

Importance of rural bioenergy for developing countries

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Abstract

Energy resources will play an important role in the world's future. Rural bioenergy is still the predominant form of energy used by people in the less developed countries, and bioenergy from biomass accounts for about 15% of the world's primary energy consumption and about 38% of the primary energy consumption in developing countries. Furthermore, bioenergy often accounts for more than 90% of the total rural energy supplies in some developing countries. Earth life in rural areas of the world has changed dramatically over time. Industrial development in developing countries, coming at a time of low cost plentiful oil supplies, has resulted in greater reliance on the source of rural bioenergy than is true in the developed countries. In developed countries, there is a growing trend towards employing modern technologies and efficient bioenergy conversion using a range of biofuels, which are becoming cost wise competitive with fossil fuels. Currently, much attention has been a major focus on renewable alternatives in the developing countries. Renewable energy can be particularly appropriate for developing countries. In rural areas, particularly in remote locations, transmission and distribution of energy generated from fossil fuels can be difficult and expensive. Producing renewable energy locally can offer a viable alternative. Renewable energy can facilitate economic and social development in communities but only if the projects are intelligently designed and carefully planned with local input and cooperation. Particularly in poor rural areas, the costs of renewable energy projects will absorb a significant part of participants' small incomes. Bio-fuels are important because they replace petroleum fuels. Biomass and biofuels can be used as a substitute for fossil fuels to generate heat, power and/or chemicals. Generally speaking, biofuels are generally considered as offering many benefits, including sustainability, reduction of greenhouse gas emissions, regional development, social structure and agriculture and security of supply.

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1. Introduction

More than half of the world's population living in rural areas still has no access to modern forms of energy. Energy is central to economic development, and there is a clear correlation between energy consumption and living standards. Energy resources will play an important role in the world's future. The energy sources have been split into three categories: fossil fuels, renewable sources and nuclear sources. Table 1 shows the energy reserves of the world, and the world energy consumption is given in Table 2

[1,2]. Worldwide energy consumption has increased 22.6-fold in the last century, and emissions of CO₂, SO₂ and NO_x from fossil fuel combustion are primary causes of atmospheric pollution [3]. The majority of the world's energy needs are supplied through petrochemical sources, coal and natural gases. With the exception of hydroelectricity and nuclear fusion energy, all of these sources are finite, and at current usage rates, will be consumed shortly [4].

The rapid decrease in resources of fossil energy and the accumulation of carbon dioxide and other greenhouse gases in the atmosphere is thought to be at the origin of changes in climate, which are suspected to have dramatic consequences on humans and other living organisms. These changes have led to the development of renewable energy sources, sustainable development and eco-friendly

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Table 1
Energy reserves of the world

Deuterium	Uranium	Coal	Shale oil	Crude oil	Natural gas	Tar sands
7.5×10^9	1.2×10^5	320.0	79.0	37.0	19.6	6.1

Each unit = 1×10^{15} MJ = 1.67×10^{11} Bbl crude oil.

Source: Ref. [1].

Table 2
World energy consumption

Years	1875	1900	1925	1950	1960	1970	1980	1990	2000
Cons. (Gtoe)	0.27	0.43	1.08	1.84	2.97	4.92	6.24	7.76	9.73

Source: Ref. [1,2].

concepts. Crude oils are limited reserves concentrated in certain regions of the world. Known crude oil reserves are estimated to be depleted in less than 50 years at the present rate of consumption [5]. Therefore, countries lacking such resources are facing foreign exchange crisis, mainly due to the import of oil [6]. Countries dependence on imported oil, environmental issues and employment in rural areas are reasons for replacement of fossil fuels by bio-fuels [7].

Renewable alternatives have been considered as sources of different energies and have led to the development of various research programs. The main renewable energy sources are biomass, hydropower, geothermal, wind and solar energies. Fig. 1 shows the percentage share of each renewable energy source in 1995 [8]. Investigations in this direction have been based on the following concepts: (1) renewable energy sources can be replenished in a short period of time; (2) renewable energy is a clean or inexhaustible energy like hydrogen energy; (3) renewable energy sources occur naturally in the environment and, therefore, should never run out; and (4) they also produce lower or negligible

levels of greenhouse gases and other pollutants when compared with the conventional energy sources they replace.

The petroleum crisis in the 1970s and rapidly increasing prices of petroleum leads scientists to work on new and renewable alternative energy sources, so vegetable oil studies become current among various investigations. There are mainly three objectives of energy policy, namely security of supply, competitiveness of the energy industry and environmental protection. Energy produced through centralized thermal, hydroelectric and nuclear power stations rarely flows to rural areas but has seen considerable progress in the most developed countries. Earth life in rural areas of the world has changed dramatically over time. Industrial development in developing countries, coming at a time of low cost plentiful oil supplies, has resulted in greater reliance on the source of rural bioenergy than is true in the developed countries. In developed countries, there is a growing trend towards employing modern technologies and efficient bioenergy conversion using a range of biofuels, which are becoming cost wise competitive with fossil fuels [9]. Interest in renewable energies has increased recently due to environmental concerns about global warming and air quality, a decline in the cost of the technologies for renewable energy and improved efficiency and reliability.

Energy is central to current concerns, which is not an end in itself, but rather the means to achieve the goal of sustainable human development [10]. Every nation in the world has access to some form of renewable energy. Interest in harnessing this resource has been sparked by the central role of energy in development, which was highlighted during a decade of rapid escalation of world oil prices [11]. The diversification of kinds and sources of primary fuel is becoming vital energy issues in developing countries. In this regard, biomass energy like biodiesel and bio-oil fuels is, thus, becoming attractive due to environmental and energy policies for promoting sustainable development and environmental pollution mitigation in developing countries [12].

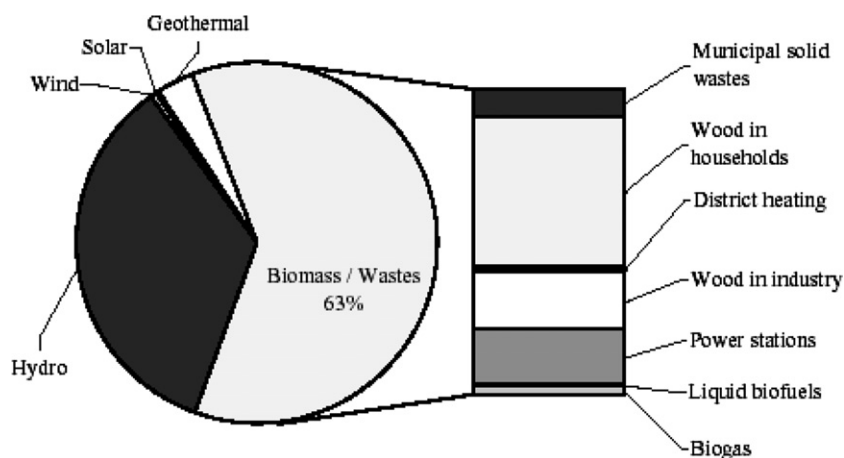


Fig. 1. Percentage share of each renewable energy source in 1995. Source: Ref. [7].

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