

## PREFACE

Major changes are occurring in society's attitude toward energy and fuels. Even the oil companies and electric utilities are urging the public to consume *less* gasoline, *less* electricity and *less* energy in general. The changes are partly the result of our increasing realization that higher monetary costs of energy are inevitable. Perhaps more importantly, they are happening because of our realization that increased energy utilization may be causing irreversible damage to the environment. Energy consciousness and education are becoming more important than ever. Energy issues have ceased to be the exclusive concern of the specialists. None of us can afford to be ignorant of, or indifferent to, the role of energy and fuels in society.

The final impetus for converting a set of lecture notes into this textbook came after reading an article on the problems of science education in the United States ("Project 2061: A Place to Start Educating the Public," *The Scientist*, August 7, 1989, p. 11). I knew very well that a large number of popular books and several textbooks on energy have appeared since the price of a barrel of petroleum skyrocketed from \$2 to \$34 in the 1970s, and up to \$40 and back down to about \$25 during the time of this writing. But teaching experience told me that one of the arguments made by the authors of this article was quite correct: "The typical survey courses [...] are more concerned with providing a systematic overview of a scientific discipline than with conveying the perspectives and thinking skills that students will be able to use in their own lives." Indeed I found that hardly any among the available books have succeeded in prescribing a balanced dose of knowledge to the general reader, or to college students who do not major in science or engineering. General science education is a laudable goal, and one that is increasingly being rescued from undeserved oblivion. However, the degree to which this goal is achieved in practice is directly proportional to the daily-life relevance of the material taught.

The book's subtitle underscores my eminently practical objectives: (a) general understanding of energy-related media reports, which undeniably shape public opinion, and (b) evaluation of energy bills (both the monetary and the environmental ones), especially those of single-family homes. The selection of topics, their order and, most importantly, the space devoted to each of them were carefully pondered and decided with these objectives in mind.

A cursory analysis of the page numbers in the Contents shows that, despite these political and economic objectives, the emphasis is on technical issues and facts. Their understanding, albeit at a very basic level, is necessary (though not sufficient) for formulating sensible policies. However, this is *not* a physics or chemistry textbook in disguise. I have resisted the understandable but mostly unjustified temptation to explain technical concepts from first principles. This would require dwelling on physical and chemical principles that perhaps should be, but are not, familiar to a typical high-school graduate or college freshman. For example, I discuss thermodynamics only to the extent necessary to understand the central concept in energy utilization, the *efficiency* of energy

conversion from one form to another. Also, even though it would be nice to learn about the Pauli exclusion principle and the Maxwell-Boltzmann distribution, elementary mass balances are sufficient to understand why burning coal produces a more serious greenhouse effect than burning natural gas, and to appreciate the other virtues and liabilities of fossil fuels. Finally, elementary atomic physics is discussed only to the extent necessary to (a) introduce the concept of nuclear ‘pollution’ and (b) explain why fusion is essentially a nondepletable energy form while conventional fission is a depletable energy form. It turns out that this is also sufficient to understand what happened at Three Mile Island and Chernobyl. Inevitably such an approach occasionally leads to oversimplifications (which may disappoint some science teachers); classroom experience tells me that this is all right, as long as such oversimplifications are not misleading.

The book is based on a 3-credit general education course offered to freshmen and seniors alike, majoring in disciplines as diverse as liberal arts and business administration. I hope that the readers of daily and weekly press who want to develop a more critical attitude toward energy-related issues will also find it useful. No math beyond the four basic operations is needed. However, I do dwell on back-of-the-envelope calculations that place into perspective – in a somewhat simplistic but powerful way – the energy supply-demand balance, or lack thereof, at both the microeconomic and the macroeconomic level. High-school exposure to physics and chemistry is helpful, but is not taken for granted.

The transition from a course outline to the various versions of lecture notes, and finally to this book, was made easier with the help of a number of individuals. Robert Jenkins (now at the University of Cincinnati) and Alan Scaroni, my predecessors in teaching this course at Penn State, generously shared their experience and notes when I needed them most. Special thanks go to Harold Schobert for his contributions to the earlier version of the book, especially in Chapters 7-11; some of this material was retained in the present edition. Our MatSc 101 students challenged us with logical questions for which I often had no simple immediate answers. This book is, in a way, a belated response to them, as well as a timely response, I hope, to our future students. They also provided numerous energy-related clippings from the daily and weekly press and compiled and analyzed their home energy bills. Some of these were used throughout the book, and particularly in Chapter 19.

I am indebted to Dale Lancaster, Jan Pels and Mirjam Kooren for valuable comments. Ruth Krebs helped with some of the figures. Several anonymous reviewers, who preferred to see more scientific rigor, pointed out some errors or difficult passages in the 1st edition and suggested quite a few improvements, both substantive and stylistic.

Last and most of all I thank my wife, Marcela Moreno-Sepúlveda, and my children, Aleksandar and Magdalena, for their patience and understanding, even on occasions when the enthusiasm for completing these pages made them question my priorities.

University Park, Pennsylvania  
July 1997

Ljubisa R. Radovic  
lrr3@psu.edu  
<http://www.ems.psu.edu/~radovic/Radovic.html>