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Renewable energy and sustainable development in Turkey

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Abstract

Achieving solutions to environmental problems that we face today requires long-term potential actions for sustainable development. In this regard, renewable energy resources appear to be the one of the most efficient and effective solutions. So clean, domestic and renewable energy is commonly accepted as the key for future life for Turkey. Turkey's geographical location has several advantages for extensive use of most of these renewable energy sources. Because of this and the fact that it has limited fossil fuel resources, a gradual shift from fossil fuels to renewables seems to be serious and the sole alternative for Turkey. This article presents a review of the present energy situation and sustainability, technical and economical potential of renewable energy sources and future policies for the energy sector in Turkey. Also, potential solutions to current environmental problems are identified along with renewable energy technologies. Throughout the paper several problems relating to renewable energy sources, environment and sustainable development are discussed from both current and future perspectives. The renewable energy potential of the country and their present use are evaluated here based on the available data. The present study shows that there is an important potential for renewables in Turkey. © 2001 Elsevier Science Ltd. All rights reserved.

1. Introduction

Energy is considered a prime agent in the generation of wealth and also a significant factor in economic development. The importance of energy in economic development has been recognized almost universally, the historical data attest to a strong relationship between the availability of energy and economic activity. During the

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Nomenclature

COP	heat pump coefficient of performance
f	fraction of the load met by free energy (%)
I	monthly-average hourly global radiation on horizontal surface (W/m ²)
I_D	monthly-average hourly diffuse radiation on horizontal surface (W/m ²)
I_0	monthly-average hourly extraterrestrial radiation on horizontal surface (W/m ²)
kton	thousand tonnes
ktoe	thousand tonnes of oil equivalent
RH	relative humidity (%)
Q	heating load of the building (kW)
T_a	ambient air temperature (°C)
N	number of working days of the series heat pump system per month
η_{col}	collector efficiency
η_{st}	storage efficiency
YDD	yearly degree days

past two decades the risk and reality of environmental degradation have become more apparent. Growing evidence of environmental problems is due to a combination of several factors since the environmental impact of human activities has grown dramatically because of the sheer increase of world population, consumption, industrial activity, etc. Achieving solutions to environmental problems that we face today requires long-term potential actions for sustainable development. In this regard, renewable energy resources appear to be the one of the most efficient and effective solutions. That is why there is an intimate connection between renewable energy and sustainable development [1].

The Kyoto Protocol to the United Nations Framework Convention on Climate Change, agreed to in December 1997, marks an important turning point in efforts to promote the use of renewable energy worldwide. Since the original Framework Convention was signed at the Earth Summit in Rio de Janeiro in 1992, climate change has spurred many countries to step up their support of renewable energy. Even more ambitious efforts to promote renewables can be expected as a result of the Kyoto pact, which includes legally binding emissions limits for industrial countries, for the first time, specially identifies promotion of renewable energy as a key strategy for reducing greenhouse gas emissions [2].

Coal, oil, and natural gas are all fossil fuels that were formed millions or even hundreds of millions of years ago from decaying prehistoric plants and animals. Although fossil fuels are still being created today by underground heat and pressure, they are consumed much more rapidly than they are created. Fossil fuels are non-

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