issues promptly.
- **Maintenance Records:** Keep comprehensive records of maintenance activities, repairs, and replacements for each piece of equipment.

Setting up a robust operation and maintenance setup requires meticulous planning, training, and a commitment to continuous improvement. By ensuring the safety of personnel, optimizing plant processes, and prolonging equipment lifespan through effective maintenance, you can achieve efficient and successful biomass pellet plant operations.

10 MANPOWER REQUIREMENT

The manpower requirement for a biomass pellet plant can vary based on factors such as the scale of the plant, production capacity, degree of automation, and specific processes involved. Here's a general overview of the key roles and positions typically required for our proposed biomass pellet plant:

10.1. Management and Administration:

Plant Manager:

- Develop and implement operational plans and strategies to meet production targets and business objectives.
- Monitor and manage production processes to ensure efficient and high-quality pellet production.
- Manage plant resources, including human resources, equipment, materials, and utilities.
- Ensure compliance with environmental regulations and oversee emissions monitoring and control.
- Implement preventive and predictive maintenance programs.
- Address equipment breakdowns promptly and coordinate repairs to minimize production disruptions.
- Implement quality control processes to meet customer specifications and industry requirements.
- Recruit, train, and supervise plant staff, including operators, technicians, and support personnel.
- Develop and manage the plant's budget, monitor expenses, and identify cost-saving opportunities.
- Prepare regular reports on production, safety, quality, and plant performance for upper management.
- Address and resolve operational challenges, emergencies, and unexpected issues that may arise in the plant.
- Represent the plant in interactions with local communities, regulatory agencies, and industry associations.
- Stay updated on industry trends and technological advancements to identify opportunities for innovation and efficiency improvements.

The Plant Manager plays a pivotal role in ensuring the biomass pellet plant operates smoothly, safely, and efficiently. Their leadership, strategic thinking, and ability to manage resources effectively contribute to the plant's overall success and growth.

10.2. Operations Department:

01 No. Supervisors

02 No. Plant Operators (for various process stages like grinding, drying, Pellet)

02 No. Technicians (for equipment maintenance and repairs)

01 No. Material Handlers (for feedstock loading and unloading)

02 No. Feedstock Preparation Operators (chipping, shredding, drying)

03 No. Security Guards for plant safety and security.

Keep in mind that these are general roles, and the specific titles and responsibilities may vary depending on the plant's setup and processes. Additionally, as automation and technology continue to advance, some positions may require more technical and specialized skills.

11 ENVIRONMENT IMPACT

The environmental impact of a biomass pellet plant can vary based on factors such as feedstock sourcing, production processes, emissions control measures, and overall sustainability practices. Here's an overview of potential environmental impacts and considerations associated with biomass pellet plants:

11.1. **Positive Environmental Benefits:**

- Renewable Energy Source: Biomass pellets are considered renewable energy because the feedstock, such as agricultural residues, is replenished naturally.
- Reduced Greenhouse Gas Emissions: Biomass pellets emit fewer greenhouse gases (GHGs) compared to fossil fuels like coal and oil. When produced sustainably, they contribute to lower carbon emissions.
- Waste Reduction: Utilizing biomass feedstock that would otherwise be discarded reduces waste and encourages more responsible resource management.

11.2 **CO2 emission reduction**

- In Open field burning, 1 Ton of Paddy Straw releases 1,460 Kg of CO_2
- Emission during conversion of Paddy Straw to Pellets is 339 Kg of CO_2
- 1 Ton of Torrefied Pellets of Paddy Straw release 648 Kg of CO_2
- Approximate Calorific Value of Torrefied Pellets is 4,000 Kcal/Kg which is similar to the average Calorific Value of Coal used in Power Plants
- In Thermal Power Plants, 1 Ton of Coal releases about 2,070 Kg of CO_2

CO2 Emission	Kg/ton
Paddy Straw burning in open field	1460
Torrefied Pellet	648
Paddy Collection & Pellet Manufacturing	339
Coal in thermal power plant	2072
Effective CO2 Saving from Pellet	2545

