BOOK REVIEWS

Green Illusions: The dirty secrets of clean energy and the future of environmentalism, by Ozzie Zehner. (University of Nebraska Press, 2012) 464 pages. ISBN: 978-0-8032-3775-9. Paperback.

The author's main message, which is not revealed until you've paged through roughly half the book, is that we do not have an energy supply crisis, but rather a consumption or demand crisis—we simply use and waste too much. Another key message, revealed after half a dozen chapters in which the author systematically criticizes and rejects nearly all forms of energy and fuel types, but particularly renewable energy resources as dirty, impractical and expensive is to admit that, "Some day, renewable energy will supply most of humanity's energy needs." Why the author has chosen to categorically reject, and then embrace renewable technologies—and efficient use of energy—is a puzzle.

On page 177, roughly half way in the 348 page book (the balance includes lengthy notes and references) he discloses "a little secret," stating that, "After all, the only thing I promised you on the (book's) cover was the dirty secrets of clean energy. I never vowed to dismiss it altogether. Renewable forms of energy fueled humanity before the age of fossil fuels, and soon they will after the fossil fuels are gone. A problem remains, however. There likely won't be enough of the precious renewable energy to go around." If it sounds confusing—speaking from both sides of the mouth—it indeed is.

The book is organized into three main parts. Zehner, starts with a critical assessment of virtually all known forms of energy and fuels, titled Seductive Futures. In close sequence, he systematically rejects solar energy, wind, biofuels, nuclear, hydrogen, clean coal and hydropower as expensive, inadequate, dirty, unreliable, impractical or a combination of the above. He is particularly critical of renewable technologies, focusing on their intermittency, low energy density, up-front investment costs—you name it. He relishes and delves into the "dirty secrets of clean energy," the subtitle of his book, for example, describing the adverse side effects of manufacturing solar PV panels. Conventional technologies do not fare better. Zehner does not seem to like any form of energy or any type of fuel.

While his criticisms are, for the most part, justifiable, Zehner does not address the main issue—namely that all forms of energy have negative side effects, and the fact that in real life, we often have to choose not among better and best, but between bad and worst. If solar, wind, biofuel, nuclear, hydrogen, clean coal and hydro are rejected, what are we left with?

In the book's second part, From Here to There, Zehner begins to ask, "Why do we seem to have a predisposition for preferring *production* over energy *reduction*? (Emphasis in the original)" and observes, ". . . that which is produced is good and those who produce should be rewarded." The discussion, however, is equivocal—one is left wondering what to make of it.

Part three of the book, The Future of Environmentalism, presents a puzzling mix of ideas, starting with women's rights—population growth, family planning, contraception—followed by a discussion on improving consumption, where it is stated, "The *best* material consumption is *less* material consumption (Emphasis in the original)," where the author criticizes conspicuous consumption and the notion that material wealth does not necessary lead to happiness.

Suggestions and solutions are sprinkled in random, and in no apparent order. Junk mail industry, for example, is wasteful and so is product over-packaging. Downshifters, defined as people who have ". . . shifted from a live-to-work mentality to a work-to-live mentality . . . ," it is suggested, will lead happier lives. Zehner says, "Perhaps Socrates had a point when he claimed, 'contentment is natural wealth, luxury, artificial poverty.'"

To improve consumption, Zehner has a long list of suggestions—thrown in at random and in a haphazard way, leaving the reader with no sense of what is important and what may be nice but trivial. For example, advertising to kids should be banned; taxes should shift from income to consumption. While both are arguably good ideas, the latter is likely to be far more effective—and challenging to implement—than the former. The book not only mixes apples and oranges, but gives no sense of order, priority, significance, impact, or cost-effectiveness.

Zehner contrasts today's environmentalism as misguided, offering his own. He says, "I would argue . . . that 'a little, plus a little, plus a little' won't get a growing consumption-based economy very far. We would need 'a lot, plus a lot, plus a lot' for that," but it is not clear what the a lot, plus a lot, plus a lot consists of.

The book is ambitious, perhaps too ambitious, in scope—it takes on more than it can handle. And despite many clever ideas, it fails to deliver in the end.

