

## The Solutions, Policies and Actions of Renewable Energy Uses in Turkey

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**Abstract.** Energy efficiency is main concern of human being in the world. Renewable energy technologies have been current issues in last decade. Sustainable cities and zero carbon environments is the big picture of energy uses. Universities and research institutions study on energy efficiency of industries, houses, and cities. Municipalities in Turkey are the main customers of renewable energy technologies. Material recycling, building, environment, and food-drink are four main components of the energy technologies. Energy production from material recycling, green buildings, zero emission of environment, and ecological food are new development related with renewable energy or environmental concern. Planners have been focusing on Environment respect of planning where they used to take into consideration Economics accepts of planning. Production requires Environmental and Economic efficiently. Implementation of new renewable energy technologies is still blocked by high cost of the technologies. Investors, operators, local governments, and city planners have to work on decreasing the cost. The objective of this study is to review literature of renewable energy conferences hold in 2011 in Turkey in order to determinate recent structure or circumstances of Renewable Energy Uses in Turkey. In this study, Turkey's existing condition and more effective use its potential renewable resources have been investigated. And some proposals are presented in order to solve Turkey's energy problem.

**Keywords:** renewable energies, Turkey renewable energy policies, renewable energy resources

### 1. Introduction

The accounts of fossil, renewable and nuclear energy resources within world total energy production are 87%, 6% and 7%, respectively. World total electricity obtained from fossil is about 64.5% (38.7% from coal, 18.3% from natural gas and 7.5% from oil). It is estimated that in next 30 years, total world energy requirement of 88% will be met by fossil resources (Bayraç, 2011).

According to 2007 records, United States is the most developed nation with 23.9% of oil consumption out of total world consumption. However, total share of the world oil consumption for China, India and Turkey was only 13.4% in the year 2007 with China 9.3%, Indian 3.3% and Turkey 0.8%. Many experts stated that oil price changes and shocks have direct or indirect effect on the economic activity. Mehmet (2009) reported that increase in oil prices leads to an increase of cost of production which adversely affect growth of output and productivity. The increase in oil price leads to increase in demand of money, increase in inflation rate, and decrease in investment.

The gap between energy supply and demand is the key element of Turkey's energy policy. Energy is an important factor influencing Turkey's foreign policy. Russia has traditionally been Turkey's largest gas supplier. Turkey's foreign policy objectives are defined by its history, geography, and international interests. Turkey is not only a significant energy consumer but also emerging as a key energy distributor, especially

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for Europe. Turkey will enable the European countries to diversify and secure their energy supply. Promoting renewable energy will create regional stability, security and prosperity of Turkey's foreign policy.

In present, 46% of total world oil is very important interest for the interregional trade and it will be reached up 63% in the year 2030. The production of natural gas will increase and the amount of natural gas transport will increase from 15% to 26% in year 2030.

Due to the high production, easy consumption, as well as safe heating materials, coal, one of the fossil resources is very widely used in the world. In present, about 25% of global energy requirement is obtained from coal resources, but it is accepted as a local heating material for the global trade markets (Bayraç, 2011).

In examine the energy profile of Turkey, it is obviously seen that renewable energy resources are vital important. On the other hand, use of those resources such as solar and wind are very little even lower than 1%. Turkey is an energy importing country and more than half of the energy requirement has been imported. The consumption rate of energy resources in Turkey are 39% of oil, 27% of natural gas, 27% of coal, and 13% of renewable energy resources. The rate of import in energy consumption is about 70%. Turkey is highly dependent to the foreign countries in energy issue for instance 65% of natural gas has imported from Russian Federation (Bayraç, 2011).

Use of natural gas has been growing rapidly in Turkey. On the other hand, Turkey, with its young population and growing energy demand, its fast growing urbanization, and its economic development, has been one of the fast growing power markets of the world for the last two decades. Oil has the biggest share in total primary energy consumption. Table 1 shows the amount of fossil energy resources in Turkey.

Table 1. Fossil energy resources in Turkey (Koyun, 2007)

Sources	Apparent	Probable	Possible	Total
Hard coal (million tons)	428	449	249	1126
Lignite (million tons)	7339	626	110	8075
Asphaltite (million tons)	45	29	8	82
Bituminous schist (million tons)	555	1086	269	1641
Oil (million tons)	36	—	—	36
Natural gas (billion m <sup>3</sup> )	8,8	—	—	8

Like other industrializing countries, energy related environmental problems are growing fastly in Turkey. Table 2 shows Renewable energy potential of Turkey.

In Turkey, electricity is produced by thermal power plants, consuming coal, lignite, natural gas, fuel oil and geothermal energy, and hydropower plants.

Table 2. Renewable energy potential of Turkey (Koyun, 2007)

Energy type	Usage purpose	Natural capacity	Technical	Economical
Solar energy	Electric (billion kWh)	977.000	6.105	305
	Thermal (mtoe)	80.000	500	25
Hydro power	Electric (billion kWh)	430	215	124.5
Wind	Direct energy (land)	Electric (billion kWh)	400	110
	Direct energy (off shore)	Electric (billion kWh)	—	180
Wave energy	Wave energy	(billion kWh)	150	18
	Geothermal energy	Electric (10 <sup>9</sup> kWh)	—	—
Biomass energy	Thermal (mtoe)	31.500	7.500	2.843
	Total (mtoe)	120	50	32

Industrialization has been emerging searching new source of renewable energy in last decade. The mechanisms of renewable energy markets are strengthened with international organization supports. The increase in renewable energy demand in the world has been taken priority by research and development. Turkey has been preparing for 2023 which the universal of Turkish Republic. The perspective of the energy

and natural resources policy of Turkey has prepared as Strategic Plan for energy policy. Renewable energy considered as national priorities of Turkey. The production and distribution of renewable energy accepted research priorities since the greenhouse gas emissions out of the energy production and consumption are considered as the main reason for the climatic change caused by human beings. The geostrategic position of Turkey and various rich renewable energy resources offered advantages for renewable energy. The high rate of import dependence in terms of primary energy resource and high amounts of financial resource need renewable energy resource brings research and development studies very important for Turkey.

