

Annotated Bibliography on Biomass Energy

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Abstract

It is always of due concern regarding the consistent developing energy systems which involves that the final product requirements should be noted duly, hence this article focuses on the storehouse in a renewable energy system which does not have any usage of fuels such as fossils. It has been statistically estimated that the storage capacity increases efficiently when the factor of conversion losses is included. In the operation of power plant, various worthy parameters involving velocity of the particle, solid particles concentration and the stability and reliability of pulverized fuel flow in the fuel injection pipelines are helpful to detect initial fuel supply problems. Experimental investigation helped in regulating biomass flow using the developed system and inferred that the particle velocity across a vertical pipe is more regular than a horizontal pipe. On the other hand, the waste and sewage generated from such plants can, in turn, be used as an appreciable amount of energy. They can be exploited locally to cover the electricity and wastewater demands of such a purification plant. Moreover, the usual large expanse of these plants help for additional harvest of renewable particularly, wind and solar energy on the site. Through this review article, which involves the study of the years from 2012 to 2017 now focuses on innovative approach which exposes that even the state-of-the-art usage of techniques for energy harvest under the proper design and combination including intelligent operation of devices could lead to replacement of external energy supply with sewage plants under reasonable

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INTRODUCTION

With the increasing energy demand in the various sectors and the depletion of the affordable energy resources the focus for energy generation has now shifted to renewable energy resources. The efficient use and generation of energy is required for a sustainable development [1]. For this, the energy generation has to be eco-friendly so that there is least environmental impact and reduced greenhouse emission India is one of the fastest growing countries in the world and to support this growth and to perform on the global level, our country needs more alternatives to the depleting energy sources [2] to increase its power generation capacity for further growth. The conventional fossil fuels are depleting continuously due to its over exploitation and, therefore, it is of utter importance to explore the unconventional energy resources for energy production. One such renewable sources of energy is biomass. There are many projects started in the rural

India where biomass is used as the primary source for energy generation for households. Biomass constitute of biological material that can used by converting it into bio fuel for efficient energy generation. The renewable energy systems are popularly use in hybrid forms as this increases their reliability, performance, and is economically viable. Even though biomass emerges as a good option[3] to supply future energy demands, the energy efficiency of this technology is still limited and it has high investment cost as compared with the low returns. Its transmission losses are more and reliability of supply is less. It faces the challenge of sufficient supply as it depends on the seasons and other agricultural factors. The water content present in the supplied material further decreases the overall efficiency of the plant as more energy is required for combustion due to the moisture content. These drawback of the biomass can be removed by use of proper technologies and improved machinery. In the current economic

development of India, biomass plays a key role in energy production of our country. It is also a cleaner fuel that reduces the emission of greenhouse gases and creates a balance in the ecosystem. The technological advancement in this field has helped in reducing the operating cost which has made biomass as one of the feasible and popularly used fuels. Currently, the contribution of energy generated using biomass is very low, but the progress in this field and the increased awareness has led to an increase in the percentage of its contribution and with proper implementation schemes and infrastructural development, biomass will become one of the major energy source India in the future.

Review on Research and Development

An inclusive review is projected in the following covered sections as per the Indian and worldwide basis.

O. Singh [4] surveyed that solar energy could be manufactured efficiently and economically with Indian government tax capacity of 1 Kilo-watt on monthly basis would be cost nearby Rs. 60,000 in Indian market costing and inclusive taxes by June 2016 onward. Thus, solar electric production systems utilize either concentrated solar energy or photo-voltaic systems.

Biomass energy can be used as a primary fuel in reducing the dependency of India on nonrenewable energy sources by combining with other eco-friendly fuels and forming hybrid energy sources. Moreover, expanded use of biomass based fuels will be driver in securing the atmosphere. Furthermore, the increase use of biomass energy will prevent consecutive atmosphere damage. The biomass energy source is a better option as it reduces dependency on fossil fuels for the production of heat, steam, and electricity for residential, industrial, and agricultural use [5]. It also helps in enhancing the service options and sustained growth in the rural areas. Adding on, it could support in improvising the agricultural cost. India having a huge population, wherein the majority falls under the agricultural sector, the biowaste generated is sufficient enough for electrification of rural areas. Therefore, the combination of hybrid biomass energy plants

with nonrenewable sources would be advantageous as the investment and operational cost is reduced greatly in India.

