JOURNAL OF CHEMICAL EDUCATION

Book and Media Review

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Review of *Chemistry of Sustainable Energy*

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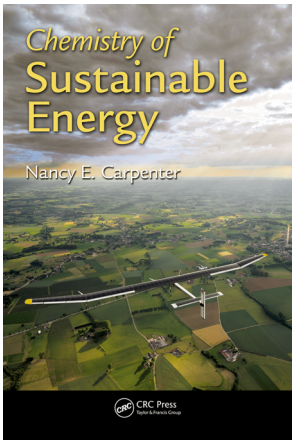
Chemistry of Sustainable Energy, by Nancy E. Carpenter. CRC Press: Boca Raton, FL, 2014. 446 pp. ISBN: 978-1-4665-7532-5 (paperback). $79.95.

As climate change becomes an ever more pressing problem and demands for energy keep increasing, we must find ways to develop the energy needed, ideally without destroying our environment. Because of this complex problem, renewable energy is an increasingly important topic for researchers and for students. Chemistry is central to many of the processes by which energy is produced, as well as to the processes that result in climate change. As such, it is fitting that chemists may tackle sustainable energy.

Nancy Carpenter's book, *Chemistry of Sustainable Energy*, seeks to prepare students, the researchers of the future, to solve these problems. This text focuses on the chemistry of energy development rather than taking the interdisciplinary approach many others have used. This textbook is aimed at upper-level undergraduate students who already have a strong grasp of the basic concepts of chemistry. It serves as a way to review those essential concepts through application to a scientifically and culturally relevant issue.



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The book begins by reviewing some of the concepts most essential to understanding of the chemistry of energy and by discussing how those concepts play out in our current fossil-fuel driven systems of energy development. In the chapter on energy basics, Carpenter focuses on defining energy in a way that is meaningful to principles of power generation and building the understanding that sustainability is impacted by many factors, some of which are almost completely unrelated to science. Here she also makes a strong case that if sustainable energy options are not found, issues around energy and climate are going to continue. Next, a discussion of fossil fuels covers how these fuels are formed, extracted, and refined. In addition to providing a section on carbon capture and storage, the author discusses how we might someday help to mitigate some of the harmful effects of fossil fuels. The three introductory chapters are rounded out by a review of thermodynamics as applied to energy.

Next, Carpenter dives into some of the methods that may be able to provide us with sustainable energy in the future, including chapters on wind energy, hydrogen production, fuel cells, solar photovoltaics, and biomass conversion. This book does not cover every potential source; however, those selected give a broad overview of research into sustainable energy and are "arguably and at this point in time" the most promising for sustainability. While nuclear energy comes with its own set of sustainability issues, as well as other well-known negatives, it is also discussed as an alternative, in part, because it has been in use for energy production.

It is also important to note that sustainability is a complicated issue for many of the energy production methods selected. In some cases the method itself is sustainable, but the materials needed to use the method may not be. Carpenter points to these problem issues as areas for which further research may be needed to find alternatives.

Each topic is covered in its own chapter, which includes any additional concepts essential to understanding that particular topic, as well as information on current practice, and on what current research implies may be common practice in the future. In the chapter discussing wind energy, Carpenter begins with a review of polymers and the ways that structure impacts properties and those properties impact potential applications. She explains what materials have been used in wind energy and why and what changes could be made as research continues to improve the generation of wind energy, such as reinforcing polymer turbines with carbon nanotubes or investigating new designs for wind turbines. Throughout this discussion, sustainability remains a factor. In the case of wind energy, sustainability is questioned in particular because current synthesis methods are not environmentally friendly. Green synthesis methods are being researched, so this sustainability problem may not always remain an issue.

Throughout the chapters focused on energy production, many other chemistry topics are also discussed. Some of these additional topics are catalysis and hydrogen storage, electrochemistry, selection of materials for energy uses based on properties, and basic biochemistry and thermochemistry processes. Discussions of each production method are detailed, and concise and ample additional sources are recommended.

Chemistry of Sustainable Energy is written very accessibly. Concepts are explained succinctly, but in sufficient detail for upper-level undergraduate students. Figures are used well to

dx.doi.org/10.1021/ed5008298 | *J. Chem. Educ.* XXXX, XXX, XXX−XXX

illustrate more complicated concepts and to highlight key points. Additionally, this book explicitly states that, though chemistry is central to solving issues with energy and climate change, many of the greatest challenges of this problem are not the science issues, but those centered on people. This challenges students to ask hard questions not only about what is possible, but also what is feasible.

An elective course for chemistry and related disciplines based around this book would engage students by offering a way to apply their knowledge to an important problem while reinforcing that knowledge. As the author acknowledges in the introduction, energy is an important and highly researched topic. *Chemistry of Sustainable Energy* and any other book on sustainable energy is inherently outdated, but by combining this book with more current materials from the literature, students can be given a sturdy background alongside the most current work in sustainable energy. I recommend this book as a resource for background in alternate energy, whether as a part of a course, or as a part of a library collection.

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Notes

The authors declare no competing financial interest.

dx.doi.org/10.1021/ed5008298 | *J. Chem. Educ.* XXXX, XXX, XXX−XXX