

Renewable Energy Resources and Their Importance in Rural Areas in Turkey

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Abstract: Turkey is a net importer of energy and its imports continue to grow. As fossil fuel energy becomes scarcer, Turkey will likely face higher energy prices, energy disruptions, and greater energy insecurity within the next few decades unless important steps and measures towards alternative energy supplies, conservation, and proactive government policies are taken. Turkey has substantial renewable energy potential. Primary renewable energy resources in Turkey are hydro, biomass, wind, geothermal and solar. Turkey has several advantages to utilize renewable energy sources, but the potential benefits of renewable sources are not fully realized. Investments in renewable energy sources will not only reduce energy costs to rural consumers but they will also create new job opportunities for rural populations. Rural area households and industries in developing countries suffer greatly from energy scarcity. Energy, an essential need for every individual and for economic development, has always been lacking in rural areas of developing countries. The income of these rural populations depends largely on farming. Energy is needed primarily for pumping water for agriculture and domestic activities. Most of the energy needs in rural areas are met with traditional biomass for household cooking and heating, and human animal power for agriculture. Energy efficiency and production on the farm are important components for agriculture sustainability. This paper analyzes the potential of renewable energy sources and examines the negative effects of energy insufficiency in rural areas.

Keywords: Renewable energy, rural areas, sustainability, Turkey.

1. INTRODUCTION

Energy is an important input for the provision of basic human needs and services such as cooking, water supply, lighting, health services, communication and education. It is also an essential input for the enhancement of rural production and food security, through land preparation, fertilization, irrigation, agro-processing, conservation and transport. In many rural areas of developing countries, energy needs are, at present, predominantly supplied in the form of traditional biomass fuels, human and animal labor. The current circumstances prevent people living in rural areas from improving their agricultural productivity and overall quality of life [1].

Today, there are 1.4 billion people around the world who do not have access to electricity, with around 85% from rural areas. Without additional dedicated policies, by 2030 the number of people drops, but only to 1.2 billion. The number of people who rely on the traditional use of biomass as a primary energy source today (2.7 billion) is expected to reach 2.8 billion by 2030 [2].

Turkey is a developing country with an annual population growth rate of 1.3%, and it is estimated that

Turkey's population will reach 83.4 million by 2022 [3]. Based on the population growth rate, Turkey's total energy demand is increasing rapidly. In 2000, the country's total energy demand was 77.6 million TOE/year, which reached 108.2 million TOE/year within the next decade [4]. Turkey is still an energy importing country and its energy consumption is met by imports which continue to grow each year. As fossil fuel energy becomes scarcer, Turkey can face energy shortages, higher energy prices, and energy insecurity within the next few decades if important steps and measures towards energy savings, alternative energy use, and government policies are not taken in time. Since 2000, Turkish government has been trying to support private sector to invest in renewable energy, but it is not enough.

Turkey has substantial renewable energy resource potentials. Main renewable energy resources in Turkey are hydro, biomass, wind, geothermal and solar. The country also holds 8% of the potential geothermal energy in the world. Turkey has several advantages to utilize renewable energy sources, but the potential benefits of renewable sources are not fully realized. Investments in renewable energy sources will not only reduce energy costs to rural consumers but they will also create new job opportunities for rural populations. Rural areas in developing countries suffer significantly from energy scarcity. Energy, an essential need for every individual and for economic development, has

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always been particularly lacking in rural areas of developing countries. The income of a rural population depends largely on farming. Energy is used primarily for households (mainly cooking) and other domestic uses plus pumping water for agriculture. Most of the energy needs in rural areas are met with traditional biomass for household uses, and human and animal power for agriculture.

This document analyzes the potential of renewable energy sources and examines the negative effects of energy insufficiency in rural areas in Turkey.

2. RENEWABLE ENERGY SOURCES IN TURKEY

Turkey has a favorable climate and environment, with substantial reserves of renewable energy sources to meet increasing energy demands. These energy sources are the second largest domestic energy source after petroleum. Main renewable energy resources in Turkey are hydro, biomass, wind, geothermal and solar.