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Handbook of Renewable Energy Technology, edited by AHMED F. ZOBAA and RAMESH C. BANSAL (Singapore: World Scientific Publishing Company) 876 pages, ISBN 978-981-4289-06-1, hardback.

Recent years have seen a renewed focus on increasing our use of renewable energy sources. Environmental, geopolitical, and supply concerns associated

with traditional fossil fuels are making renewables an increasingly important part of the future energy mix. There are, however, major technological, technical, and economic barriers to widespread use of renewable energy. There is also uncertainty regarding how technology, manufacturing, and integration improvements can affect the viability of different renewables in the future. This book, *Handbook of Renewable Energy Technology*, offers a broad view of different renewable energy sources available to us today, as well as "up and coming" technologies that may be technically and economically viable in the future. It also provides a discussion of some of the power engineering challenges that renewable electricity sources raise and proposes means to address and mitigate these issues.

The book is a collection of edited chapters, divided into six sections, written by experts in the respective fields and technologies discussed. The first four sections cover specific renewable technologies—wind, solar, bio-based, and hydro and ocean energy. The remaining two sections cover more general renewable integration issues.

Chapter 1 provides background information on wind generation, including the basic physics behind wind energy, turbine design considerations, grid integration issues, and cost estimates. Chapter 2 provides more details on turbine design, including different generator types and power electronic converters. Chapter 3 discusses wind turbine, generator, and power electronic modeling. Chapter 4 delves into wind resource assessment. The authors discuss the types of data needed for a robust wind assessment, standard software tools available, and other considerations (e.g. right of way and infrastructure) that can affect siting decisions. Chapter 5 provides a more detailed discussion of the cost of wind and introduces a number of standard metrics used to compare the cost of wind to other generation technologies. Chapter 6 describes line-side converters, which are used to control active and reactive output from variable-speed wind generators. Chapter 7 introduces wake effects from wind turbines on overhead transmission lines and discusses associated implications for wind turbine spacing and siting.

Chapter 8 introduces the second section on solar energy by providing fundamental derivations used to model real-time solar resource availability. This includes modeling of seasonal and diurnal patterns, the coordinates of a candidate location, and cloud cover. Chapters 9 and 10 describe photovoltaic and solar thermal (which is also referred to as concentrating solar power) technologies. Chapter 11 discusses the important issue of maximum power point tracking in photovoltaic solar systems, which is the real-time control of the bus voltage to maximize energy yield. Chapters 12 and 13 introduce non-electric uses of solar energy. This includes solar drying, cooking, and water and building heating.

Chapters 14 and 15 introduce biomass as a source of energy. Chapter 14 discusses different types of biomass and their energy contents and harvesting and conversion processes. Whereas chapter 14 discusses all possible feedstocks, chapter 15 focuses on the use of forest species. It also includes a discussion of how local climactic conditions can affect the viability of forest-based biomass. Chapters 16 and 17 focus on the conversion of biomass to liquid fuels, specifically

bioethanol and biodiesel. This includes a discussion of different feedstocks, preparation and conversion processes, and issues raised by the use of mixes of bio-based and conventional liquid fuels in vehicles and other end uses.

Chapter 18 introduces a number of different marine energy technologies, including ocean wave and tide energy. Since these technologies have, thus far, largely been restricted to demonstration projects, the chapter estimates the potential for marine energy and possible locations for development. The chapter also includes a discussion of potential environmental impacts that may be encountered with wider development of the technology. Chapters 19 and 20 focus on operational and frequency control challenges with small-scale hydroelectric power. These issues become especially pertinent in distributed generation settings, wherein the hydroelectric plant is the primary (or possibly only) electricity source.

