BOOK REVIEWS

Introduction to Energy Analysis, 2nd edition, by KORNELIS BLOK and EVERT NIEUWLAAR, (Routledge, 2017), 310 pages, ISBN 978-1-138-67114-0, Hardback, ISBN: 978-1-138-67115-7 Paperback.

In the second edition of *Introduction to Energy Analysis*, Professors Kornelis Blok (Delft University) and Evert Nieuwlaar (Utrecht University) provide an excellent and concise overview of energy systems and methods for their analysis. The volume is intended for upper-level undergraduate and graduate students with a background in natural sciences and engineering. Professionals who are relatively new to energy systems analysis will also find it worthwhile reading, as an introduction to the field.

The opening chapter discusses the relation of energy use with human development, environmental impacts and security of supply. Next, the authors present energy units and conversions, and give a brief introduction to energy balances. The remainder of the book can be divided into two parts. Chapters 3 to 6 are descriptive and serve as an overview of energy systems around the world. They examine energy demand by major end-use sector, supply of non-renewable and renewable energy sources, energy conversions, and characteristics of energy markets, with an emphasis on price formation. The reader is also introduced to how carbon markets work under a cap-and-trade system.

Chapters 7 to 15 have a more technical character and illustrate methods for the analysis of energy systems from the fields of science, engineering and economics. Coverage includes exergy analysis, life-cycle energy analysis, cost-benefit analysis, techno-economic analysis, and decomposition methods to explain how activity level, structure and energy efficiency affect energy use. A section is dedicated to approaches to measuring energy efficiency, and touches upon rebound effects and the role of energy service companies. Further, the authors propose a useful categorization of policy instruments to reduce carbon emissions, improve energy efficiency and stimulate energy production from renewable sources, and discuss methods to evaluate the effectiveness of these policies. The book concludes with a chapter on energy system models for developing scenarios, and discusses limitations of the scenario approach.

The authors have done a remarkable job at choosing a coherent and logical layout to present a range of methods and tools that are commonly used for the analysis of energy systems. Despite its vast scope, the volume is compact and easily accessible to the novice reader thanks to its clarity of exposition. A major contribution lies in the book's multidisciplinary approach. For instance, in contrast to many studies of energy systems, which focus on the first law of thermodynamics for tracking sources and destinations of energy flows, Blok and Nieuwlaar emphasize the relevance of exergy analysis. Second law principles should also be considered to compare energy conversions processes, especially when they involve heat transfer. The authors convincingly argue that exergy analysis, which accounts for the quantity as well as the quality of energy carriers, reveals potentials for improved performance better than analyses only relying on first law principles.

In addition to learning objectives and practical exercises, the book features useful "boxes" that illustrate key concepts, like the smart grid and power plant dispatch, or present numerical examples, e.g. for the calculation of higher and lower heating values. Further, at the end of each chapter the authors provide an extensive list of current references and additional readings by topic, which may be helpful to those who would like to gain a deeper understanding of specific energy issues.

This volume is an up-to-date primer on energy systems, and does a good job of introducing interested, non-expert readers to methods for energy systems analysis. Its interdisciplinary per-

spective provides a novel contribution to the literature, and makes it a valuable reference for its intended audience of students and energy policy analysts.

Chiara Lo Prete
Assistant Professor of Energy Economics
John and Willie Leone Family Department of Energy and Mineral Engineering
The Pennsylvania State University

* * *

Energy Efficiency: Building a Clean, Secure Economy, by JAMES L. SWEENEY (Hoover Institution Press, Stanford University, 2016) 196 pages. ISBN: 978-0-8179-1954-2. Hardback. Price: $29.95.

This timely and highly readable book makes a strong case supporting the following quote in the forward from George P. Schultz, former U. S. Secretary of the Treasury and Distinguished Fellow of the Hoover Institution, Stanford University:

"What is the cleanest energy around? The energy that is not used. What is the least expensive energy around? The energy that is not used. What is the most secure energy around? The energy that is not used."