Historically, hydropower is considered as the most important renewable energy source in Turkey. And currently it is the second largest domestic energy source after coal. Turkey's gross annual hydroelectric potential was estimated to be of 433,000 GWh. This is around 14.0% of Europe's and 1.0% of the world's total hydropower capacity [5]. Turkey has the highest hydropower potential in Europe with its 216 TWh/yr technical hydropower energy. Turkey uses 18.3% (39.6 TWh) of this technical hydropower potential for the year 2005. European countries on the other hand, make use of their economically feasible hydropower potential much more efficiently, within the range of 65 to 100% [6]. The economically feasible hydropower potential of Turkey has shown an upward trend in the last decades. For the year 2006, Turkey has a total hydropower potential of 36,750MW. 35% of this potential has been harnessed and 9% is under construction. Furthermore, 573 hydropower plants with a total capacity of 20,765MW have been planned [6]. In 2013, the renewable energy share in electricity production was 29% of the total production and 40% of the installed capacity. Hydropower, which supplies nearly 25.0% of Turkey's electricity requirement, is the primary renewable energy source in the country [7].

Agricultural and forest residues, as well as purpose-grown energy crops, are potential energy resources. Homegrown energy sources will reduce dependence on oil to a considerable extent and thus oil imports will

be decreased [8]. Fuel wood and animal waste are the main biomass fuels used for heating and cooking in many urban and rural areas. Total biomass production was 7.3 Mtoe in 2005 and is expected to be 52.5 Mtoe in 2030. This estimate is based on the recoverable energy potential from agricultural residues, livestock farming wastes, forestry and wood processing residues and municipal wastes.

Turkey's technical wind energy potential is 88,000MW but the current wind energy potential that is economically viable is 10,000MW. The country been classified into six different wind regions with a low of about 3.5m/s and a high of 5m/s at 10m altitude, which corresponds to a theoretical power production of between 1,000 and 3,000kWh/(m²yr). The most attractive wind energy sites are the Marmara Sea region, the Mediterranean Coast, the Aegean Sea Coast.

Turkey is ranked as the seventh richest country in the world in terms of its geothermal potential for electricity generation and direct use of this energy [9]. After China, Japan, USA and Iceland, it is the fifth biggest country using geothermal energy for hot spring and heating purposes [10]. Unlike the rest of the world, the utilization of heat pumps and development of enhanced geothermal systems has not gained any footage in Turkey. Heat pump utilization is very limited due to its high capital costs. But greenhouse heating looks very profitable. The cost of constructing a 10 ha greenhouse which will pay for itself in two years is estimated to be 5 million dollars [11]. 55% of the geothermal areas in Turkey are suitable for heating practices. In Turkey, a total of 120 ha greenhouses and 100,000 houses in 15 different settlements are heated with geothermal energy [12].

Turkey lies in a sunny belt between 36N and 42N latitudes. The yearly average solar radiation is 3.6kWh/m²-day and the total yearly radiation period is approximately 2640h, sufficient for solar thermal applications. Despite this huge potential, flat-plate solar collectors for domestic hot water production in coastal regions are the only real use of solar energy. Clearly, both photovoltaic and solar-thermal systems could be used to great effect. Use of solar thermal is already widespread. Turkey's total solar energy potential is 35 Mtoe per year and solar energy production is expected to reach 1,119 kilo tonnes of oil equivalent (Ktoe) in 2020.

Table 1: Primary Production of Renewable Energy (Thousand Toe)

2003	2013	Share of Total, 2013 (%)				
		Solar	Biomass and Waste	Geothermal	Hydropower	Wind
10.021	13.718	5.8	33.0	19.2	37.2	4.7

Source: [13].

The share of renewable energy supply by biomass and wastes, hydro energy, geothermal energy, solar and wind energy are 33.0%, 37.2%, 19.2%, 5.8% and 4.7% respectively with a total of 12.6% in the total energy demand (Table 1).

3. IMPORTANCE OF ENERGY

Energy is an important component of almost any activity in our life. The IEA presented a three-step definition that helps to clarify an evolution in access to energy services, starting from the case of full deprivation. At the first level, energy is needed for basic human needs: lighting, health, education, communication and community services. Then, energy is needed for productive uses that include modern fuels and other energy services to improve productivity, such as in agriculture, water pumping for irrigation, fertilizer, mechanized tilling and in commercial uses of agricultural processing, cottage industry and transport, and fuel. At a third level, energy is needed for modern society needs of domestic appliances, increased requirements for cooling and heating (space and water), and private transportation [14].

4. LACK OF ENERGY IN RURAL AREAS

In Turkey, approximately 4 million farm holdings, the majority of them small and over-fragmented, in rural areas are mainly involved in agriculture. Their main information source is public extension service.