Thus, each MT of Paddy Straw Torrefied Pellets have the potential to save approx. 2,545 Kg i.e. 2.5 Ton of CO_2

12 SOCIO-ECONOMIC IMPACT

The socio-economic impact of a biomass pellet plant can extend beyond energy production and environmental considerations. It can influence local communities, job markets, economies, and even contribute to rural development. Here's an overview of potential socio-economic impacts associated with our biomass pellet plant:

12.1. **Employment Opportunities:**

- Direct Employment: Biomass pellet plants require a range of skilled and unskilled workers, from plant operators and technicians to administrative staff, providing employment opportunities in the local area.
- Indirect Employment: The supply chain, including feedstock providers, transportation, and equipment suppliers, can also generate additional employment opportunities.

12.2 **Local Economy:**

- Income Generation: Wages and salaries paid to employees directly contribute to the local economy by boosting spending power.
- Business Growth: Ancillary businesses, such as transportation, maintenance services, and catering, may benefit from increased activity related to the plant.

12.3. **Rural Development:**

- Diversification: Biomass pellet plants can diversify rural economies, reducing dependence on traditional agricultural activities.
- Infrastructure Development: The establishment of a plant may lead to improvements in local infrastructure, such as roads and utilities.

12.4. **Feedstock Sourcing:**

- Agricultural Sector: Engaging local farmers for feedstock sourcing can provide additional income streams for agricultural communities.
- Waste Management: Utilizing agricultural residues or wood waste reduces waste generation and provides an alternative income source.

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12.5. **Carbon Mitigation:**

- Climate Benefits: Biomass pellets, when produced sustainably, contribute to carbon mitigation by replacing fossil fuels and reducing greenhouse gas emissions.

12.6. **Social Engagement:**

- Local Collaboration: Collaboration between the plant and local communities can foster positive relationships and engagement.

13 PROJECT FINANCIALS – COST ESTIMATE, FEASIBILITY & FINANCIAL ANALYSIS

Capex and Funding assumptions in crores	
Chipper / Grinder	0.6
Hammer	0.6
Pellet Mill	2.1
Civil, Shed & Electricals	1.02
Torrefaction Machine / Furnace	2.5
Preliminary Expenses	0.1
LAND for the plant 1 acre on lease	
Consultancy charges	0.25
Total	**7.17**
Working capital	1.56
Grand Total	**8.73**
Particulars	**Rs Crs**
Promter's equity	2.15
Term loan from bank (incl Working Capital)	6.57
Investment	**8.73**

Operational assumptions		
Revenue assumptions		
Biomass Pellet Production	40000	Kg/Day
No of days	330	
Price of Biomass Pellets	9.0	Rs/Kg
-Transportation cost of pellets	1.5	Rs/Kg
Cost of power	8.5	Rs/unit
Income from Biomass Pellet	**11,88,00,000.00**	Rs/year

RM - Cost assumptions		
Raw material required – Agri residue	57.1	tons/day
Average Cost of raw material	2800	Rs/ton
Annual Expenditure on Raw Material	**5,28,00,000.00**	**Rs/year**

Power - Cost assumptions

Auxiliary Power Consumption - Hourly Consumption		
Shredder machine	48.0	Units
Chipper dryer	41.0	Units
Hammer	48.0	Units
Pellet Mill	137.1	Units
Lighting Load	10	Units
Miscellaneous	10	Units
Total running Load	**190**	Units
Expenditure/day @ running load	32300	INR
Expenditure/year	**1,06,59,000**	INR
Inflation Rate	**3%**	Per year

Rated capacity of equipment's may be higher. However, since the equipment's will run only for a limited time period during the day, the total day's consumption has been averaged out on hourly basis for 20-hour working format.

