

BIOMASS POWER GENERATION: A CASE STUDY OF TWO BIOMASS BASED POWER PLANTS OPERATING IN KOTA DISTRICT OF RAJASTHAN

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Abstract: Technologies to produce electricity from biomass through combustion and heating are on the rise. Various different technologies are used for the production of electricity through biomass. Caused by the logistic frame conditions of biomass production, storage and transportation as well as the possibility to use the thermal energy for community heating, decentralized power plants are the most economical. The use of Biomass is continuous on the rise as it has emerged as a viable energy source for generating power.

Biomass energy generates far less emissions than fossil fuels. Its use leads to environment benefits particularly to the reduction of atmospheric CO₂ concentrations. In India the principal competing source for electricity is the coal based power. Associated with conventional electric power plants are some negative social and environmental externalities. Throughout the coal and nuclear fuel cycles there are significant environmental and social damages, contrarily biomass energy cost is highly variable depending upon the source, location etc. In this research paper a review and study is done of two Biomass based power plants operating in Kota district of Rajasthan. These plants are using Biomass as a feedstock for the generation of power.

Keywords: Power, electricity, biomass, feed stock.

1. Introduction

All organic matter is known as biomass, and the energy released from biomass when it is eaten, burnt or converted into fuels is called biomass energy. Biomass provides a clean, renewable energy source that could dramatically improve our environment, economy and energy security. Biomass energy generates far less air emissions than fossil fuels.

Biomass Energy in India: India had set up around 500 MW of Biomass Capacity by 2007 and has increased it by almost 150 MW since then to reach around 1 GW capacity in 2010. Most of India's' Biomass Electricity is being generated in Andhra Pradesh, Maharashtra, Tamil Nadu, Karnataka and Rajasthan. A lot of new capacity is being built in Punjab and Chattisgarh as well. India with a total biomass capacity of around 1 GW is planning to increase it by 10 times to 10 GW by 2020. Between 200-600 acres of land are required to support 1 MW of Biomass capacity. This is much more than what is required for even thin film solar energy which is around 10 acres. The large land requirements make Biomass energy scaling a difficult proposition. However, it has a great use in niche applications where there is a large amount of crop and animal residue/waste available.

Biomass Energy in Rajasthan: The Government of Rajasthan has accorded a high priority to setting up power projects based on non conventional energy sources in the State. With a view to promote generation of power from these sources, Government of Rajasthan issued a "Policy for Promoting Generation for Electricity from Non Conventional Energy Sources" in 1999. Keeping in view the requirements, this Policy has been amended from time to time. Lately, the Government of Rajasthan had issued "Policy for Promoting for Generation of Electricity from Biomass, 2010" (Policy-2010).

It was found that on an average about 92.5% of Biomass generated from the agricultural activity goes for consumption in local for fodder, manure, fuel for thermal energy consuming industries, biomass power plants, brick kilns etc, and about only 7.5% is available for other activities or exported to nearby states. The major portion of wheat stalks, barley stalks, paddy hay, jowar stalks, bajra stalks, maize stalks are consumed by animal as fodder and these biomass should not used as a fuel per the Policy of 2010. Mainly Mustard stalks, husks and soyabean stalks are used for power generation as can be seen from their generation and consumption pattern. There is a surplus of 11,62,679 tons /year of Mustard stalks and husks. Similarly, there is a surplus of 3,32,178 tons/year of Soyabean stalks and husks which can be used as feedstock in the power generators . This mustard husk, which is considered a total waste and not even used as fodder for cattle, is very light with a density of about 105 Kg/m³.

Around 10-12 power plants are operating in the Kota region of Rajasthan. Some of them are totally dependent on biomass husk which is used as a feedstock for generating power. One of them is Surya Chambal and the other one is Shriram Rayons.

2. Surya Chambal Power Ltd.,

Formally known as Chambal Power Ltd., is a 7.5 MW capacity biomass (mustard husk) based power plant, located at Rangpur Village of District Kota, about 8 kms from Kota railway station on the banks of the Chambal river. The project was started in April 2004 and the plant was commissioned and synchronized with the Rajasthan Power Grid at 33 KV on 31st March, 2006. Thus starting the supply of power through its Gopal Mill GSS situated near Kota railway station. The company collects biomass for the whole year during the season of harvesting of mustard ie from March to May directly from the farmers. The biomass collected are the remains of the plants of mustard which are of no use to the farmer, which if not used would be burnt by them as parali which is a terrific cause of the air pollution. As can be seen in Punjab, Haryana, and NCR areas that the air pollution is on the rise which is on a large scale affecting the lungs and causing health issues.