S. Saha [6] discussed a recent survey by Indian Institute of Science, Bangalore and Indian Biomass Resource Atlas wherein farm waste estimation in India accounted 120- to 150-million tones every year. These farm wastes could further be used for power generation of approximately 18,000 MW. The government of India provides subsidies and incentives to promote biomass projects through its ministry and IREDA. Furthermore, some incentives like concession in custom duty for importing machinery, excise duty exemption, preferential tariff on purchase of power from these projects are also provided. Consequently, through the paper they inferred that biomass has taken up an important position due to a minimal emission level of carbon dioxide. The various other traditional sources of fossil fuels include the major risk of harmful pollutants including CO₂ emission in comparison with other sources. Figure 1 depicts the comparative analysis of electricity cost and carbon dioxide emissions per kilowatt hour for different resources.

A survey was conducted and summarized by S. Patel[7] where he covered three villages Rangpur, Bhadana, and Nayagaon that are located at the outskirts of the city Kota in Rajasthan, India. The choice of these villages was influenced by the proximity of Surya Chambal biomass power plant. The article further specified that 167 respondents were personally interviewed from these villages. The number being, 119 from Rangpur, 34 from Bhadana, and 14 from Nayagaon. The plant is located at Rangpur village Figure 2.

Thus, the qualitative conclusion of the same included that about 62% respondents considered the biogas plant to be environment friendly and around 65% respondents realized that it is important for their village to develop biogas plant in the current scenario. Whereas, approximately 25.7% respondents were not familiar with the materials used for the biogas plant. Advantages and necessities of small biogas plants have been briefly analyzed and found to be carbon neutral, widely available and cheaper compared with fossil fuels.

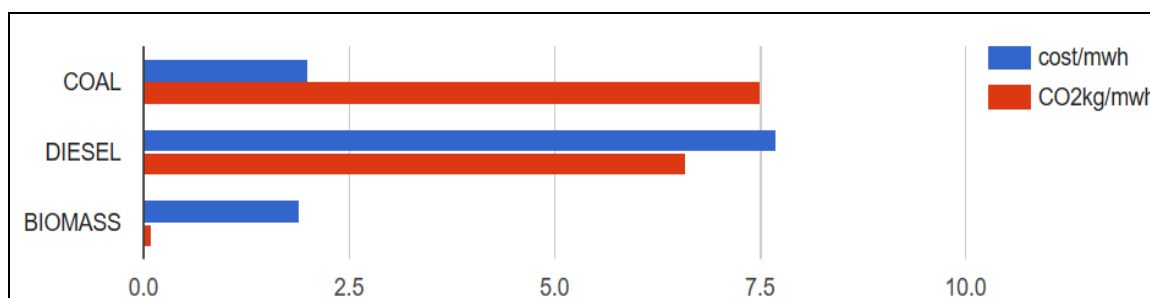


Fig. 1: Comparative analysis of electricity cost and carbon dioxide emissions

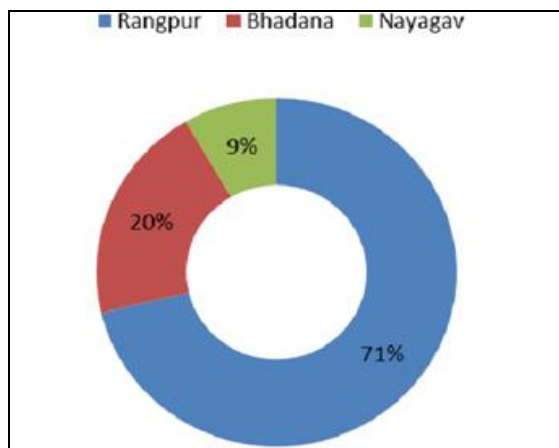


Fig. 2: Location of Interviewees.

Small biogas plants give emission free power results for number of remote location communities throughout the world such as those in Nepal, India, China, and Peru as well as for greatly industrialized nations like the United States of America and the United Kingdom.

Equation 1 shows the fuel utilization efficiency (FUE)

$$FUE = \frac{W+Q}{E} \quad (1)$$

where,

W = Overall Useful Mechanical/Electrical Work

Q = Overall Useful Heat

E = Overall Fuel Energy

V.K.A. Araujo [8] calculated a conversion capacity of the use of biomass as fuel to generate energy, using an estimate of biomethane generation in Equation 2

$$EP = \frac{Q_{biogas} \times HHV_{biogas} \times \eta_{generation} \times 41868}{86400} \quad (2)$$

where,

EP= electric power (kW)

Q_{biogas}= biogas flow m³/day

HHV_{biogas} = heat value (kcal/m³)

$\eta_{Generation}$ = electric power conversion efficiency (%)

4.1868 = conversion factor kcal into kJ

86400 = the conversion factor between a day and seconds

Figure 3 depicts the biomass pyramid-energy losses between trophic levels. Thus, resulting in pyramids based on biomass (dry weight of a collection of designated organisms).

