

ENERGY AND THE ENVIRONMENT

Abbas Ghassemi, Series Editor

**INTRODUCTION TO
RENEWABLE
ENERGY
SECOND EDITION**



**Vaughn Nelson
Kenneth Starcher**



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SERIES EDITOR

Abbas Ghassemi

New Mexico State University

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Preface

The big question: how do we use science and technology such that spaceship Earth will be a place for all life to exist? We are citizens of Earth, and within your lifetime, there will be major decisions over the following: energy (including food), water, minerals, space, and war (which we can state will happen with 99.9% probability). These previous statements were made over 30 years ago, when Nelson first taught introductory courses on wind and solar energy. Since then, the United States has been involved in a number of armed conflicts, so my prediction on war has been fulfilled. The era of armed conflict over resources has already started—Oil War I (Gulf War) and Oil War II (Iraq War)—and a sustainable-energy future primarily fueled by renewable energy is paramount to reduce the possibility of an Oil War III between China and the United States over dwindling supplies of petroleum. This is also the opinion of one of my Chinese colleagues working in renewable energy.

We are over 7 billion and heading toward 11 billion people, and we are all participants in an uncontrolled experiment on the effect of human activities on the Earth's environment. Renewable energy is part of the solution to the problem of finite resources of fossil fuels and the environmental impact of greenhouse gases. Renewable energy is now part of national policies with significant goals for percentage increase in generation of energy within the next decades. The reason is that there are large amounts of renewable energy in all parts of the world; in contrast to fossil fuels and minerals, renewable energy is sustainable, and it reduces greenhouse gas emissions. The growth of renewable energy has been very large, at 20% per year since 2005; however, this large growth rate is attributable to the original low levels of renewable energy generation, except for hydroelectric power generation, growth for which is around 2% per year. Hydroelectric power still remains the top source of renewable-energy generation, with an installed capacity of 1,000 GW; however, at the end of 2014, the installed capacity of wind farms was 360 GW and photovoltaics was 180 GW (a significant part of new electric plant capacity from all sources). Compare these values with the numbers from the first edition of this book (2011): installed capacity energy from wind farms was 158 GW and from photovoltaics was 23 GW.

Policies for supporting renewable energy have spread from 48 countries in 2004 to over 140 countries in 2014. Renewable energy targets along with feed-in tariffs have had the biggest impact on increasing the renewable energy market. In 2004, the majority of local governments did not consider the renewables in their energy supply, and now many of them have become leaders in advancing renewable energy, some even setting targets of 100% renewables. The future for renewable energy is very bright and you can be a part of that future by working in the field or by supporting the implementation of renewable energy.

Vaughn Nelson

and

Kenneth Starcher

West Texas A&M University

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Vaughn: I express my gratitude to my wife, Beth, who has put up with me all these years. Dana and Vaughn Nelson (my grandchildren) assisted my efforts, especially with the PowerPoint presentations.

Ken: I credit my wife, Madeleine, with making me get up each morning and making it well worthwhile to come home each evening. I have never really had a “job,” but the lifetime of involvement in renewables has been worth all the years of doing it.

Authors

Vaughn Nelson, PhD, has been involved with renewable energy, primarily wind energy, since the early 1970s. He is the author of 3 books and 4 CDs, has published over 50 articles and reports, was the principal investigator on numerous grants, and has given over 60 workshops and seminars from the local to the international level. His primary work has been on wind resource assessment, education and training, applied R&D, and rural applications of wind energy. Presently, he retired from West Texas A&M University (WTAMU). He was director of the Alternative Energy Institute (AEI) from its inception in 1977 through 2003 and then returned for another year in July 2009. He retired as the dean of the Graduate School, Research and Information Technology, WTAMU, in 2001. He served on Texas state committees, most notably the Texas Energy Coordination Council during its 11-year existence. He has received three awards from the American Wind Energy Association, one of which was the Lifetime Achievement Award in 2003; received an award as a Texas Wind Legend in 2010 from the Texas Renewable Industries Association; received an award in 2013 for Outstanding Wind Leadership in Education from Wind Powering America; and served on the board of directors for state and national renewable energy organizations. One of his projects was a renewable energy demonstration building at the AEI Wind Test Center. Dr. Nelson developed the material for a new online course in renewable energy at WTAMU in the spring of 2010, and the first edition of this book was the result. Dr. Nelson is the author of *Wind Energy* (2009, 2nd ed., 2013) and *Renewable Energy and the Environment* (2011). He received the Lifetime Achievement Award from the American Wind Energy Association in 2003.

Dr. Nelson's degrees include a PhD in physics from the University of Kansas, an EdM from Harvard University, and a BSE from Kansas State Teachers College, Emporia. He was at the Departamento de Física, Universidad de Oriente, Cumana, Venezuela, for two years and then at WTAMU from 1969 to 2003.

Kenneth Starcher began his college career and involvement with renewables in the fall of 1976. This led to a BS in physics/computer science at West Texas State University (1980). In 1980–81 he took courses in electrical engineering, electronics, and physics at Texas Tech University. He earned an MS in engineering technology at WTAMU (1995) and then took some courses in agricultural economics at WTAMU.

Starcher has been a field worker for most of the projects at the Alternative Energy Institute (AEI) since 1980. He has been the educational funnel for onsite training and public information for students and public workshops for AEI. He has served as a trainer at wind and solar training workshops locally, nationally, and internationally. He has served as a research technician, research associate, assistant director, director, and associate director (training, education, and outreach) for AEI over the past 35 years.

Starcher served as a board member of the American Wind Energy Association, is on the executive board of Class 4 Winds and Renewables, was chosen as the individual member of the year for Texas Renewable Energy Association in 2005, was chosen as the small wind educator at the Small Wind Conference in 2010, and was awarded an Outstanding Wind Leadership Education Award from Wind Powering America in 2013.

Starcher has installed and operated more than 85 different renewable energy systems, ranging in scale from 50 W to 500 kW. He has served as a consultant for wind companies in the United States and produced wind resources maps for counties, states, and Thailand and Honduras.

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