In developing countries, rural people use biomass such as wood or dung as their primary source of cooking and heating. Usually young girls and women carry cow dung and collect wood in the bushes and carry them back to home. This is a hard work and they spend too many hours in the bushes to collect wood. In developing countries, women spend two to nine hours every day for fuel collection and cooking chores [15].

The World Health Organization estimates that 1.6 billion people die from the adverse affect of indoor air pollution each year, or one person every 20seconds.

Billions of people, nearly half of the global population, have to depend on wood, dung, agricultural residues and coal to meet their cooking and heating needs, which they mostly burn indoors over open fires and stoves. The smoke has no place to escape, and women and children are usually trapped with it while meals cook [16].

Agricultural activities such as tilling, irrigation and processing also need energy. Instead of using human labor or draft animals for these activities, energy can be used if it can be supplied in a cost effective way.

The case study was conducted in India about promoting biogas engines and the study shows that although the technology was economic from the viewpoint of society, it was not adopted by farmers on a large scale due to the unfavorable macro environments created by the government and because of an inappropriate pricing policy by the manufacturer [17]. Extension can help farmers delivering information with emphasizing the economic feasibility of renewable resources. Different research centers, offices and universities have several resources about renewable energy and these resources and information should be gathered by extension service and should be delivered to farmers by extension personnel. Before disseminating the new technology, first all farmers should be informed about the availability, pros/cons of renewable energy resources and what they can do with these technology. Demonstration of renewable energy supplies at these research centers could be key to getting more widespread adoption and greater economic growth across Turkey.

Renewable energy technologies create income generating activities for male landless and marginal farmers and for women from such households, while reducing environmental problems, like deforestation and indoor air pollution from cooking with poor-quality fuels. Because of the high capital costs of renewable energy technologies, in Bangladesh, the model proposes an extension of the well-known micro-credit approach developed by such NGOs as the Grameen

Bank and BRAC. With the assistance of an External Agency composed of NGO, business, government and university representatives, such groups of villagers would form Village Organizations, comprising cooperatives or other forms of business, borrow money from a bank or large NGO, and purchase a renewable energy technology based on biogas, solar or wind, depending upon location for women from such households, while reducing environmental problems, like deforestation and indoor air pollution from cooking with poor-quality fuels [18].

Improvements in energy efficiency and renewable energy use can reduce farm operating costs and reduce greenhouse gas (GHG) emissions. 224 farmer opinions were gathered from a mail survey to assess use and interest in energy efficient and renewable energy options on farms in Nova Scotia, Canada. Energy efficiency options used the most were behavior, insulation, and lighting. Few farms used renewable energy options. Approximately 78% of farmers indicated an interest in implementing energy efficiency and renewable energy options. Interest varied by farm type and size. Interest increased with farm size. The two main efficiency options of interest were lighting (60.8%) and insulation (43.7%), while wind power development (55.5%) and solar water heating (24.5%) were the main renewable options of interest. Farmers concerned about power and equipment reliability were less likely to be interested in implementing options. Farmers concerned about the environment were more likely to be interested in implementing options. Current use of certain energy efficiency technologies, such as efficient lighting, influenced implementation interest [19]. Extension can help farmers supporting adoption and use of wind, solar, biomass and geothermal energy systems by providing information. Such as, farmers can use solar space heating systems in livestock, dairy and also other agricultural activities.

Extension service can create educational strategies, materials and provide training to support farmers about production of bio-energy in the form of biogas, biodiesel, ethanol, etc. on research-based knowledge to improve the lives of farmers in the rural areas. Because alternative energy is quite capital intensive, the need to understand how to calculate the rate of return to an alternative energy investment over time is essential. Thus, basic business planning skills will be an important component of an agricultural extension outreach program.

5. CONCLUSION AND DISCUSSION

Renewable energy can play an important role as Turkey's preparations for accession to the European Union are underway. In the agricultural arena, cross compliance (part of EU Common Agricultural Policy) dictates the allowable ratio of grassland to agricultural land, and has an important influence on the types of biofuels to be supported [20].

Another aspect impeding the growth of certain renewable power technologies is the high capital cost, which can be addressed with feasible financial options, direct subsidies or tax exemptions [21]. Relying only on market incentives to invest in renewable energy will bring about less investment than is socially optimal, due to the externality of pollution ills generated from traditional biofuels.

Agricultural extension and education in Turkey should examine renewable energy for the benefits it offers small farmers and women.

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