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BIOMASS RESOURCES AND ITS POTENTIAL USE AS ENERGY SOURCES IN TURKEY

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Abstract

Due to economic growth, urbanization, population increase, energy use and demand increase around the world. Therefore, meeting energy demand is one of the most important issues of the countries. Today, many countries are dependent on energy sources from abroad. Hence, Turkey also exports natural gas and oil to meet energy demand as well. Therefore, objective of this study is to explain and discuss advantages and disadvantages of using wood based energy sources to meet energy demand of Turkey. Turkey has some international obligations for reducing carbon emissions and has to increase use of national energy resources. If these policies are applied in country scale, international obligations will be executed; employment will be increased and dependent on foreign energy resources will decrease by exporting less oil and natural gas. Due to these strategies, it is believed that country's forest resources will be managed more efficiently and productively.

Results showed that Turkey has some potential and capacity in terms of using wood based energy sources. If wood based energy sources are used, about 2-3% of country's total energy demand will be supplied. In contrary, wood based material use for energy decrease amount of raw material supply fore forest industry.

Key words: *biomass resources; forest policy; forest resources; wood; Turkey.*

INTRODUCTION

Fossil fuels are the most commonly used resources to meet humanity's energy needs. Their excessive consumption is now being regarded as the root cause of several problems facing the world today. Moreover, factors such as concerns to secure firm energy, the goal to minimize energy import dependency, rising energy prices, financial crises and their economic and social consequences have led governments to seek for and to utilize alternative energy sources. Furthermore, emissions and waste resulting from undue use of fossil fuels to meet industrial, agricultural and urban needs have begun to threaten the natural habitat and to disturb the ecological balance. While providing energy for modern societies, the fuels in question also took center stage in the global warming debate. In this regard, improvement and pervasiveness of new and renewable energy sources are starting to be included among imperative goals within the scope of national sustainable development strategies around the world (Bacak et al. 2009).

Besides aforementioned complications, taking the volume of investments made in the energy efficiency sector and other recent developments into consideration, forecasts brought forward by numerous institutions suggest that energy requirement will double by 2020. The most significant indicator of this is the consistent upsurge in energy consumption on a daily basis (Bilgen et al. 2008; Barış and Küçükali 2012; Cambero and Sowlati 2014). Other indicators include economic expansion, rapid urbanization, population growth, increasing societal demands and the need for more energy in response to such demands. Subsequently, this periodic rise in demand leads to an increase in fossil fuel consumption.

In Turkey, as well, it is being projected that there will be a rise in demand for energy in the upcoming years. Turkey's young population, rapidly growing economy, ongoing industrial investments and per capita electricity consumption which remains below world average come forward as indicators of the expected increase in energy demand (Çağatay et al. 2010; Yılmaz 2012).

In Turkey, work and processes related to the energy sector fall within the domain of the Ministry of Energy and Natural Resources (ETKB). In this regard, as ETKB statistics (2012) suggest, while Turkey's Total Primary Energy Supply (TPES) in 2011 totalled 114.5 million tonnes of oil equivalent (toe), this figure increased to 119.5 million toe in 2012. The distribution of TPES is observed to be as follows: 34.4% coal, lignite and other solid fuels (i.e., wood, asphaltite, animal and plant waste), 32.2% natural gas, 26.6% petroleum, 3.9% hydraulic power, 2.8% wind and other sources (i.e., solar and geothermal) (Demirtaş, 2013). Additionally, studies conducted by ETKB predicts that Turkey's energy demand will demonstrate an annual increase of 6.5 to 7.5% until 2021 (ETKB 2012). These projections indicate that Turkey is a country with a consistently rising demand for

energy and that meeting this demand plays an important role in achieving her economic and development goals.