Employee costs

Particulars	Nos	Salary	Total
Plant Manager	1	75000	75000
Supervisors	1	45000	45000
Operators	3	25000	75000
Labours	4	15000	60000
Security	3	15000	45000
Total	12		**300000**
Expenditure for a year			**36,00,000**

Annual Repair & Maintenance	
Particulars	**Rs Crs**
Electro-Mechanical Equipments*	0.24
Pellet Mill	0.42
All Other Machinery	0.125
	0.79

Investment required: INR Cr

Particulars	Rs Crs
Promter's equity	2.15
Term loan from bank (incl Working Capital)	**6.57**
Total	**8.73**

ALMATIN ENERGY

Profit & Loss Statement

Year	I	II	III	IV	V	VI	VII	VIII	IX	X
FY	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
Capacity	70%	80%	80%	80%	90%	90%	90%	90%	90%	90%
Income										
Renenue from Sale of										
Biomass Pellets	8.3	9.5	9.8	10.1	10.4	10.7	11.0	11.3	11.7	12.0
Total Income	8.3	9.5	9.8	10.1	10.4	10.7	11.0	11.3	11.7	12.0
Expenditure										
Purchase of Raw material	3.70	4.22	4.35	4.48	4.62	4.75	4.90	5.04	5.19	5.35
Power	0.75	0.85	0.88	0.90	0.93	0.96	0.99	1.02	1.05	1.08
Maintenance	0.79	0.79	0.81	0.83	0.86	0.88	0.91	0.94	0.97	0.99
Transportation cost of supply	1.39	1.58	1.58	1.58	1.78	1.78	1.78	1.78	1.78	1.78
Labour & salaries	0.36	0.36	0.37	0.38	0.39	0.41	0.42	0.43	0.44	0.46
Interest on Bank Loan	0.72	0.72	0.62	0.52	0.41	0.31	0.21	0.10		
Depreciation	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Land Leese charges + Misc.	0.18	0.20	0.20	0.20	0.21	0.22	0.22	0.22	0.23	0.23
Total Expenditure	7.88	8.73	8.81	8.91	9.21	9.31	9.42	9.54	9.66	9.90
EBIDTA (in Crs)	0.44	0.78	0.98	1.18	1.18	1.39	1.60	1.81	2.03	2.14
Net Profit (Pre-tax)	0.44	0.78	0.98	1.18	1.18	1.39	1.60	1.81	2.03	2.14
Profit After Tax	0.29	0.52	0.65	0.79	0.79	0.93	1.07	1.21	1.36	1.44

Prepared By: ALMATIN ENERGY PVT LTD, Sector 135, Noida – Uttar Pradesh - 201034
E mail: info@almatinenergy.com Telephone:

Projected Cash Flow Statement (in Rs Lacs)

Year	I	II	III	IV	V	VI	VII	VIII	IX	X
FY	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32
Inflows										
Net profit	0.29	0.52	0.65	0.79	0.79	0.93	1.07	1.21	1.36	1.44
Depreciation	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Inflow from Equity	2.15									
Inflow from Debt	6.58									
Total Inflows	9.90	1.39	1.53	1.66	1.66	1.80	1.94	2.09	2.23	2.31
Outflows										
Construction of building,	8.73									
Plant and machinery										
Repayment of term loan	0.00	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.00	0.00
Total outflows	8.73	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.00	0.00
Opening Balance	0.00	1.17	1.62	2.21	2.93	3.66	4.52	5.52	6.67	8.90
Surplus/Deficit	1.17	0.45	0.59	0.72	0.72	0.86	1.00	1.15	2.23	2.31
Closing Balance	1.17	1.62	2.21	2.93	3.66	4.52	5.52	6.67	8.90	11.21

Term Loan repayment schedule

Principal			6.58	
Rate of Interest			11%	
Sr No	Principal	Interest	Total	Balance Principal amount
1	0.00	0.72	0.72	6.58
2	0.94	0.72	1.66	5.64
3	0.94	0.62	1.56	4.70
4	0.94	0.52	1.46	3.76
5	0.94	0.41	1.35	2.82
6	0.94	0.31	1.25	1.88
7	0.94	0.21	1.15	0.94
8	0.94	0.10	1.04	0.00
	6.58	**3.62**	**10.20**	

14. CONCLUSION

Executive Dash Board		
Investment	8.7	INR Cr
Avg. DSCR	2.06	
IRR	30.7%	
NPV	11.94	INR Cr
Payback period	3.26	Years