Section 5 focuses on feasibility studies and grid-integration challenges raised by renewables. Chapter 21 summarizes a number of software tools that are available for feasibility, economic, and emissions analysis of pure and hybrid renewable energy systems. This includes a comparison of their modeling capabilities, as some tools are limited in being able to model all facets of a renewable energy system. The remaining three chapters of this section delve into issues raised by distributed renewable generation. Chapter 22 introduces the range of effects that distributed generation can have, for instance on ancillary services, power voltage and harmonics, and power flows. It also uses a case study to demonstrate how the physical location of distributed generation assets can affect losses within a distribution system. Chapter 23 builds off of this by introducing a number of different algorithms that can be used to optimize the location of distributed generation to minimize such losses. Chapter 24 introduces the concept of a virtual power producer (VPP). The VPP is an aggregation of multiple distributed generation resources that can participate in the market to provide energy and ancillary and other services. The chapter also explains the use of a multi-agent simulator to model the potential interactions between VPPs and other market participants.

The final section returns to the issue of power electronics and quality, which is first introduced in the context of wind. Chapter 25 discusses different power electronic converters available for wind, solar photovoltaic, and energy storage systems. Chapter 26 presents models that can be used to study the use of induction generators in wind turbines, while chapter 27 treats voltage control of doubly-fed induction generator in wind systems. Chapter 28 raises the issue of power quality instrumentation and measurement with renewables. This includes how often power quality measurements should be conducted, where meters should be physically sited within a power system, and how to process the resulting data. Chapter 29 finally introduces a goal programming model to determine how energy resources should be allocated to different uses. The chapter uses a number of case studies based on rural villages in India, and demonstrates that depending on the priorities of the planner, different energy technologies should be promoted or put to different end uses.

The clear strength of this book is its broad coverage of many technologies. This ranges from the well known (e.g. wind and solar) to the niche (e.g. solar drying). Thus, the overview chapters that discuss the various technologies can serve as a handy reference for anyone dealing with renewables, whether seasoned or a novice. These chapters may also be of interest to people simply wanting to know more about renewable technologies. Many of the chapters, especially those dealing with power engineering issues, can be rather terse, however. These often include complicated derivations, which may prove indecipherable to those without an electrical engineering background. Unfortunately, these derivations typically lack a more rudimentary explanation for the layperson to follow, making it difficult to recommend this book to readers without strong engineering backgrounds.

Another weakness of this book is that it does not address some important power system engineering issues raised by renewable integration. This includes resource forecasting, unit commitment and dispatch, and long-term capacity planning. These are real challenges facing the power system engineering and energy economics communities, with real market-design, policy, operational, planning, and economic consequences. Chapters 21, 24, and 29, deal with feasibility studies, participation of renewables in energy markets, and energy resource planning. These come the closest to touching on these important issues, although additional chapters that further explore these issues would be a welcome addition to this volume.

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Peeking at Peak Oil, by KJELL ALEKLETT, translated by Michael Lardelli, (Springer, 2012) 336 pages, ISBN 978-1-4614-3423-8. Hardcover.

Humanity has a deeply rooted need for prophetic visions of an impending doomsday, be it in the form of plagues, famines, economic depressions, climate change or resource collapses. To satisfy this need, there has been a steady supply of such visions, from Nostradamus in the 16th century through the Club of Rome in the 1970s, predicting a crumbling of the physical resources on which civilization is based, to concurrent scares of disastrous climate change. Peak Oil is a vision of looming catastrophe, as an inadequate oil resource base leads to culminating output in the near future (2014 in the latest prediction), followed by secular decline and an everlasting oil crisis. Its tantalizing message has found a broad following and even some policy reactions in the course of the past decade.

This truly prophetic book summarizes the somber Peak Oil gospel and paints a highly deterministic picture of the prospects for oil production. Its assertions have little solid base and must be strongly refuted.

Oil is produced from proved reserves, so this is a central concept when judging production capabilities. According to BP (annual), global reserves in 2010 amounted to 1650 billion barrels (Gb). Over the past decades, they have grown faster than extraction, and now correspond to 54 times current annual output. Reserves result from new discoveries and subsequent appreciation as further prospecting uncovers additional volumes in discovered fields, and as extraction technology improves during the decades of a field's life. Appreciation is important. Historical data from the U.S. reveal (IEA, 2005) that the ultimately recovered oil when a field ceases to produce is on average six times the volume announced at the time of initial discovery.