Moreover, in Turkey, forward-looking strategies for the energy sector have been defined by "The Declaration of Strategies concerning Market for Electrical Energy and Security of Supply" in 2009. These essential strategies include (WWF 2011; ETKB 2012):

- ✓ All known lignite and coal resources are to start being exploited by 2023; coal fields are to be capitalized on through implementation of electricity production projects,
- ✓ The share of nuclear power plants in total electricity production is to be increased to 5% by 2023,
- ✓ All technically and economically feasible hydroelectric energy potential is to be made available for consumption by 2023,
- ✓ Wind power capacity is to be set up to 20,000 MW by 2023,
- ✓ The 600 MW of geothermal energy potential declared as suitable for electricity production is to be processed in its entirety,
- ✓ Technological advancements are to be followed in order to ensure maximum use of solar energy potential,
- ✓ In response to other resources put into use, the share of natural gas in electricity production is to be reduced to 30%.

It has been calculated that a total of USD 130 billion in investments is required by 2023 in order to reach these intended targets; increasing the share of domestic participation rate in sectoral investments has also been listed as one of the target areas mentioned in the Declaration of Strategies (Demirtaş 2013). As evidenced by the above-listed strategies, no considerable strategy aiming to increase investments in renewable energy sources can be pinpointed. However, the use of domestic resources, which requires government backing in its early stages, is a particularly significant alternative for energy-importing countries like Turkey.

This study aims to explore the advantages and disadvantages of using wood-based energy, which is included among renewable energy sources in Turkey. The employed approach will proceed under the assumption that wood-based energy, with regards to electrical energy production, has the potential to play an instrumental role in economic development. In addition, the known disadvantages of wood-based energy production in terms of carbon emissions when compared to other sources of renewable energy and consequent questions regarding its efficiency as a means of alternative energy production will also be discussed under this study. Moreover, this study also encompasses a discussion on how compatible forestry policies and energy policies are with regards to expanding the use of wood as a source of energy.

ELECTRICITY PRODUCTION AND RELATED POLICIES IN TURKEY

Looking at Turkey's electrical energy production in terms of resources used, one sees that natural gas holds the highest share by 43.8%. It is followed by hydraulic (24.8%), lignite (12.6%), imported coal (12.2%), wind (3.1%), fuel oil (1.6%), coal (0.7%), geothermal (0.5%), asphaltite (0.3%), and other sources (0.4%) respectively. As evidenced by this list, petroleum-based resources are used as primary sources of energy to meet the electrical energy demand (ETKB 2012). Furthermore, natural gas –the most significant supply—is imported; thus increasing energy import dependency.

Established policy targets focusing on other functional resources and alternative sources of energy included among policies aiming to realign the above-mentioned ranking with national interests are as follows:

1- To put all lignite and coal reserves into use for electrical energy production by 2023,

2- To ensure that all technically and economically feasible hydroelectric potential is used for electrical energy production by 2023,

3- To increase wind power set-up capacity to 20,000 MW by 2023.

Among these recent policies defined above, there is no specific policy focusing on the use of wood in energy production. In the context of putting domestic and renewable sources of energy into use, it is necessary to take wood into consideration.

In Turkey, as is the case around the world, growing population and industrialization lead to an upsurge in demand for energy along with which arises the idea of using sources of energy that are less harmful to the environment. In this sense, to meet energy demands, biomass energy stands out as one of the sources that does not pollute the environment and can be supplied on a sustainable basis. Biomass energy is also favored as a noteworthy source of energy due to its potential to assist social and economic progress particularly in rural areas (Durak 2003; Topal and Arslan 2008).

Biomass has been converted into energy, mainly for heating and cooking purposes, since ancient times (Demirbaş 2000; Demirbaş 2009). In Turkey, as well, it has been used for ages particularly in rural areas. As is the case in Turkey, biomass can be transferred to generate electrical energy once the energy quality is augmented either by burning or via various physical processes (Şen 2006). As previously mentioned; biomass, in traditional terms, has been a source of energy known and utilized since the invention of fire. The use of biomass, in contemporary terms, has occurred in the 21st century. In contemporary applications, biomass energy is converted into sources of energy such as biogas, bioethanol, biodiesel, biomethanol, bio-dimethyl ether, and biocrude (Haykiri-Acma and Yaman 2010; Demirbaş 2009; Akova 2008; Öğüt 2007).

