

A Review on Biomass Production Status, Challenges and Prospect in South Asia

Md. Johir Uddin¹, Mohammad Zonal Abedin²

Student¹, Professor²

Department of Mechanical Engineering

Dhaka University of Engineering Technology, Gazipur-1707, Bangladesh²

Corresponding Authors' Email: - johirk070@gmail.com¹, abedin.mzoyanal@duet.ac.bd²

Abstract

This article discusses the advances in technology, the market conditions and the biomass solid fuel availability in South Asia. The energy mix in South Asia (SA) is known to be a highly polluting one with important CO₂ and particulates emissions. Following the introduction for several of the countries in the Asia Union and the signature by most of them of the Kyoto protocol, severe caps have been imposed on the CO₂ emissions. Most of the SA countries have a significant expertise in thermal combustion units based on lignite and coal. Therefore, the use of the solid biomass fuel for electricity generation has started being applied progressively as a means of electricity generation. Pure biomass plants and biomass co-firing plants are actually studied and developed in many of these countries. We refer to as solid biomass all agricultural residues, rice husk, wood flakes or pellets, olive pomace and any plants that can be used as solid biofuels. Each country among the ones in South Asia have different biomass type availability which can be transported inside the country or exported to close distances. In this article we will discuss the technologies that have already been applied in South Asia for different types of biomass. We will stretch the point of biomass solid fuels availability, the regions that can supply important quantities and which neighboring countries can be considered in case of a shortage. The latter availability will be closely linked to the technology that is used each time and the influence of the biomass mix to the technology used. Finally, in order to describe the

financial feasibility of these projects we will refer to some financing and feed-in-tariff schemes that are actually applicable.

Keywords: *Kyoto protocol, Biomass production, Status, Challenges, Prospect, South Asia.*

INTRODUCTION

We define as SA (South Asia) electricity market the group of the countries of: China, India, Bangladesh, Pakistan, Srilanka, Afghanistan, Nepal, Bhutan. Historically and actually there has been intensive collaboration among these countries for Exchange, Trading, Generation Project development and Transmission electricity coordination [1].

SA region, during the last 5 years has demonstrated significant potential for development in the field of energy with highly promising biomass field advances. Furthermore, during these years a series of green incentives relevant to biomass have been initiated in these countries. In this presentation we will present an overview of the biomass development in SA for electricity generation as a single fuel or as a supplementary fuel for co-firing in coal plants.

Generation Mix in South Asia

SA is characterized by a highly CO₂ emitting generation mix consisting mainly

of coal, gas and heavy fuel and with a very low renewable energy source penetration [2]. More specifically the above mentioned thermal energy accounts for approximately 65% of the installed capacity with a renewable penetration around 1%. The latter mix in combination with the aged power units yields an important level of CO₂ emissions ranging in the levels of 755MTons per year with an average of 88.2 T/inhabitant. Moreover, the solid biomass technologies used for a single fuel are almost non-existent in the SA market. Nevertheless, the practices of co-firing with coal are in some countries already applied.

Solid Biomass in South Asia

There is an important variety of available biomass types in the SA. These can be separated into agricultural residues, agricultural plants and wood products [3]. More specifically the agricultural residues biomass class consists of: wheat residues, rice husk, cotton residues, corn residues, raisin residues and olive residues and other agricultural residues that can be found

after their processing. These biomass products vary significantly in their calorific value, their ash content, their chemical consistency and the form that is collected and distributed [4]. The latter factors have a direct impact on the final cost of the available biomass suitable for electricity production and the type of technologies applied, hence the cost, of the generation unit. Agricultural biomass for power generation is usually considered as the residues which are mentioned above. Nevertheless, lately, a plant dedicated to solid biomass, called Cynara Carunculosa, has been cultivated [5].

This plant has been naturally improved in order to offer an important yield and a calorific value similar to the one of wood. In addition, Cynara is a plant that requires small quantities of water and no fertilizer. Wood biomass can be classified into wood residues and wood branches. As wood residues in SA we consider all forms of wood that can be found in the wood factories after the main processing both in pieces and in saw dust. In most of the SA countries these quantities are rather important. In addition to the wood residues an important part can be sourced from the annual tree branch trimming that could take place. This wood has a high density and appropriate humidity levels making it

thus suitable to be used directly into the biomass plants.

Biomass Technologies in South Asia

According to paragraph II, the thermal power generation units have a significant percentage of the installed capacity in SA [6]. Among the thermal units in SA a significant part are coal units which are suitable to accommodate co-firing of biomass and therefore sell the produced electricity either in feed-in tariffs or emit green certificates.

