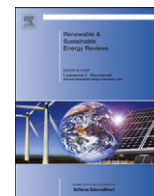




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Biomass energy policies and strategies: Harvesting potential in India and Indonesia

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ABSTRACT

India and Indonesia are privileged with abundant biomass resource potentials, 23 Giga-watt (GW) and 50 GW equivalents respectively, yet both countries harvest small proportions, with fundamentally different deployed policies and articulated strategies. In this regard, this paper focuses on analyzing evolution and deployment of different policies and execution of strategies by two countries. It analyzes the effects of the biomass energy policies and executed strategies in India and Indonesia with a holistic approach. Such an approach takes the policy and strategy of the whole biomass energy sector rather than a segmented and separated sector as biofuel, biogas, biodiesel, etc. Furthermore, how they have resulted in different outcomes is also addressed. Our analysis shows that India's biomass energy policy has evolved from incremental to more radical changes, while Indonesia's policy remains incremental. India has also a relatively more unified biomass energy strategy than Indonesia. India has been more focused on technology development and deployment along with strong institutional creation, whereas Indonesia has not been able to create any biomass sector supporting strong institutions. Therefore, in terms of biomass energy utilizations, India has demonstrated better performance than Indonesia.

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1. Introduction

India and Indonesia (besides China) are the most populated developing countries, with relatively high economic growth. Despite the global economic turnaround since 2009, the gross domestic product (GDP) annual growth rates in India and Indonesia were 6.90% [1] and 6.50% [2] respectively in 2011. This growth is very high in comparison to other world economies. Hence, the energy consumption of both countries also increased significantly. It reached 669 million tonnes of oil equivalent (Mtoe) and 214 Mtoe in India and Indonesia, respectively. Since 2005, energy consumptions in the respective countries have been growing at rates of 4.92% and 3.93% per year [3]. The primary usage of energy in India and Indonesia is still dominated by fossil fuels. India's primary energy consumption in 2009 was mainly shared by coal, 42%, oil, 23%, and natural gas, 7% [3]. Similarly, in Indonesia, the total energy was proportionately supplied by oil, 32%, coal, 19% and natural gas, 18%, in the same year [3]. Moreover, in the near future, the rising demand for energy due to economic growth has to be matched with additional sources of energy. But, in absence of any additional sources, such additional demands could be matched by increased supply of coal in both the countries. However, India's domestic production of coal cannot cope with its increasing energy demand. Therefore, India needs to import coal [4] and acquire coal reserves in different countries. Meanwhile, having sizable coal resources, Indonesia under its policy would increase usage of coal up to 33% of its total energy mix by 2020 [5]. Inevitably, the increased use of coal in both countries will lead to higher green-house gas (GHG) emissions and increase other environmental problems. Therefore, this indicates for exploring other energy resources like renewable energy (biomass and solar) for tackling the above challenges.

India and Indonesia are endowed with abundant biomass resources for increasing additional energy supply. The biomass energy contributes about one-third of their total energy consumption. It was 26% and 27% in India and Indonesia respectively in 2010 [3]. Biomass is a vital energy source for rural households for cooking and heating in India. It is also the most common energy source used by several small-scale industries and independent power plants. The estimates show that 120–150 million metric tons of biomass per year is generated in India by agricultural and forestry residues, which is equivalent to a potential of about 18 Giga-watts (GW) [6]. In addition to this, around 550 sugar mills could also generate about 5 GW additional power [6]. Similarly, most biomass energy in Indonesia is also utilized in households, agriculture, wood and sugar industries, in rural area for cooking, lighting, rice milling, drying agri-produce, and heat and power generation. The Indonesian biomass potential is estimated as equivalent to 50 GW. It consists of 15.45 million cubic meters of forest residues per year, 64 million tons of plantation residues per year, 144.50 t agricultural residue per year, and 11,330 t municipal waste per day [7]. However, it remains under-tapped and underutilized.

Despite the huge potential of biomass in both countries, its utilizations are still in traditional ways (e.g. cooking and lighting

in rural areas). The technologies used are not efficient and environmental friendly. There is also less innovation in its utilization. It shows that biomass is not used in a sustainable way. Therefore, approach of sustainability is missing. For instance, in terms of power generation, biomass is less utilized for supplying electricity for rural households than what is used by sugar and oil palm plantations, and small and medium enterprises. Therefore, power supply from biomass to rural households is a major challenge for government policies and strategies.

In the meantime, the governments of both countries have encouraged policies and executed strategies for the utilization of renewables for energy supply (i.e., biomass) in order to reduce reliance on fossil fuels in the long term, improve efficiency, and reduce GHG emissions. Consequently, it creates sustainability in the energy sector. This needs to be explored since research is lacking on the above aspects of biomass energy issues up to some extent.

So far, literature on biomass energy reflects that research on biomass energy in India and Indonesia have been focused mainly on its utilization for households, small-industries, plantations, small-distributed power generation, and transport separately. Such compartmentalized researches address aspects on biomass energy conversion technology and production like biomass gasification [8–10], biofuel [11], biodiesel [12], and biomass cogeneration [13]. Few researches touch upon the policy context, e.g. prospects, barriers, and policy option of biomass [14–16]. However, research focusing on the effects of the policy and strategy regarding biomass energy with a holistic approach in both countries is missing. The analytical framework here takes the policy and strategy aspects in holistic approach as a whole sector of biomass energy rather than a segmented and separated approach as biodiesel, biofuel, biogas, etc.

Therefore, this review paper focuses on biomass energy policies and strategies in India and Indonesia, in particular by addressing the following issues with a holistic approach: (1) How the potentials of biomass energy resources in both countries are harvested; (2) what are the achievements of deployed policies, and how the strategies were articulated and executed for attaining policy objectives in both countries and (3) which policies and strategies are relatively more effective between the two countries? By addressing these questions, this paper attempts to create an understanding about policy deployment and strategy articulation and their effects in two important developing countries. Although the main focus of the paper is on India and Indonesia, it would be relevant to other developing countries which would be looking to further develop their biomass energy resources.

The paper is organized as follows: Section 2 reviews biomass energy policies deployed by India and Indonesia for the development of biomass energy resources. Section 3 reviews different adopted and deployed strategies in both countries. Section 4 discusses the effects and the achievements of policies and strategies in both countries in the biomass energy sector. Section 5 discusses the relative effectiveness of the policies and strategies in the two countries for harvesting the potential of biomass energy. And finally, Section 6 concludes, with possible scope for future research.

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