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Nicholas Jenkins , Janaka Ekanayake
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Renewable Energy Engineering

Provides a quantitative yet accessible overview of renewable energy engineering practice and the technologies that will transform our energy supply systems over the coming years. Covering wind, hydro, solar thermal, photovoltaic, ocean and bioenergy, the text is suitable for engineering undergraduates as well as graduate students from other numerate degrees. The technologies involved, background theory and how projects are developed, constructed and operated are described. Worked examples of the simple techniques used to calculate the output of renewable energy schemes engage students by showing how theory relates to real applications. Tutorial chapters provide background material, supporting students from a range of disciplines and ensuring they receive the broad understanding essential for a successful career in the field. Over 150 end-of-chapter problems are included, with answers to the problems available in the book and full solutions online, password-protected for instructors.

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Renewable Energy Engineering

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PREFACE

The popularity of renewable energy as a subject of study at undergraduate level is growing rapidly, stimulated by the widespread recognition that ways must be found to provide the power, light and heat that society needs while minimising damage to the environment. Many countries throughout the world are adopting policies to support the use of renewable energy as part of their commitment to limit the emission of greenhouse gases and there is a critical shortage of engineers and technologists to develop, construct and operate renewable energy schemes.

The book has been developed from a number of courses given by the authors to classes of undergraduate engineering students, often together with those following Masters conversion courses who had previously studied a range of science and other numerate subjects. Students from a wide variety of backgrounds wish to study the engineering aspects of renewable energy and this textbook is intended to be accessible to all of them. A general level of high school physics and mathematics is assumed, and examples throughout the text demonstrate the various calculation techniques. Problems are provided at the end of each chapter with their numerical answers. The problems are graded in terms of their difficulty and the early questions of each chapter can be used by the reader to quickly check their understanding of the subject matter. The full solutions of the problems as well as extended exercises for coursework are on the companion website www.cambridge.org/Jenkins that is intended for instructors/teachers or those studying independently.

The book provides ample material to support the teaching of a one-semester course, giving an introduction to the commonly used renewable energy technologies. It describes the various renewable energy resources, how they can be quantified and the fundamentals of their conversion to useful energy. The material presented to the students can be chosen based on their particular interests and backgrounds. After Chapter 1, ‘Energy in the Modern World’, the chapters can be studied in almost any order to reflect the interests of the reader, with the exceptions that Chapter 4 ‘The Solar Energy Resource’ is a pre-requisite for Chapter 5 ‘Photovoltaic Systems’ and Chapter 6 ‘Solar Thermal Energy’. Chapter 7 ‘Marine Energy’ uses concepts from both Chapter 2 ‘Wind Energy’ and Chapter 3 ‘Hydro Power’ and so should be read after them. The three tutorial chapters on electricity, fluid flow and heat transfer provide an introduction to these subjects for those who have not previously studied them and are intended for private study.

In addition to their academic careers, the authors have had direct experience of developing and installing renewable energy schemes. Thus Chapter 9 ‘Development and Appraisal of Renewable Energy Projects’ describes the role that engineers play in the early stages of projects while Chapter 10 ‘Electrical Energy Systems’ addresses the increasingly important question of how to integrate high penetrations of renewable energy into electrical power systems.

As an engineering textbook, a large number of drawings are used throughout the book to demonstrate the principles of the renewable energy technologies, as well as photographs to show examples of plant and equipment. Dave Thompson created the illustrations throughout the book and his assistance and patience are gratefully acknowledged. Photographs were kindly provided by: Ceylon Electricity Board, Drax Power, Gilkes, Lanka Transformers Ltd., New Mills Engineering, Renewable Energy Systems, RenewableUK, Richard Jones, Rhico, and RWE Innogy UK. The authors would also like to acknowledge the generous assistance given by their Cardiff University colleagues, particularly Muditha Abeysekera, Meysam Qadrdan, Richard Marsh, and Tracy Sweet.