A series of important factors have to be taken into consideration such as humidity, ash content, chemical consistency and the form at which the biomass is fed into the system [7]. The latter parameters will determine the level of interventions that would have to be made on the existing unit, the percentage of biomass that would be co-fired and the preprocessing before the co-firing. Considering pure biomass units, there are only very few installed in SA. The main reason for their low level penetration into the generation mix was the lack of financial incentives and their high cost of construction. Lately, there has been observed an increased interest for biomass units for electricity generation for medium and small scale applications.

Biomass Incentives in South Asia

The actual incentives within SA can vary from feed-in-tariffs and green certificates for the operation of the unit to governmental grants for the construction of the unit [8]. More specifically feed-in-tariffs are offered for a period of 15-20 years under obligation of power purchase from the governmental authorities. The feed-in-tariff can be an all included price or a price over the actual electricity wholesale price [9]. In cases where green certificates are offered these can be related to the installed capacity of the unit or can be related to the generated energy. In a different approach, some countries also offer governmental grants that cover a significant part of the construction cost and thus rendering the investment viable. In addition to the abovementioned incentives and because of the SA's highly CO₂ emitting generation mix, biomass has a very positive perspective within these countries as a means to reduce emissions and hence reduce the overall system's marginal price.

CONCLUSIONS

Biomass is a highly debated subject in the electricity generation field. More specifically, the parameters that intervene in the decision making process for the development and design for such energy

systems are numerous. Important roles play the quality of biomass, its chemical consistency, its form of distribution, the transportation area and the available market incentives. However, SA is a market that offers a solid ground for biomass development in both co-firing and single fuel use technologies. In addition, the existing mix of power generation in SA, based heavily in coal, makes possible the extensive use of biomass as a supplement to the existing fuel. The latter can be applied with low level interventions in the existing units and offer the possibility of transforming a part of the actually generated electricity into green electricity. Nevertheless, the chain from the biomass cultivation to the electricity generation has to be analyzed with care. Long transport courses, intensive transformation and drying processes, high ash content and corrosive elements during burning might have a significant impact on the green identity of the process. Therefore, large utilities seek to certify the entire process from cultivation to electricity generation and guarantee that way the positive ecological impact.

ACKNOWLEDGMENT

The authors gratefully acknowledge the contributions of D. Papavasiliou from the Center for Renewable Energy Sources in

Greece for its work on the original version of this document.

REFERENCES

1. Journal of Applied Fluid Mechanics, Vol. 15, No. 1, 2022, 179-191. Available online at www.jafmonline.net, ISSN 1735-3572, EISSN 1735-3645. <https://doi.org/10.47176/jafm.15.01.32684>.
2. Hu, Xiaoying; Dong, Changqing; Yang, Yongping; Zhang, Junjiao; Li, Yongsheng; Zhang, Hanfei; Dong, Zhihui (2009). [IEEE 2009 International Conference on Environmental Science and Information Application Technology, ESIAT - Wuhan, China (2009.07.4-2009.07.5)] 2009 International Conference on Environmental Science and Information Application Technology - Mechanism Study on N₂O Reduced with Biomass Gas., 2009, 52–56. doi:10.1109/esiata.2009.463.
3. Xiaoxu, Fan; Qi, Xiao; Leizhe, Chu; Dongyan, Guo; Ligu, Yang. [IEEE 2011 International Conference on Consumer Electronics, Communications and Networks (CECNet) - Xianning, China (2011.04.16-2011.04.18)] 2011 International Conference on Consumer Electronics, Communications and Networks (CECNet) - The effect of alkali metal in biomass ash on operation of fluidized gasification, 2011, 5324-5327.
4. N Carvalhais, et al. Global covariation of carbon turnover times with climate in terrestrial ecosystems. *Nature*, 514, 2014, 213-217.
5. Christopher B. Field; J. Elliott Campbell; David B. Lobell. Biomass energy: the scale of the potential resource, 23(2), 2008, 0-72. doi:10.1016/j.tree.2007.12.001.
6. José Goldemberg; Suani Teixeira Coelho. Renewable energy—traditional biomass vs. modern biomass, 32(6), 2004, 711–714. doi:10.1016/s0301-4215(02)00340-3.
7. CL Quere, et al., Ecosystem dynamics based on plankton functional types for global ocean

biogeochemistry models. Glob
Change Biol., 11, 2005, 2016-
2040.

8. Stanislav V. Vassilev; David
Baxter; Lars K. Andersen;
Christina G. Vassileva. An
overview of the chemical
composition of biomass, 89(5),
2010, 913-933.
9. Iliadis, N.A. [IEEE Energy Society
General Meeting (PES) - Calgary,
Canada (2009.07.26-2009.07.30)]
2009 IEEE Power & Energy
Society General Meeting - Biomass
development and potential in South
East Europe, 2009, 1-2.