Renewable and Sustainable Energy Reviews 45 (2015) 530–539

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

A review on biomass energy resources, potential, conversion and policy in India

Anil Kumar [a,*], Nitin Kumar [a], Prashant Baredar [a], Ashish Shukla [b]

[a] Energy Centre, Maulana Azad National Technology, Bhopal-462 051, India
[b] Civil Engineering, Architecture and Building, Faculty of Engineering and Computing, Coventry University, Coventry, UK

ARTICLE INFO

Article history:
Received 21 May 2014
Received in revised form
25 September 2014
Accepted 2 February 2015
Available online 23 February 2015

Keywords:
Biomass Energy
Resources
Potential
Conversion
Policy

ABSTRACT

In this communication biomass energy resource, potential, energy conversion and policy for promotion implemented by Government of India are discussed. The total installed capacity for electricity generation in India is 2666.64 GW as on 31st March 2013. Renewable energy is contributed 10.5% of total generation out of which 12.83% power is being generated using biomass. India has surplus agricultural and forest area which comprises about 500 million metric tons of biomass availability per year. In India total biomass power generation capacity is 17,500 MW. At present power being generated is 2665 MW which include 1666 MW by cogeneration. The various category of biomass in India is also discussed in this paper. And the research reveals that India has large potential for bio mass feed stock from different sources. Government of India deployed different policies and executed that the strategies for biomass power generation. Such approaches have included the whole biomass energy sector which incorporated the bio gas, bio diesel etc. in the policies. Government of India has focused on the deployment and development biomass energy sector with strategic policy and program which is notable portion of this review paper.

Contents

1. Introduction . . . 531
2. Available biomass resources in India . . . 531
   2.1. Residue of agricultural crop . . . 531
   2.2. Agricultural feed-stocks-energy plantation . . . 532
   2.3. Biomass wastes—A potential feedstock for biomass power production . . . 533
3. Installed potential of biomass energy in India . . . 534
4. Biomass energy conversion technologies . . . 535
   4.1. Thermo-chemical conversion . . . 535
      4.1.1. Combustion . . . 535
      4.1.2. Gasification . . . 535
      4.1.3. Pyrolysis . . . 536
   4.2. Bio-chemical conversion . . . 536
      4.2.1. Fermentation . . . 536
      4.2.2. Anaerobic digestion . . . 536
   4.3. Mechanical extraction . . . 536
5. Indian biomass energy conversion policy . . . 536
   5.1. Subsidy for generation based projects . . . 536
   5.2. Subsidy for cogeneration based projects . . . 537
   5.3. Central financial assistance and fiscal incentives . . . 537

* Corresponding author. Tel.: +91 9425680448; fax: +91 755 2670562.
E-mail address: anilkumar@gmail.com (A. Kumar).

http://dx.doi.org/10.1016/j.rser.2015.02.007
1364-0321/

6. International acceptance of biomass. 537
7. Conclusions 538
References 538

1. Introduction

Many developed and developing countries has promoted biomass energy generation through instrumented policies and financial incentives. Many governments introduced feed in tariff schemes as a policy mechanism to accelerate investment in renewable energy sector.

India is a fast developing country; with high economic and industrial growth energy demand is also growing. The major source fulfill the energy requirement of India are Oil and coal. The energy consumption of India using these conventional sources are—151.3 GW by thermal (coal, natural gas and oil), 4.78 GW by nuclear energy, 30.49 GW by hydro and 27.54 GW by renewable energy. Fig. 1 shows the percentage share of various energy resources in India up to 31st March 2013 [1].

Non-renewable resources have used frequently in India due to lack of awareness and acceptability of renewable energy sources by power consumer. There are many disadvantage of using non-renewable energy resources as they have limited existence in environment, non-eco friendly and not economical as India import all these type of energy resources. Therefore it is essential to explore many others sustainable energy sources. One of those non conventional sources is biomass energy which can provide firm power of grid quality. Biomass is a renewable source of energy contains complex mix of carbon, nitrogen, hydrogen and oxygen. Biomass of this content is obtained from living or dead plants, by product of crop production, wood and agro based industry [2].