MATERIAL AND METHODS

Comparative Study Between Fossil Fuel and Biomass Energy

India being the seventh largest country spanning 328 million hectares has ample source for biomass production. Presently, the production of biofuel is 450- to 500-million tons per year [9] providing only 32% of all the primary energy. However, the current share of biofuel in total fuel consumption is very low, study of which has been explained thoroughly [10]. The added advantage of low carbon emission has made biomass a popular choice in fuels as compared to coals and other traditional sources of fossil fuel which bear the risk of the most carbon emission and other pollutants than any other fuel sources. Hence, biomass energy is a better, greener, and cleaner alternative.

In terms of availability it has been found that biomass energy outsources the other traditional fuels. It can be availed through the most minimum efforts and bears a very low cost due to its abundance. It takes carbon out of the atmosphere while it is growing, and returns it as it is burned. If managed on a sustainable basis, biomass is harvested as part of a constantly replenished crop. This is either during woodland or arboriculture management or coppicing or as part of a continuous

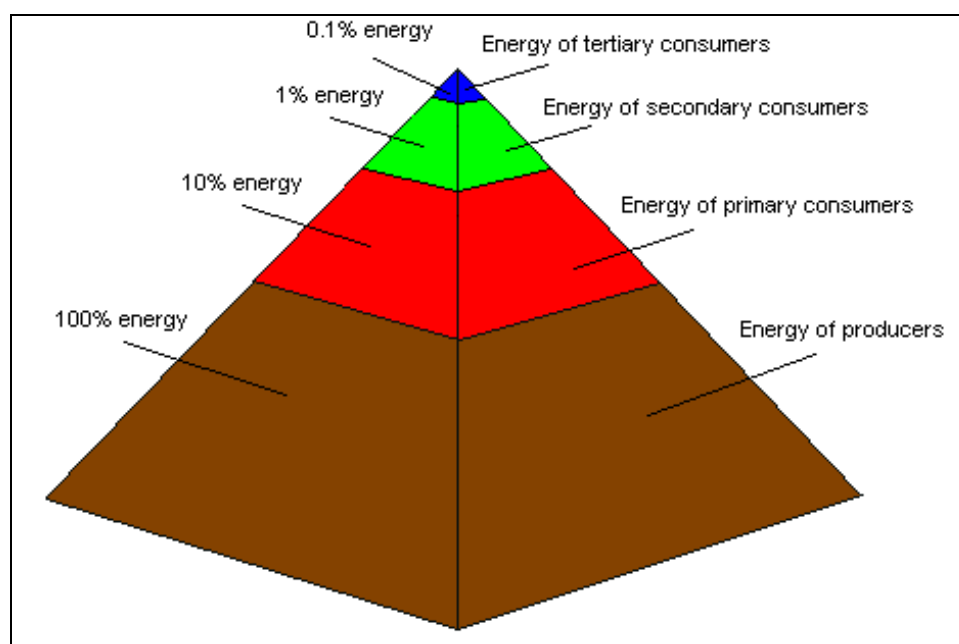


Fig. 3: Biomass Pyramid-Energy Losses.

program of replanting with the new growth taking up CO from the atmosphere at the same time as it is released by combustion of the previous harvest. It is a constant and uninterrupted flow of renewable energy [11] as compared with fossil fuels which rapidly decay and exhaust thus making the power generation more and more expensive. The biomass energy has many pros but still encounters some constraints such as poor infrastructure, inability of any technical skill and skilled workers. Additionally, it includes a high initial setup as well as management expenditure cost as compared with the fossil fuels.

LIMITATIONS OF BIOMASS

Currently, the division of biofuel in the total consumption is extremely low. This is due to the technical limitations, such as, lack of important and detailed information and general awareness among the people. Also, effective policies and management rules are not standardized by the government of India [12]. The geographical location and land requirement to grow plants for biomass energy use is large. The production of biomass fuel also encounters large amount of waste production. Soil and forest land erosion have been listed as one of the concerning factors wherein, biomass vegetation removal from the land area exposes the land to wind and rainfall causing a major threat. The forest lands

generally lose major quantities of soil, water as well as their nutrients whenever trees are cut and harvested. Water resources are also affected by the rapid and sudden runoff during harvesting of crop. The burning of fuel wood as well as crop residues become a pollution hazard and consequently, lead to alarming increase of air pollution level due to the inclusion of nitrogen particulates and various other pollutants in the smoke[13].

