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Published by

WIT Press
Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK
Tel: 44 (0) 238 029 3223; Fax: 44 (0) 238 029 2853
E-Mail: witpress@witpress.com
http://www.witpress.com

For USA, Canada and Mexico

WIT Press
25 Bridge Street, Billerica, MA 01821, USA
Tel: 978 667 5841; Fax: 978 667 7582
E-Mail: infousa@witpress.com
http://www.witpress.com

British Library Cataloguing-in-Publication Data

A Catalogue record for this book is available
from the British Library

ISBN: 978-1-84564-147-4

Library of Congress Catalog Card Number: 2008909438

The texts of the papers in this volume were set individually by the authors or under their supervision.

Printed in Great Britain by MPG Books Groups, Bodmin and King's Lynn.

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Preface

Conventional energy sources based on oil, coal and natural gas are damaging economic and social progress, the environment and human life. Many people are concerned about these problems and wish to address the symptoms as a matter of urgency, but not all understand the basic causes and consequently do not realize that not only technological, but also social changes are required. It is now widely acknowledged that renewable energy capacity has to be increased by exploiting its enormous potential.

During the last few years the 'energy issue' has been assuming a more and more important role among any other choice, strategy and policy concerning human survival and development.

Nowadays the energy model is almost totally centred (for the 80%) on the exploitation of fossil fuels such as petrol, natural gas and coal. To the industrial–economic costs connected with these fuels, social and environment costs, which cannot be overlooked, have to be added.

First of all, fossil fuels are exhaustible energy sources; their formation time is infinitely lower than the one which refers to their exploitation and for this reason are also defined as 'non-renewable resources'. Although the level of the world's fossil fuel supply cannot be considered as worrying in the short term, the increased difficulties in reaching the fields have made the cost–benefit ratio of the extraction processes less and less favourable.

Secondly, the political, social and economic instability, deriving from the world consumption distribution (only 20% of world population consumes the 80% of available resources) and the increasing number of wars connected with the geopolitics of fossil resources and with the control of international supplies, represents a risk for the security and the possible normal development of nations.

Eventually it is necessary to consider the environmental impact caused by the exploitation of fossil energy sources; actually their combustion process brings on the emission of noxious substances such as sulphurous anhydride, nitrogen monoxide and carbon anhydride (15 billion tons of CO_2 are poured

out into the atmosphere every year). Sulphurous anhydride and nitrogen monoxide contribute to the formation of acid rains while carbon anhydride is the main greenhouse gas which causes global warming (greenhouse effect). So behind fossil fuel exploitation is hidden the risk of worrying consequences regarding both the Earth (desertification, arctic ice melt, sea level rise...) and indirectly human health (rise in respiratory diseases, decrease of drinkable water...) .

The analyzed context brought us to review in a critical way the concepts and models of development which have been taken into consideration to date and which have centred on the massive exploitation of fossil sources. During the last few years this review has led to elaborate the concept of sustainable development, which is based on energy consumption reduction and optimization, and also on the use of renewable energy sources (the Sun, the Wind, hydraulic energy, geothermic resources, tides and wave motion; this definition is completed by the biomasses, although these resources can only be considered as renewable if run with the purpose to make their exploitation time consistent with their renewal time).

In comparison to fossil fuels, renewable sources could contribute to the development of a sustainable energy system and to environment and territorial protection; they could also provide new economic growth opportunities.

Recently, the European Union passed new legislative measures to delineate in a binding manner the plan, from now to 2020, to decrease the climate effects caused by present energy consumption levels; that is to say that at least 20% of primary energy will have to be produced by renewable sources, greenhouse gas emission will have to be reduced of 20% and another 20% will have to be an energy saving which the EU means to reach by a wide energy efficiency recovery.

The importance placed upon renewable energy sources now and in the future inside the world energy panorama led us to focus this study on what can be defined as the most relevant renewable source: the Sun.

A policy of energy sustainability can't leave solar energy exploitation out of consideration. Actually its incident quota on the terrestrial surface is 10,000 times greater than the yearly energy requirement of the world's population. Besides being the origin of almost all the other energy sources, renewable and conventional, excluding geothermic, nuclear and gravitational (tides) ones, the energy provided by the Sun is free, endless and clean (the devices used to exploit solar energy are characterized by very low emissions while running). Moreover solar energy is easy to harness and distribute (it is particularly abundant in many world areas with depressed and difficult economic situation).

The first chapter of this study is dedicated to the analysis and calculation of solar radiation incident on an inclined surface at an instantaneous, hourly and daily level.

The second chapter offers a summary and an analysis of all technologies available today to use solar energy: the solar thermal (technologies which exploit solar radiation in order to produce thermal energy that can be used in domestic, civil and productive fields; the differences between low, medium and high temperature solar thermal energy will be identified).

In the last part of the book we judge through a deeper investigation the opportunities offered by the exploitation of biomass energy.

Renewable energy education is a relatively new field and previously it formed a minor part of traditional university courses. However, over the past decade, several new approaches have emerged: we see these in the new literature and, even more clearly, in new books. The present treatise, in the authors' auspices, represents a contribution to this new 'incoming science'.

The book is highly recommended to professors, students and professionals in mechanical, civil, environmental, chemical and agricultural engineering. It is also recommended to all the readers interested in the aims, philosophy, structure, design, strategies and overcomes in the use of energy from 'solar thermal and biomasses'.

The Authors, 2010