The aim of this paper is to evaluate present renewable energy potential of Turkey as well as recommend some practical solutions for sustainable energy uses.

## **2. Renewable energy use in Turkey Agriculture**

As mentioned above, renewable energy includes energy from the sun, earth and wind. Most renewable energy comes either directly or indirectly from the sun.

Sunlight intercepted by the earth provides renewable solar energy that can be used to generate electricity, provide heat and light. The sun's heat also drives the earth's winds. The earth's rotation and topography combine to produce predictable wind patterns that can be used by large wind turbines to generate electricity. Biomass is defined as any plant or animal matter used to produce electricity, heat or transportation fuels.

When we analyze the situation with respect to Turkey, Turkey's renewable energy sources are plentiful and extensive and represent the second-largest domestic energy source after coal. Primary renewable energy resources in Turkey are: hydro, biomass, wind, biogas, geothermal and solar.

Similar to other industrializing countries, with the increases in energy consumption and economical growth, energy related environmental problems are rapidly growing in Turkey.

Turkey is a rich country from the point of variety and potential of renewable energy resources. It has the 8 % of the geothermal energy potential in the world which does not exist in most countries. In addition, the solar energy is abundant due to its geographical place in the world. Turkey is also one of the countries in the world with has a high amount of hydro energy potential. Wind energy potential in Turkey is estimated as 160 TWh. As well known, cost of these renewable energy resources is not high (Gençoglu, 2004)

The benefit from greater exploitation of these sources would be enormous: (i) reduced reliance on imported fuels (increased energy security); (ii) decreased environmental impact compared to fossil fuel and nuclear power plants (i.e. no greenhouse gas emissions (except biomass and biogas) or toxic waste); (iii) competitive costs (which are still decreasing) compared to many conventional technologies; and (iv) no fuel costs (except biomass and biogas) and virtually inexhaustible fuel sources (Guner Law Office, 2008).

In recent years, we have seen large fluctuations in the cost of natural gas, oil, and electricity due to global economics, market deregulation, and political events in some parts of the world. Renewable energy is not subject to sharp price changes because it comes from sources such as sunshine, flowing water, wind, and biological waste, all of which are free. This gives people greater certainty about the cost of energy, which is good for society and the economy. By comparison, fossil fuels are limited in their supply, and their price will increase as they become scarcer. Turkey's demand for energy and electricity is increasing rapidly and heavily dependent on expensive imported energy resources that place a big burden on the economy. As would be expected, the rapid expansion of energy production and consumption has brought with a wide range of environmental issues at local, regional and global levels. Air pollution, for example, is becoming a great environmental concern in the country.

The agriculture sector, like other sectors, has become increasingly dependent on energy resources such as electricity, fuels, natural gas and coke. Continuous demand for increase in food production has resulted in intensive use of chemical fertilizers, pesticides, agricultural machinery and other natural resources.

However, intensive use of energy threatens public health and environment (Dalgaard et al., 2001) and is partly responsible for the deterioration of world peace and development (Demirbas, 2006; Grennan, 2006).

## **3. Evaluation of Renewable Energy Policy**

The main objectives of Turkey's current energy policy are (Bascetincelik et al., 2006):

- To meet demand using domestic energy resources as the highest priority.
- To develop existing sources while accelerating the penetration of new and renewable sources.
- To diversify energy sources and to avoid dependence on energy imports from a single source or country.
- To encourage private-sector investment and to accelerate capacity construction and privatization in the power industry.
- To improve energy efficiency in end-use and transformation,
- To facilitate friendship environment and public health care.

#### **4. The Solutions, Policies and Actions of Renewable Energy Uses in Turkey**

Suggestions of Renewable Energy Uses in Turkey can be summarized as follows;

- Large power plants are in general monopolized organizations.
- Solar and wind energy are main sources of renewable energy of Turkey. Turkey has obtained biomass energy from Black Sea region.
- The hilly places are good at for wind energy.
- Municipalities in Turkey start creating best practices and enhancing their capacities. There is a need to force the legal frameworks and leading groups.
- There are new operation models for utilization of renewable energy. Private companies invest in renewable energy by using credit from the government and sell the energy to the government for payment of the credit.
- Solar energy's technologies are still expensive in Turkey. It uses mainly for water heating in summer.
- Wind energy enlarging market for local and foreign investors
- Policies in the demand side and public intervention towards market development are critical in other renewable energy technologies.
- Renewable energies creating new employment.

#### **5. Conclusion and Some Important Recommendations**

It is clearly seen that energy resources are vital important for the nations as well as indicator of power of the countries. Renewable energy resources have been used for different purposes within the world and Turkey. In agricultural perspective, they are used especially in agricultural machinery, modern irrigation technologies as well as heating green houses or food processing. However, the production of renewable energy in Turkey is still very low by comparison to the developed countries. The possible reasons are lack of budget, mismanagement of financial resources and also deficiencies in current energy policies. Turkey is a rich country according to the renewable energy resources and also very suitable place for the renewable energy investments. To increase the renewable energy production, firstly external financial supports should be diverted to the Turkey. These resources are friendship of environment and never result harmful effects especially for the sustainable agriculture.

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