USAGE OF BIOMASS

A. Scope of Biomass

- Rural applications of biomass energy
- Urban and industrial applications of biomass energy
- Biomass as a primary source for large scale electrical power generation
- Present contribution of biomass energy is generally between 4% and 18% of total energy consumption of various countries

B. Merits of Biomass Energy

- Biomass used as a fuel reduces need for fossil fuels for the production of heat, steam, and electricity for residential, industrial and agricultural use [14].
- Biomass is always available and can be produced as a renewable resource.
- Biomass fuel from agriculture wastes maybe a secondary product that adds value to agricultural crop.

- Growing biomass crops produce oxygen and use up carbon dioxide.
- The use of waste materials reduce landfill disposal and makes more space for everything else.
- Carbon dioxide which is released when Biomass fuel is burned, is taken in by plants.
- Less money spent on foreign oil.

C. Issues Related to Biomass Energy

- Agricultural wastes will not be available if the basic crop is no longer grown.
- Additional work is needed in areas such as harvesting methods.
- Land used for energy crops maybe in demand for other purposes, such as faming, conservation, housing, resort or agricultural use.
- Some biomass conversion projects are from animal wastes and are relatively small and therefore are limited.
- Research is needed to reduce the costs of production of Biomass based fuels.
- Is in some cases is a major cause of pollution.

PROSPECTS IN INDIA

Despite of the various advantages of biomass, the utilization of this energy is still far behind in comparison with other energy sources in India. Our country is still hugely dependent on the conventional energy sources [15]. We can

get an overview of the usage of biomass energy in different states of India from the following bar graph.

CONCLUSION

India is currently facing power crises due to depletion of conventional energy sources and lack of technological development in the field of renewable energy. The increasing demand of energy due to the industrial development of our country has led to search for alternative energy sources so that we get constant energy supply for our stable, unhindered industrial advancement. The biomass energy being a clean fuel is one such alternative in future. Currently, the lack of proper schemes and researches in this field has resulted in less usage of this renewable resource to overcome this we need funding of money in this area and a proper, planned, and effective schemes by the government.

FUTURE WORK

- Study on carbon impacts of forest biomass for energy
- Optimal use of biomass in large suspension-fired boilers
- Influence of load, operation conditions and fuel mixing on ash deposition and shedding
- Study on development of lab scale for continuous process set up for biomass liquefaction

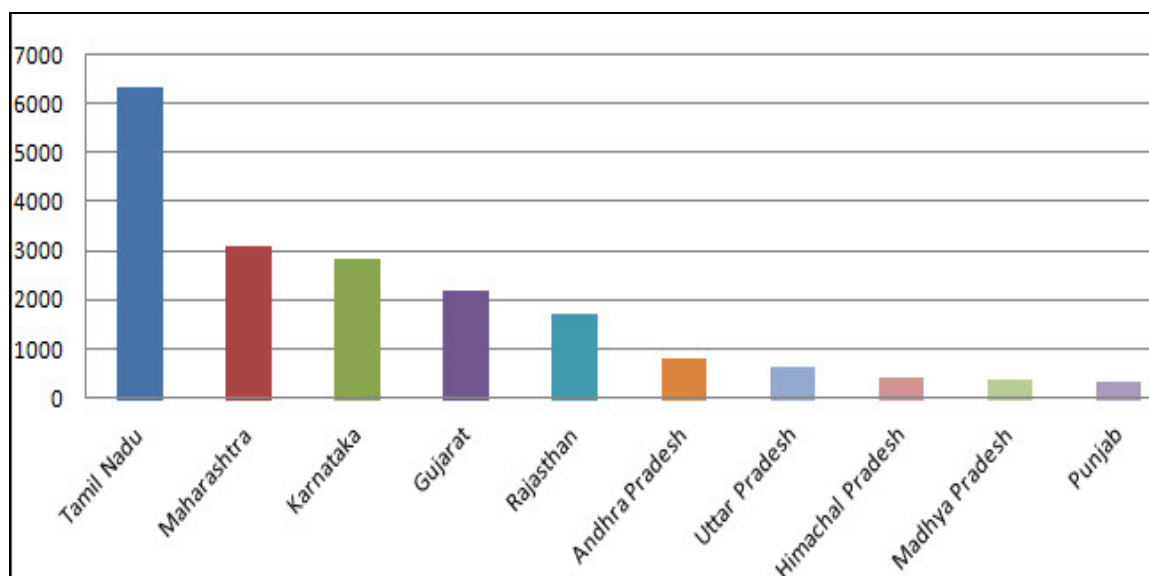


Fig. 2: Usage of Biomass Energy in Different States of India

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