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Analysis of potential for market penetration of renewable energy technologies in peripheral islands

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Abstract

Cape Verde Islands have important energy and water problems that limit their social and economic development. A field study will be performed focused on Cape Verde Islands to describe the present and future regional power market and to give a clear indication of the best strategies for the optimization of the power energy supply mix in Cape Verde Islands. The study will take into consideration renewable energy technologies and the concerned social, economic and environmental aspects of a given set of possible strategies. One case study will be considered in detail: the situation of the Santo Antão Island. Different energy technologies will be considered: solar, wind, geothermal and biomass. The present structure of the energy sector (capacity, distribution); energy demand, supply and trend; generating plants and infrastructures of Santo Antão will be described. © 1999 Elsevier Science Ltd. All rights reserved.

Keywords: Cape Verde; Insular region; Energy self-sufficiency; Renewable energy; Sustainable development; Energy management

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1. Introduction

A significant portion of the about 140 developing countries in the world are islands that have a population of less than 5 million and a very small gross national product (GNP). These countries have a special set of economic, political, geographic and environmental characteristics that set them apart from the larger developing countries. Insular and remote regions present some specific problems related to energy supply due to their isolation, the lack of conventional energy sources and small dimension of the energy market [1].

Almost all small islands and some remote regions have substantial renewable energy resources, which are not developed yet to their full potential. As indigenous resources, the use of renewable energy resources can enable local development, contributing to reduce the dependence on energy imports, to minimize CO₂ emissions, to create jobs and to improve living standard. This is particularly outlined in the European Union White Papers for a Community Strategy and Action Plan [2], which attest the high interest in this approach. The objective 100% power supply from renewable resources is also highlighted as one of the main key action to promote renewable energy [2].

Small island developing states (SIDS) have special energy problems aggravated by a lack of land resources. Resource management schemes applied in other countries can therefore only have little impact in these countries. Renewable sources of energy such as solar, wind, biomass and wave power offer some hope in the long term, especially if islands work together to develop technologies that are tailored to their unique requirements.

In many cases, renewable resources are used for the production of energy for different purposes. The American Island State of Hawaii shares with many other isolated regions the problem of identifying a secure and affordable supply of energy. Sufficient progress has been made to date in commercializing a number of alternative energy sources that prove that Hawaii will be able to achieve energy self-sufficiency with its indigenous renewable resources [3].

The Cyclades is a complex of 32 small islands in the Southwest Aegean Sea. Lack of energy resources and high transportation cost are the major constraints in economic development of the islands. However, the islands have a wealth of renewable and non-conventional sources namely solar, wind and geothermal energy. The economic compatibility of the soft energy sources for a variety of technologies and end-uses were demonstrated by using an energy optimization model to determine optimal allocation of these sources [4].

Cape Verde, as one of the smallest and poorest SIDS, has additional constraints resulting in poor alternatives. Fuel costs are of the order of twice the world market price. The shortage of water resources leads to the use of desalination plants, which are heavy energetic consumers. The country has wind energy resources from the trade winds providing a strong northeasterly flow for most of the year. Wind turbine technology enables extraction of energy from the wind for conversion into electricity. Since the early 1980s many experiments have documented the technical and economic feasibility of today's wind energy

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