Stubble burning in Punjab and Haryana in northwest India has been cited as a major cause of air pollution in Delhi. Smoke from this burning produces a cloud of particulates visible from space, and has produced a "toxic cloud" in New Delhi, resulting in declarations of an air-pollution emergency. Stubble burning is a relatively new phenomenon. Historically, farmers harvested and plowed fields manually, tilling plant debris back into the soil. When mechanized harvesting became popular in the 1980s, stubble burning became common because the machines leave stalks that are about one-foot tall. For solving this problem of farmers the company (Surya Chambal) had installed special plates in the harvesting machines so that the remains of the plants could be removed from a very lower side and least part of the plant is wasted.



Fig 1 : Combine Harvester

Source: <https://www.reference.com/business-finance/uses-combine-harvester-99d801be86cd7604>

Technical details of Surya Chambal Biomass Plant are as follows:

- Power generation capacity of the thermal unit is 7.5 MW
- Type of boiler-Stoker Fired
- Boiler efficiency-70.1-80.0%
- Type of fuel used in the boiler- mustard husk
- Gross calorific value of biomass is around 3598 Kcal
- Ash content in biomass is around 6.8%



Fig 2 : Surya Chambal Biomass power plant Kota

Source: <https://biomasspower.gov.in/document/Magazines/Bioenergy%20Magazine-MNRE/Issue%201-%20Sep%202009.pdf>

The company has never used fossil fuel to support biomass and purchases Rs. 10–12 crore of biomass annually and thereby generates income for farmers and others in a region of 50 km radius from the plant. This has improved the quality of life of villagers who are now using cooking gas, buying television sets, motor cycles and even sending their children to the school. The company faced initial teething troubles. However, after carrying out certain technical modifications, it started yielding satisfactory results.

The company is also engaged in continuous improvement programs for operating the plant at optimum efficiency and projects for energy saving etc. The company is fully conscious of its social responsibilities and carries out various activities to raise the quality of life of the villagers of Rangpur, like repairing of roads, providing water and lighting facilities, development of village school, encouragement to children by providing them with scholarships, conducting various sports & games, awarding prizes at functions and competitions, conducting blood donation camps, joining and participating in religious functions/festivals, etc.

Having gained confidence by successfully running the plant at Rangpur, the company is now expanding and putting up another unit of 10 MW at Khatoli village in Kota, about 100 kms. from Rangpur. Its sister concerns, Sathyam Power Pvt. Ltd. is putting up a 10 MW plant at Merta Road in Nagaur district and Prakriti Power Pvt. Ltd. is putting up a 12 MW Power Plant at Gangapur city in Sawai Madhopur district.

3. Shriram Rayons

Another major producer of energy using Biomass is DCM Shriram Rayons located in Shriram Nagar Kota Rajasthan. Their power generation capacity is 9.2 MW. They have four boilers one is working completely on coal, another on Mustard husk and other two on coal and mustard husk both. Their daily consumption of biomass husk is around 300 tonnes. The price of Biomass husk at factory gate is approx 3000 Rs/MT which keeps on varying according to the availability of Biomass across the year. So roughly they purchase biomass of thirty six crores (36 crores) in a year which is quite less if we compare it with coal (price is around 6500Rs/MT) or any other fossil fuel used for generating power. The main advantage of such plants is the concern shown by organizations for the environment and use of renewable resources like biomass for generating energy which is otherwise a waste.

Technical details of Shriram Rayons Biomass Plant are as follows:

- Power generation capacity of the thermal unit is 9.2MW
- Type of boiler-Stoker Fired
- Boiler efficiency-70.1-80.0%
- Thermal unit efficiency of the plant is 30.1-40.0%
- Type of fuel used in the boiler- Soyabean husk, mustard husk and Bituminous coal
- Gross calorific value of biomass is around 6000-6300Btu/lb
- Gross calorific value of coal is 7000-7500 Btu/lb
- Ash content in biomass is around 4.36%
- Ash content in coal is around 30-40%



Fig 3 : Shriram Rayons Kota

Source:<https://www.financialexpress.com/industry/shriram-rayons-gets-green-nod-for-rs-163cr-expansion-project/358760/>

On regular basis the company is engaged in advancement of the people living in nearby DCM Rayons, the company is also very well aware of its social responsibilities and carries out various activities to raise the quality of life of the villagers of nearby areas, like repairing of roads, providing water and lighting facilities, development of village school, provide encouragement to children by helping them with scholarships and also providing fees and books to the poor children, conducting various sports & games, awarding prizes and gifts at various functions and competitions, conducting blood donation and medical camps, joining and participating in religious functions/festivals, etc.