Economists often argue that if energy efficiency is so economical, why aren't people doing it. James L. Sweeney, director of the Precourt Energy Efficiency Center and Stanford Professor, uses some straight forward reasoning to make a credible case that they actually are. He notes that many small changes in the U.S. since 1973 have, indeed, added up to a large change. Annual energy efficiency gains of 2.7% a year from 1973 to 1985 and 1.7% a year, thereafter, have led to a 57% reduction in energy use per real $ of GDP and a 39% reduction in carbon emissions per $ of GDP.

In chapter one, Dr. Sweeney motivates energy efficiency by noting its contribution to the economy, the environment, and energy security and makes a distinction between energy efficiency, which measures how much energy is used for a given activity or process versus the aggregate use of energy relative to GDP (energy intensity) or its inverse (energy productivity). Throughout his book, his working definition of energy efficiency is not the more narrow definition of the Physicist, which measures total useful energy out of a process relative to the energy coming in, but a more economically oriented measure that indicates that a process or technique is more energy efficient than another if it "uses less energy for the same service or provides more service for the same energy." He avoids the more ambiguous term energy conservation, which typically indicates less energy use but may mean reducing energy use by less waste or reducing energy use by consuming less energy services.

Although progress has been made, he acknowledges there are barriers to energy efficiency and includes references that discuss such barriers and concludes the chapter with a nice table listing such barriers divided into market failures, institutional barriers, and behavioral issues.

Chapter two contains a fun romp through many technologies and practices that have contributed to the efficiency improvements including lighting, refrigeration, auto technologies, aircraft design and load management, computers, building design, and company practices.

In chapter three, he extrapolates the energy use trajectory and efficiency gains prior to 1973 when cheap abundant energy was taken as a given. Then he compares this with the actual energy use after 1973. He notes the structural shift in 1973 after the energy crisis, which continued with worries of energy security and the coming awareness of the link between carbon emissions and climate change. With this comparison, he attempts to isolate the extra contribution that energy efficiency gains have made to reduce energy use since 1973. He finds them to be larger than the increases in U.S. domestic energy supply over the same period.

In chapter four, he continues his plaudits for energy efficiency and applies the same extrapolation to capture the effect of energy efficiency gains on the carbon intensity of the U.S. economy. Again somewhat surprisingly, he finds that efficiency has made a larger contribution to the reduction in carbon emissions than all the other supply side adjustments—nuclear plus renewables.

In chapter five, he considers energy efficiency changes by major economic sector and finds them widely distributed. He acknowledges that for industry, the shift away from heavy industry and increasing imports from China contributed to the decreasing energy intensity and quotes studies that indicate half of the shift was structural with the remainder from efficiency gains. He did not find trade to have a very significant effect on energy intensity in the other three sectors considered—transportation, residential, or commercial. He rounds out the chapter by acknowledging and discussing the rebound effect (i.e. since efficiency gains reduce the price of energy services, consumers may consume more energy services offsetting some of the efficiency gains)

Chapter six is my favorite and would make nice supplemental reading for policy courses relating to improving energy efficiency. In it, he explores the causes for the efficiency gains. He feels that both policy and price have been contributing elements and gives a variety of policy examples including information and labeling, LEED certification, and energy efficiency standards. The footnotes include additional studies and advocacy groups, which the interested reader can use to follow up.

His concluding chapter contains a sum up and reiterates that prices, policies, normal business incentives, and changes of attitude have all contributed to the efficiency gains all across the economy. He speculates whether President Obama's energy goal to double U.S. energy productivity (cut U.S. energy intensity in half) will be met. If historical evidence is any indication, he feels such an ambitious goal is unlikely to be met but that externality taxes and continued moves to reduce market barriers would help.

I found the book easy to read and appreciated its upbeat tone. It contains an index and is suitable for a general audience. Although it does not contain much in depth technical analysis, it contains a number of more technical references for the interested reader to delve deeper into the questions explored in the book.

Carol A. Dahl
Colorado School of Mines

Connect with
IAEE
on facebook