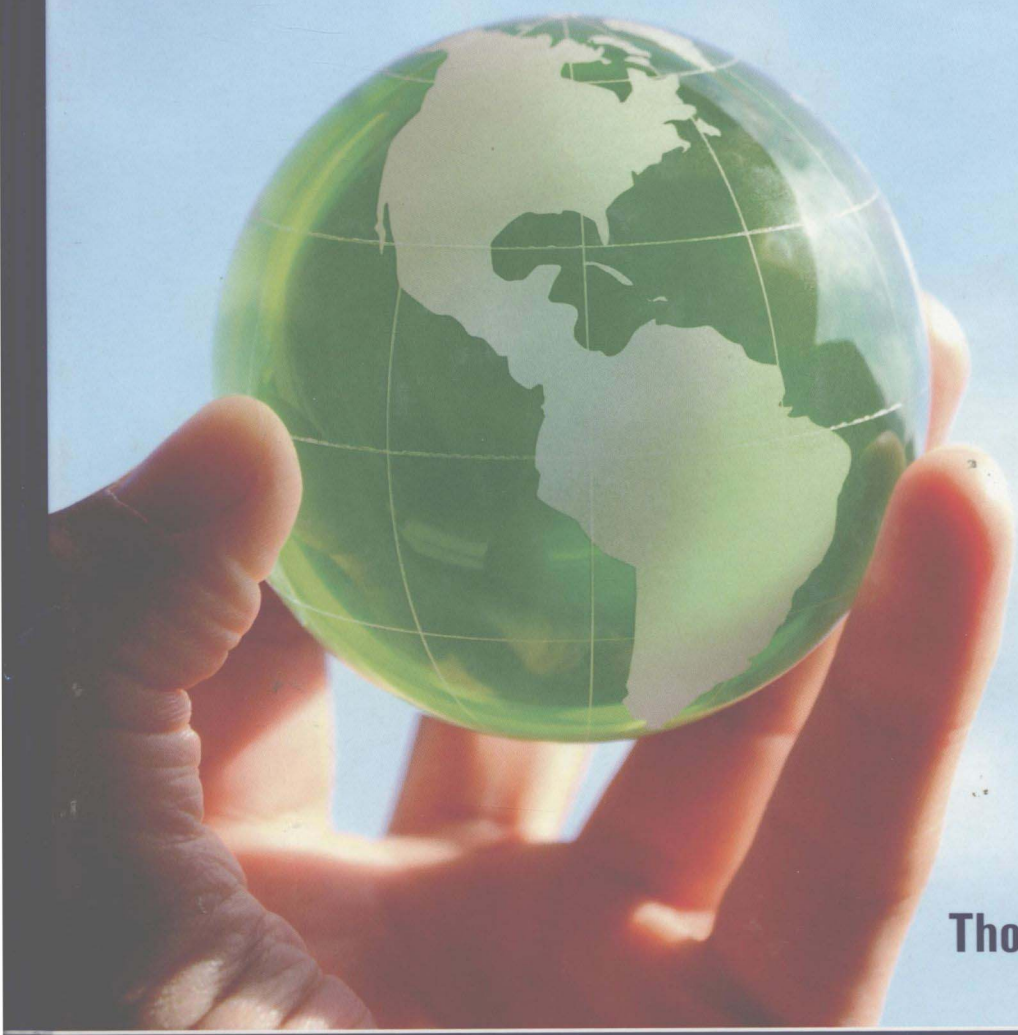
Future Energy:
Opportunities and Challenges



Thomas W. Kerlin

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Everyone is entitled to his own opinion, but not his own facts.

Attributed both to former Senator Patrick D. Moynihan and to former Secretary of Defense James R. Schlesinger

...to live on the earth's energy income rather than its energy capital.

Isaac Asimov

It is quite evident, though, that this squandering cannot go on indefinitely, for geological investigations prove our fuel stores to be limited. So great has been the drain on them of late years that the specter of exhaustion is looming up threateningly in the distance...

Nikolai Tesla (1931)

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About the Author

Tom Kerlin retired as head of the Nuclear Engineering Department at the University of Tennessee in 1998, after serving on the faculty for 33 years. His professional interests include instrumentation, nuclear reactor simulation, and dynamic testing for model validation. He has published extensively on these topics.

In addition to his university service, Dr. Kerlin founded a spin-off company, Analysis and Measurement Services Corp., to provide the nuclear industry with the testing capability that he invented for safety system sensors. Dr. Kerlin's method has been used hundreds of times in nuclear power plants in the U.S. and around the world.

Upon retiring, Dr. Kerlin studied the literature on energy production and use and concluded that there was a need for a comprehensive book on our future options that even non-specialists would understand. This book is the result.

PREFACE

A revolution in energy production and use is upon us. Huge changes are starting to rumble through our lives. We cannot avoid these changes, but we can manage them if we approach them in an informed way.

Our current dependence on fossil fuels for most of our energy must be reduced or eliminated because of resource depletion and the environmental effects of fossil fuel combustion.

This book offers no prescriptions for achieving a desirable energy future. Instead, it presents the scientific and technical information needed to evaluate our options for intelligent energy production and use.

Everyone uses energy, and many are appropriately concerned about future energy cost, availability, and environmental impact. Some are content to rely on what the "experts" tell them. Others want to know enough about how energy systems work to be able to make their own assessments. Serving this group is the focus of this book.

In order to understand energy production and use, it is necessary to build on a foundation of indisputable facts. This requires some consideration of basic science, but nothing beyond that science which is taught in high schools. Science tells us what is possible and, probably more importantly, what is impossible. Science also provides the framework for obtaining quantitative evaluations of possibilities in energy production and use. Without a basis in science, and without the use of scientific principles to generate numerical assessments, statements about energy production and use must be viewed as uninformed opinion rather than established fact.

It is expected that this book will be used in survey courses about energy in universities and colleges. The book also should serve interested citizens who want to learn about energy and energy professionals who want to learn about energy options outside their specialty. An effort was made to present the science and technology in a simple and intuitive way. When detailed

information was considered necessary for readers who wish to see the basis for assertions in the main text, more detailed discussions appear in appendices.

Exercises are provided for most of the chapters. These are intended primarily for use in college and university courses. Each exercise has one of three purposes: to provide experience in using some of the quantitative assessment methods, to send the reader to current literature to learn about the status of the rapidly changing energy enterprise, and to stimulate the reader to formulate opinions and provide the rationale for those opinions.

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