Aleklett challenges these reassuring views, but his analysis is deceptive. By attributing all appreciation to the time of the original find, he demonstrates that "discovery" since the 1980s has not matched extraction, while the size of individual finds has shrunk substantially. These conclusions rest on a fallacious approach. Old discoveries have been expanded by decades of appreciation, the more recent ones have not yet been. In support of his method, the author asserts that newer discoveries will not appreciate much, since modern technology permits a nearly full assessment of their potential from the very beginning. This assertion reveals a remarkably static perception of coming technical progress.

The book's scrutiny of reserves is both messy and disjointed. In one place (p 106), Aleklett states that recoverable reserves amount to 1800 Gb, but in another (p 122), that only 800-900 Gb of reserves remain, and, preposterously, that the total of all future discoveries will not exceed 100-200 Gb. The latter numbers reflect the central role of Ultimately Recoverable Resources (URR) in Peak Oil analyses. The problem with this concept is that URR can never be known, and that the perception of its size rises continuously with improving geological understanding and advances in the technique of extraction. Peak Oil's technological determinism is entirely oblivious of historical experience, evidenced in the thought-provoking observation by from Morris Adelman (2002):

> In 1944 world proved reserves were 51 billion barrels. In 1945–1998, 605 billion barrels were removed, leaving 1035 billion in the ground . . .

Technological breakthroughs in horizontal drilling and fracking in the course of the present century have created the base for a fundamental revolution in oil and gas extraction. The revolution has barely begun, but formerly uneconomical unconventional gas (often referred to as shale gas in the public debate) has already come to dominate production in the U.S. Growing total output has resulted in a sharp price decline, and in prospects for sizable LNG exports from a country recently believed to be permanently dependent on gas imports. Two

impending phases will follow as the revolution evolves. First, the unconventional gas technique will disperse to other continents, massively increasing global gas supply. And second, the new technology will also be applied in the extraction of shale oil, with important repercussions for global oil supply. This is already apparent for the U.S. where a rising oil output since 2006 is importantly due to this source. Shale oil production in the U.S. is expected to exceed 1 mbd already in 2015 (NYT, 26 Oct 2011) before it too spreads internationally.

Aleklett's technological myopia prevents him from perceiving the realms of what goes on. This emerges clearly in his treatment of future production prospects for "unconventional" oil. He is apparently oblivious of the revolution's impact on oil and gas reserves, making all Peak Oil's assessments of reserves and resources irrelevant. At a time of growing North American gas abundance, he sees the inadequacy of gas supply as a serious impediment to the expansion of Canadian oil sands production, and suggests, naively, that new nuclear capacity in Alberta might be a solution.

Energy economists will be appalled by the complete absence of economic analysis in the book's deliberations. Those who have followed the Peak Oil saga will not be surprised. The stand among its adherents seems to be that insights into geology have determined the extractable quantities of oil once and for all, so economics is not of relevance to production levels. Concepts like prices and investments hardly play a role in their world. However, the attitudes of Aleklett and his associates go further than that. They exhibit outright contempt for economics, and refer to "flat earth economists," a derogatory epithet, when criticized on economic grounds.

Peeking at Peak Oil should perhaps not be criticized for its scientific shortcomings, and be primarily regarded as a piece of work to promote ASPO, the Association for the Study of Peak Oil and Gas, and Kjell Aleklett, its president since 2003. There are some reasons for believing so. The book is filled with entertaining, sometimes esthetically appealing graphics and other illustrations to support the arguments. These may entice the layman, but the scientifically oriented reader will encounter problems in deciphering their precise content. The book is also filled with a tiresome self-promotion by the author. His eminence is underlined both in the preface, in the concluding chapter, and in between. We repeatedly read how he is telephoned from distant places and called to participate in important meetings, much like Arthur Koestler's Call Girls. We learn how he hobnobs with princes, ambassadors and other celebrities during his worldwide travels on missions to make the "truth" of Peak Oil known. His prominence is truly revealed through the instant permission for him to visit Bab, Abu Dhabi's largest oil field during a short visit to the country, a privilege denied the Swedish ambassador despite four years of energetic diplomatic effort, we are told.

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