

Preface

Energy has become an important and one of the basic infrastructures required for the economic development of a country. Energy security is imperative for sustained growth of economy. The oil crisis of 1973 and concern for environment due to excessive use of fossil fuels have led to a remarkable global effort to harness alternative energy resources. The renewable energy resources, such as, solar, wind, biomass, geothermal, etc. are environment friendly and perennial in nature. These resources are also referred to as non-conventional energy resources as, at present, their large-scale use is not common. The harnessing of energy through these resources, using efficient technologies, is expected to play an important role in serving a clean energy source for the mankind. These technologies are steadily gaining technical and economic importance worldwide. Most governments have substantial plans directed towards encouraging these technologies in order to develop them commercially. However, as we had hoped and wished initially, the developments of these technologies have not been dramatic. They are yet to achieve the cost-benefit ratio possible with conventional fuels and are not likely to replace the fossil fuels in the near future. At the same time they have come to play a very important supportive role to conventional sources. Therefore, it is necessary for the energy planners/users to know the virtues as well as limitations of these technologies. The present book is an effort to explore these technologies in a balanced perspective.

THE INSPIRATION

Being a relatively new field, the subject matter is scattered in specialized research journals and a few books, written at advance level and devoted exclusively to a particular renewable energy technology. There is scarcity of publications that introduce all these technologies in a single volume to a beginner. Therefore, a natural consequence of the current volume will be to fill the void of a much needed and relatively inexpensive textbook at the undergraduate level. While teaching a course on non-conventional energy resources to undergraduate engineering students, the author himself felt this need, which inspired him to write the present book.

WHO WILL BENEFIT FROM THIS BOOK?

Human resource development in the area of energy, in general, and in new and renewable sources of energy, in particular, has been neglected all over the world, and more so in developing countries. Therefore, this book is primarily intended to serve as textbook for engineering and science students at the undergraduate level. It stresses on scientific understanding, analysis and applications of non-conventional energy technologies. Many practising engineers and scientists may not have a formal exposure to this area and may be interested to have a general training of these technologies. This book will help them in the same. It covers both basic study and its widespread applications. It describes the fundamental physical processes governing various non-conventional energy technologies and their applications.

The book may also serve to create awareness among energy planners, policy makers and other users about these technologies in general. Because of the spread of disciplines involved, it is not possible to discuss each of them exhaustively in a single book. Therefore, only the relevant background, up to a depth essential to understand the basic principles, has been included.

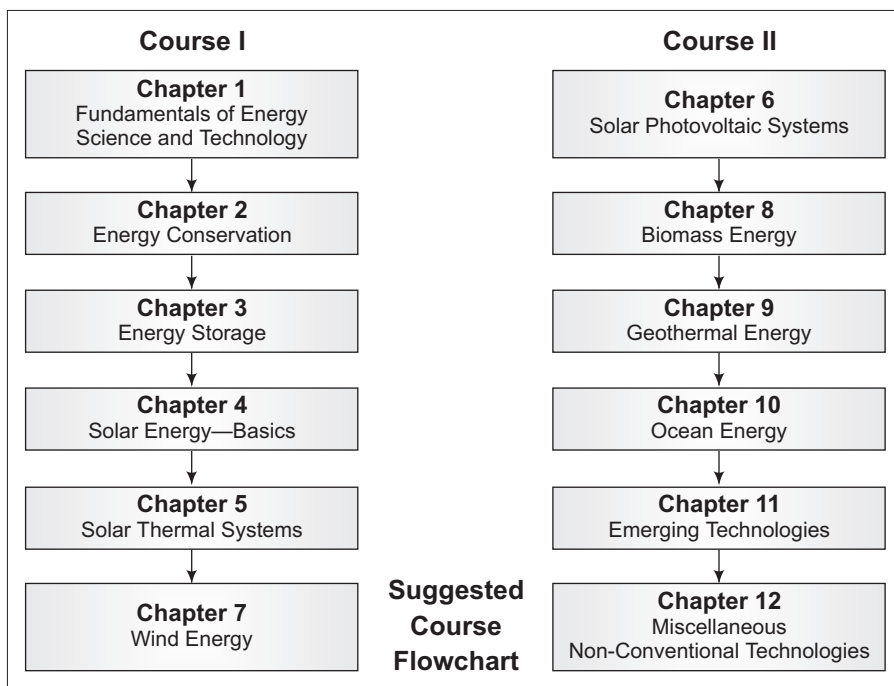
ROAD MAP

The book contains more material than could be covered in one semester course. This will enable the instructor to design a one-semester course including topics of his choice depending on the particular energy supplies that are more important in his situation. Alternatively, two courses, each of one semester duration may be planned with broad divisions. For example, Chapters 1 – 5 and Chapter 7 in first course and Chapter 6 and Chapters 8 – 12 in the second course with minor adjustments as shown in the following flowchart.

The contents of the book have been class tested for a two-semester (one year) course offered to final year B. Tech. student at AMU Aligarh. In fact, the book, in its present form, is the outcome of teaching a course on 'Non-conventional Energy Resources' for many years by the author. As a result, it has undergone extensive screening and has been revised wherever found necessary.

THE ORGANIZATION

The subject matter is logically divided into twelve chapters. A brief review of both conventional and non-conventional energy resources, highlighting the importance of non-conventional energy sources, is included in Chapter 1. The concepts of energy storage and energy conservation are introduced early in Chapters 2 and 3 respectively. General background of these concepts is helpful to understand these technologies and to integrate them in energy systems.



The topic of solar energy is divided into three subsequent chapters. Chapter 4 covers basics of solar energy while Chapters 5 and 6 cover solar thermal and solar PV systems respectively. Chapter 7 covers wind energy technology. The required background of fluid mechanics is also included in this chapter. Biomass energy again requires knowledge of organic chemistry and biology of senior secondary level. The required background is also included in Chapter 8, related to biomass energy. Chapter 9 is devoted to geothermal energy, which is important only in fairly limited geographical areas. Energy resources available in the ocean, i.e. tidal, wave and ocean are covered in Chapter 10. Emerging technologies such as fuel cell, hydrogen energy and micro hydro resources are covered in Chapter 11. Finally some miscellaneous technologies such as MHD, thermoelectric and thermionic are covered in Chapter 12.

SALIENT FEATURES

For each of the technologies discussed in the book, following salient features are included:

- ⌘ historical background,
- ⌘ preliminary estimate and its geographical variation,
- ⌘ basic principle of energy conversion,

- ⌘ system of conversion,
- ⌘ current status and
- ⌘ environmental impacts

Useful review questions including numerical problems, wherever feasible, are also included at the end of each chapter. The answers to numerical problems are provided. Some important units and their interrelations are given in the appendices. Useful Web sites covering information on supplementary material, ongoing major projects and recent updated data on the subject are also listed. All the above and some extra reading material are also available at the web site for this book. The URL for which is <http://www.mhhe.com/khan/ncer>.

I welcome suggestions and comments, from all readers for further improvement of the book.

The author had useful discussions with many individuals from different areas of specialization during the course of preparation of this book. Their cooperation is gratefully acknowledged. Thanks are due to the students who used the early versions of the manuscript in their course and provided valuable feedback. The author also thanks his family members for their cooperation, understanding and patience.

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