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Energy structure of Turkey for sustainable development

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ABSTRACT

Total energy consumption per capita of any country is a critical input for the economic and social development. But nowadays, the current energy production systems are not sustainable and they are not environment friendly. Increased fossil energy consumptions in manufacturing, transportation and standard of living in the growing population have the highest impact on the environment in terms of global warming potential and air pollution. Also fossil fuel prices are increasing because of shortening of fossil fuel sources. Sustainable development improves standard of life economically and environmentally over the long term in a way that must be supported by the industrial structure of the country. In order to sustain energy availability and keep environment livable for future generations, finding new alternatives is necessary. Increased awareness of society about environmental issues and fossil energy sources depletion support new clean alternatives. These alternatives are one of the important and determinant policy areas for the countries, and should include both short and long term energy policies. This paper discusses the environmental pollution caused by energy consumption, and the role of conventional and renewable energy technologies as one component of the effective sustainable development and solution. Also, renewable energy potential of Turkey for assessment of the green energy systems is investigated in terms of sustainable development, environmental impact and prices. All the given results in this paper will be useful to researchers, engineers, decision and policy makers in industry and government.

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1. Introduction

Although there are many definitions in the literature, sustainable development should be defined clearly as meeting the population increasing needs of the present generation without compromising the ability of the future generations to meet their own needs [1]. Consequently, sustainability should be used to describe the desired balance between economic growth, environmental preservation and energy productions [2]. Kerk and Manuel [3] have announced that sustainability is created of three components, i-) depletion of resources, ii-) environmental and ecological aspects, and iii-) quality of life. Energy production methods are one of the main indicators that should be considered in the viewpoint of the sustainable development. Indicators should be given as quantitative measures selected to assess progress towards or away from a stated goal, and tools for communicating energy issues related to sustainable development [4].

Since the industrial revolution, population has been increasing, life standards step up and technology develops, energy has gained significant importance while the energy consumption rate has increased considerably. After that, economic, environmental, technical and social benefit concerns related to energy have been described, and significant attention is paid both locally and globally. The large part of residential energy consumption is responsible for lighting, heating and cooking purposes [5]. In addition to this, due to technologic developments, increases in human population all over the world and environmental concerns are rising through society, because all energy production systems, especially the ones using fossil sources are harmful to environment and ecosystem [6].

According to Oyedepo [7] energy is very important factor for accomplishment of Millennium Development Goals such as eradicating extreme poverty and hunger, achieving universal primary education, promoting gender equality and empowering women, reducing child mortality, improving maternal health, combating diseases, and ensuring environmental sustainability.

Economy of a country is shaped mostly by energy which affects international relations such as politics and military targets. Beside, energy is a primary element for social development. Using renewable energy sources is important because of short life fossil sources and damages of fossil fuels to the environment [8]. Benli [9] stated that renewable energy sources are crucial for future of countries. In order to deal with the climate change, Turkey should take side with global efforts on sustainable development. Menanteau et al. [10] state that public authorities show rising attention to renewable energy sources (RES) due to environmental advantages over conventional energy sources. In order to control greenhouse gas emissions, these renewable energy technologies are able to be used instead of conventional electricity generation techniques.

Nowadays, much of the world's energy is supplied from fossil fuel based on unsustainable energy sources as coal, natural gas and oil. Sustainable energy sources have a large role in replacing

current fossil fuel energy sources. The cost and environmental impacts of power generation raise concern about the global future of energy utilization and its effect on the environment, human health and the economy. One of the most important issues for economic and social development of societies is to use clean and cheap energy sources. High usage of fossil resources and increasing of life standards together with population bring out some problems such as greenhouse gases, land, water, and oil usage. Solutions such as efficient use of energy and renewable resources have thus become a major option [11]. In order to meet these increasing demands for energy and keep environment clean, some precautions should be taken such as: i) short term policies should be applied such as decreasing of current energy use, efficient use of energy sources, and increment of energy saving awareness; ii) long term policies should be made actual like renewable energy usage. A successful overall strategy would aim at: reducing the gap between energy demand and supply, improving energy efficiency and conservation of energy, optimization of energy mix, using different energy resources, investing new energy infrastructure, shifting to clean and alternative sources, encouraging innovation, reducing the prices of energy, and achieving good management of energy sector.

Energy security, economic growth and environmental protection are the national energy policy drivers in any country of the world. Energy consumption of the world is estimated as 8979 Mtoe in 2012, 66% of this consumption is belonging to fossil fuel sources. Consequently, nearly 31734 Mt of CO₂ emissions are released in the atmosphere as a result of this energy consumption [12]. About 80% of the greenhouse gases affect the global warming and this is due to carbon emissions from the combustion of the natural fuels. The renewability potential of a fuel used in such process does not mean zero emission because all renewable energy production systems produce some emissions during installation, operation and maintenance, and uninstallation. Greenhouse gas emissions, waste, flexibility, energy security and independent indicators should also be taken into consideration. For future projection of energy production, the terms of renewable and sustainable are very crucial, as over usage of current energy resources are becoming disaster [13]. Although there is a little decrease in the increase of extracting of some energy resources, this precaution is still not sufficient for a greener world.

Turkey has an area of 780,580 km² with a total coastline of 8430 km, and shares its land borders with Armenia, Azerbaijan, Bulgaria, Georgia, Greece, Iran, Iraq, and Syria. The total population in Turkey was recorded as 76.6 million in 2013. Turkey is one of the fastest growing, developing and industrializing economies in the world over the past two decade. The expected growth of purchasing power and industrial production growth rate are 7.6% and 6.2% in 2015, respectively, and Turkish population will be increased to almost 80 million people with an average age of 29. Because of Turkey's strategically geographical location between three important energy transit corridors as Europe, Asia and

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