Biomass energy consumption is in practice in India since ancient time. It is used in the form of cow dung cake, firewood, husk and many available natural feed stocks. However, direct use of biomass in solid form was not safe and painless as they produce lot of smoke and ash. Therefore Biogas plant are being motivated by Indian Govt. as they produce no smoke i.e. pollution free. Many subsidies are provided for establishment of the biogas plant. New biomass gasification Technology was also evolved which converts biomass in to syngas, which are more efficient.

After judging the potential of biomass, technology also implemented the biological and thermo-chemical conversion for utilizing biomass to produce fuel gases. These fuel gases can be used for power generation. The biomass based power generation is now considerably on the rise trend. It is mainly because power demand is increasing in rural area also and less option for alternative fuel [3].

It has been fundamental now to provide energy by biomass for the development of civilization. In present scenario, global warming, decrement of resources and other international issues have led to the decision of sustainable development. And in power sector use of renewable energy like biomass is the need one of the major green source [4].

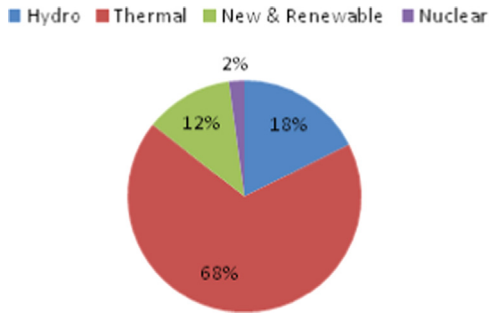

Fig. 1. Percentage share of various energy resources in India upto 31st March 2013 [1].

Larger population of India lives in rural area. According to census 2011, 68.84% population of India lives in rural area. There are 0.638 millions villages in India, therefore to plan for electrification in villages; biomass will be vital option as a renewable source of energy. Ministry of New and Renewable Energy Sources (MNERS) has proposed to reach total 4324.22 MW of power generation based on biomass power and gasification as well as co-generation. MNRE, Govt. of India, has taken initiative like central financial assistance and fiscal incentives for promoting the use of bio-energy from agro residues, plantations and from various waste of urban and industries. MNRE is using the methodology for providing the subsidies based on co-generation and generation by biomass gasification [5–7].

In this paper, state wise biomass potential of India is identified. The various category of biomass in India and their conversion processes are also presented briefly. This paper has discussed the scope, potential and scenario of implementation biomass power in India. Policy regarding providing the subsidies for biomass power in India is mentioned. Government of India has focused on the deployment and development biomass energy sector with strategic policy and program which is notable portion of this communication.

2. Available biomass resources in India

Biomass is defined as bio residue available by water based vegetation, forest or organic waste, by product of crop production, agro or food industries waste. Various biomass resources are available in India in different form. They can be classified simply in the way they are available in nature as: grasses, woody plants, fruits, vegetables, manures and aquatic plants. Algae and Jatropha are also now used for manufacturing bio-diesel. Core distinct sources of biomass energy can be classified as residue of agricultural crop, energy plantation and municipal and industrial waste [8]. Fig. 2 shows the various classification of biomass available in India.

2.1. Residue of agricultural crop

India has huge amount of agriculture land area, so massive residues are produced here. These residue contents the potential of biomass feedstock for the use of energy generation [9]. All the organic materials produced as the by-product from processing harvesting of agricultural crop are termed as agricultural residue. These agricultural residues can further be categorized as primary and secondary residue. Residue which is obtained in the field at the time of yield are field based or primary residue, whereas those are assembled during processing are defined as processing based or secondary residue [10]. Rice straw, sugar cane tops etc. are primary residue whereas rice husk and bagasse are example of secondary residue. Primary residues are also used as animal feed, fertilizers, etc. Therefore its availability for energy application is low. While secondary residues are obtained in large quantity at yielding site and can be confined as energy source. Based on survey and data collection, residues and their quantity available in India are complied in Table 1.