4. Challenges and Problems faced by both the companies

a) Prices

As per policy of Government of Rajasthan Renewable Energy Conservation Promotion policy 2004 there was restriction of using biomass by other plant within 70 km radius, but unfortunately there are a lot of plants using biomass near this area due to which prices of biomass become high and also the availability is hindered. There is no organized market for the supply of biomass feed stock. Different pricing and procurement strategies are adopted by different power producers for procurement of biomass.

b) Weather

It has a great influence on the proper harvest of biomass because it can reduce the yield of the crop, affect the biomass quality, and pose difficulty in the harvesting process by giving bad condition. The rainy season may harm the biomass stored on fields, moisture may affect the quality of biomass to be fed as a feedstock in the power generators.

c) Storage

The method of on-field storage has the advantage of low cost but on the other hand, biomass material loss is significant and biomass moisture cannot be controlled and reduced to a desired level, thus leading to potential problems in the power plant technological devices. Further-more, health and safety issues exist, such as the danger of spores and fungus formation and self-ignition due to increased moisture. Finally, the farmers may not allow on-farm storage of the biomass for a longer time period, as they may want to prepare the land for the next crop.

Several authors consider the use of intermediate storage locations between the fields and the power plant. For all biomass fuels in which the use of intermediate storage has been modeled, the fuel has to be transported twice by road transport vehicles (first from farm/forest to the intermediate storage facility and then from storage to the power station). This fact will result in a higher delivered cost than a system in which there is only one road transport movement (directly from farm/ forest to power station). Using an intermediate storage stage may add in the region of 10–20% to the delivered costs, as a result of the additional transportation and handling costs incurred.

d) High production cost

Nearly all the elements involved in biomass power generation mechanism suffer from the high cost, including raw materials, logistics service, equipment as calculated per unit of power generating capacity, maintenance of the grid-connecting device, and the overall operation of the plant. However, due to a lack of professional logistics operators, the biomass power plant has to purchase raw materials either at a designated place or directly from scattered farmers. There is simply no scale benefit in the acquisition of raw materials, therefore increasing purchasing cost. Furthermore, compared with conventional power plants, the generating capacity of biomass

power plant is smaller, yet additional facilities are required, especially special storage fuel collecting and storage facilities. Moreover, power plants are responsible for power transformation and transmission onto the grid. The aforementioned factors contributed to high investment and construction cost per KW and higher operation cost for the biomass project.

e) Low density fuel

Most forms of biomass is very voluminous i.e. it has relatively low energy density per unit of mass compared to fossil fuels. This makes handling, storage and transportation more costly per unit of energy carried. Being lighter weight, approximately 2% by weight of Biomass is blown away with wind when stored in open area

f) Capital Investment

Biomass power generation is an emerging industry, of which the technology development and market cultivation demands a large amount of capital investment. Currently, while there lacks the investment and financing channel, the market operation mechanism is also incomplete. The maturing market mechanism gives rise to insufficient input of investment and R&D from the investors and production entities in both domestic and foreign markets, as well as the excessive development in certain aspects.

Three types of losses are considered during the storage of biomass in the biomass yard.

- **Land Settlement:** Biomass at bottom of heap gets mixed with sand and cannot be used in boiler. However, with leveling of ground and proper drainage system, land settlement loss can be reduced to about 0.4%
- **Loss of Fuel during Sand Storm:** This loss can be completely eliminated by covering the biomass with tarpaulin.
- **GCV Loss due to decaying of biomass:** Decaying loss can be reduced to about 1.5% by covering the biomass with tarpaulin and proper drainage.

5. Conclusion

Very little study has been done in the field of biomass especially in Rajasthan. Through this study one can come to know about the companies operating in Kota district which are using Biomass as a feed stock and generating power, various initiatives taken by the companies and the various problems and challenges faced by them. The study will definitely help in implementation of bio-energy production projects and the researchers for further improvement.

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