ETKB has projected conventional biomass energy generation via wood in addition to animal and plant waste to be at a minimum of 243 million tonnes of oil equivalent (Mtoe) and a maximum of 561 Mtoe by 2020. With regards to modern biomass production, which has been initiated with 17 thousand tonnes of oil equivalent (Ktoe) in 2000, no projection has been specified (Atılgan 2000; State Planning Organization (DPT) 2001). One of the provisions concerning wood-based electrical energy generation is related to the production of sources of supply. In this sense, the concept of "energy forest" arises. Energy forestry is defined as the constitution of forests via forestation by means of proliferous species, particularly in wood-barren forest areas. In this regard, limiting forest administration terms to short periods is of crucial importance. Adaptation of a forestry policy of this sort, which promotes diverse production in unused areas, will not only generate raw material to meet the demand for energy production but will also prevent a raw material quagmire for the forest industry.

THE ROLE OF WOOD IN ELECTRICITY PRODUCTION AND FUTURE SCENARIOS

Considering that oil and natural gas reserves will be depleted approximately within the next 60 years, developed countries are making substantial investments in renewable energy. Interest in biomass –the only environmentally-friendly, domestic and clean source of renewable energy that can reduce CO2, which is a major contributor to global climate change—has been growing rapidly (Demirbaş 2001).

As of 1978 until 2008, the Ministry of Forest and Water Management had constituted energy forests on 620,000 hectares of land through conventional energy forestry projects in degraded oak forests. Until recently, forests in Turkey were administered as groves and coppice forests. As a decision made by the Ministry of Forest and Water Management requires, coppice forests have started to be converted into groves. Until recently in Turkey, conventional energy forestry was generally practiced with an objective to turn coppice forests into fertile ground through revitalization logging in degraded oak coppice forests while sapling planting activities were carried out concurrently. Within this scope, Turkey has a potential of 4 to 4.5 million hectares of forest area that can be put into use for electrical energy production (General Directorate of Forestry (OGM) 2014).

Turkey's annual biomass potential is nearly 32 Mtoe. Her total usable bioenergy potential is estimated to be close to 17.2 Mtoe. Studies conducted by Demirbaş (2001), Demirbaş (2008) and Gölçöl et al. (2009) examining the potential possessed by Turkey put forth annual biomass values based on sources of biomass and values of the corresponding energy generated (Table 1).

Table 1

Turkey's biomass potential and its corresponding energy supply

Source of Biomass	Annual Biomass Value (million tonnes)	Energy Value (Mtoe)
Annual plants	55	14,9
Perennial plants	16	4,1
Forest waste	18	5,4
Agricultural waste	10	3,0
Wood industry waste	6	1,8
Animal waste	7	1,5
Other	5	1,3
Total	117	32,0

Source: Demirbaş 2001; Demirbaş 2008; Gölçöl et al. 2009

When sources of biomass procurement in Turkey's forests are observed, one notices that supplies can be obtained from areas and fields where activities such as density maintenance, stand maintenance, seed coat cleaning take place; through logging practices carried out for maintenance and cleaning purposes within the scope of Project for the Rehabilitation of Burnt Areas and Establishment of Fire-Resistant Forests (YARDOP); from all sorts of barks and cones, maquis

shrublands in the Mediterranean, Aegean and Marmara regions; from areas covered in rhododendron and similar species in the Black Sea region (OGM 2009; Saraçoğlu 2010; Bayır 2010). Evidently, Turkey is a country with high potential for generating energy from wood. Hence, taking advantage of this potential will be a step forward towards eliminating energy import dependency.

Saraçoğlu (2008) states that the use of biomass in Turkey is met with significant institutional, legal and administrative obstacles and, he lists these as follows:

- Failure to inaugurate an organizational body that is accountable for ensuring a high level of coordination and collaboration among establishments, agencies, institutions and other stakeholders,
- Absence of sufficient records on present and future costs associated with the use of biomass,
- Lack of adequate databanks providing information on Turkey's sources of biomass energy,
- Particularly small-sized projects' inaccessibility to credit opportunities,
- Institutional obstacles that cause delays for foreign investors,
- Need for regulations that will solve infrastructural and operational problems in a legal context,
- Unsatisfactory participation rate of the private sector,
- Technically apt workforce requirement,
- Possible challenges that might occur during planning, project executability survey and project control phases,
- Meagreness of political and market apparatuses in environment, agriculture and energy sectors,
- Securing societal acceptance and demand.

Despite the above-mentioned obstacles, there are several benefits generating energy from wood will provide for Turkey. In this sense, another fact that also needs to be acknowledged is that forests' carbon sequestration ability cannot be matched by any other resource. Thus, the priority should be to protect the extant forests and to increase their presence. This is the primary goal of Turkey's forestry policy as well. With regards to producing energy from forests, attempts made towards energy forestry are insufficient and these attempts should be accelerated by introducing new incentives (Çağlar 2007; Yıldırım and Ünsal 2013). Furthermore, in the World, in Europe and in Turkey renewable technologies are projected to hold a significant share in tomorrow's energy market. In this regard, particularly investments towards constituting new forests become significant (Durak 2003; Çapik et al. 2012). Economically speaking, in order for these attempts that will provide benefits in the future to become prevalent throughout Turkey, sectoral investments and incentives introduced to encourage such investments are of vital importance.

RESULTS AND DISCUSSION

Financial crises are among major difficulties facing investors standing in the way of expanding production facilities. Economic downturns in Turkey have a negative effect on all investments. However, particularly in the case of electricity, in order to meet domestic demand safely, resource allocation policies must be aptly stipulated and resources must be properly managed. In the meantime, installation of a firm backup system for electricity and abiding by the policies established to attain supply security are also matters of essential magnitude.

In Turkey, biomass energy is generally consumed through conventional methods. Despite showing great potential as a source of energy, modern biomass production methods are presently at very low levels. Gençoğlu (2002) emphasizes the need for initiatives, particularly targeting rural communities, which aim to raise awareness on the significance of biomass energy and to encourage its use via modern methods. In sectors such as electricity production, which allow for the use of a variety of raw materials, Turkey's domestic and renewable sources of energy are at sufficient levels to meet the current demand (Saraçoğlu 2010). Provided that appropriate policies are promoted, energy import dependency in the case of electricity can be systematically reduced on an annual basis.

Similar to the practises in EU member states, as an overall tribute to the importance attached to renewable sources of energy, along with production incentives, tax exemption policies and financial incentives should also be employed as instruments to encourage investments.

In this respect; Karayılmazlar et al. (2011) regard the matter of generating electricity, heating, pellet and eventually biopetrol from forest-derived biomass as the key to maintaining Turkey in accord with both national and international energy policies and to ensuring regulatory integration with the EU; and as the most effective solution to problems caused by global warming. Subsequently, solutions that will attain significant improvements in solving all varieties of air pollution problems while providing the industry with augmented competitive advantage in national and international markets are required. This is only possible via a collaboration between the industry and academia.

In conclusion; when commercial electricity production is considered, it becomes evident that forest-derived biomass capacity is inadequate for high-capacity thermal power plants and other kinds of power plants. In this regard, energy production from forest biomass should not be considered in high capacities; biomass fuel should be accepted as a reinforcing supplemental fuel. Furthermore, the way should be paved for small-sized investments and as a matter of national interests, its consumption in rural areas should be extended.

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