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How Do Wind Turbines Work? Springer
One renewable energy source that has witnessed a significant growth in the recent years is wind energy, with the installation of new wind farms around the globe as well as the innovations in wind power technology, which have increased the efficiency of this source. Wind power generates electrical energy from the wind's kinetic energy without causing emissions or pollution from power production; however, environmental effects are caused by the wind turbine manufacturing, transport, and other phases. Therefore, the overall goal of this study was to analyze the environmental effects associated with wind energy technology by taking into consideration the entire life cycle for wind turbines. Specific objectives were: 1.To conduct a comprehensive life cycle assessment (LCA) for large wind turbines inTexas, including: All phases (materials acquisition, manufacturing, transportation, installation,operation and maintenance, and end of life) and ; A variety of inventory emissions and resources (greenhouse gases; traditionalair pollutants SO2, NOx, VOCs, CO and PM; water depletion; cumulative energydemand). 2.To identify a range of impacts due to uncertainty in LCA model inputs. 3.To compare impacts of wind power to literature values for coal and natural gas, asexamples of fossil fuels. The practical contribution of this study is to provide an LCA for large wind turbines in the US, which includes all life cycle phases. The study's contribution to the field of LCA is a more comprehensive LCA than has been conducted to-date for wind turbines anywhere, by including several important new elements: 1) maintenance as part of the use phase, 2) traditional air pollutants in addition to greenhouse gas emissions, 3) an energy balance to compare energy produced by the turbines over their lifetime with energy consumed to manufacture and transport them, and 4) a sensitivity analysis that examines more parameters. The study was conducted 200 Gamesa 2-MW wind turbines G83 (100) and G87 (100) located at the Lone Star Wind Farm near Abilene, Texas. SimaPro8 was used as the modeling platform. Data were collected from different sources, including manufacturers, wind turbine farms, and the database in the software used for modeling (SimaPro8). All the data were modeled according to ISO 14040 standards. Environmental impacts (acid deposition, eutrophication, photochemical smog formation, stratospheric ozone depletion, and climate change), human health impacts (human health potential and respiratory effects), and resource consumption (fossil fuel consumption, water depletion, and cumulative energy demand) were assessed. Manufacturing was the phase contributing the most impacts: >75% to the impact categories of respiratory effects, human health potential, and eutrophication; >50% to the categories of acidification, global warming, water depletion, and cumulative energy demand; and >25% to fossil fuel depletion, ozone smog formation, and stratospheric ozone depletion.Producing the large parts of the turbine such as the tower and the nacelle consume sizable amounts of energy and materials. Hence, to reduce adverse impacts from wind power, alternative methods of manufacturing should be explored. Impacts of the installation and transportation phases were moderate, but less than manufacturing. To reduce climate change impacts of the installation phase, use of green cement for the turbine foundation should be considered. To reduce impacts of the transportation phase, purchase of locally-manufactured turbines should be considered. Impacts of the remaining phases were very low. Extending the turbine life span lowers impacts per kWh of electricity produced because the impacts, which are due primarily to the manufacturing phase, will be distributed over a longer period of time. For a 20-year lifetime, the turbines produce 39 times more energy than they consume. If the turbine life span is increased to 25 or 30 years, the turbines produce 45 and 50 times more energy than they consume, respectively. The best-case wind speed recommended by the manufacturer, 8 m/s, overestimated electricity generation by a factor of 43 compared to using the wind rose at the farm site. Site-specific information should therefore be used in evaluating the potential for electricity production. Based on a comparison with values reported in the literature, global warming potential of coal-fired and natural gas power plants with carbon capture and sequestration were still 50 times the impacts of the wind turbines. Other environmental impacts ranged from 4-8 times those of wind turbines, and human health impacts were estimated to be 370 times those of wind turbines.
Design of Foundations for Offshore Wind Turbines Springer
The purpose of this book is to provide engineers and researchers in both the wind power industry and energy research community with comprehensive, up-to-date, and advanced design techniques and practical approaches. The topics addressed in this book involve the major concerns in the wind power generation and wind turbine design.
How to Build a Small Wind Energy Business Springer Science & Business Media
Contents: Large Wind Turbine Technology - State of the Art. - Outline ofWEGA Large Wind Turbine Programme. - The WEGA Wind Turbines - Design and Construction. - Comparison of Essential Technical Criteria. - Commissioning and Early Operational Experiences. - Outlook to the Future

Programme WEGA II.

Wind Power Today BoD – Books on Demand

Aerodynamics of Wind Turbines is the established essential text for the fundamental solutions to efficient wind turbine design. Now in its second edition, it has been entirely updated and substantially extended to reflect advances in technology, research into rotor aerodynamics and the structural response of the wind turbine structure. Topics covered include increasing mass flow through the turbine, performance at low and high wind speeds, assessment of the extreme conditions under which the turbine will perform and the theory for calculating the lifetime of the turbine. The classical Blade Element Momentum method is also covered, as are eigenmodes and the dynamic behaviour of a turbine. The new material includes a description of the effects of the dynamics and how this can be modelled in an ?aeroelastic code?, which is widely used in the design and verification of modern wind turbines. Further, the description of how to calculate the vibration of the whole construction, as well as the time varying loads, has been substantially updated.

Wind Energy Comes of Age John Wiley & Sons

Today's wind energy industry is at a crossroads. Global economic instability has threatened or eliminated many financial incentives that have been important to the development of specific markets. Now more than ever, this essential element of the world energy mosaic will require innovative research and strategic collaborations to bolster the industry as it moves forward. This text details topics fundamental to the efficient operation of modern commercial farms and highlights advanced research that will enable next-generation wind energy technologies. The book is organized into three sections, Inflow and Wake Influences on Turbine Performance, Turbine Structural Response, and Power Conversion, Control and Integration. In addition to fundamental concepts, the reader will be exposed to comprehensive treatments of topics like wake dynamics, analysis of complex turbine blades, and power electronics in small-scale wind turbine systems.

Hydrostatic Transmission for a 1MW Wind Turbine Design Study Child's World

This paper highlights the experience of one small wind turbine installer in California that installed more than 1 MW of small wind capacity in 6 years.

Stability Control and Reliable Performance of Wind Turbines CreateSpace

The goal of our FY15 project was to explore the use of statistical models and high-resolution atmospheric input data to develop more accurate prediction models for turbine power generation. We modeled power for two operational wind farms in two regions of the country. The first site is a 235 MW wind farm in Northern Oklahoma with 140 GE 1.68 turbines. Our second site is a 38 MW wind farm in the Altamont Pass Region of Northern California with 38 Mitsubishi 1 MW turbines. The farms are very different in topography, climatology, and turbine technology; however, both occupy high wind resource areas in the U.S. and are representative of typical wind farms found in their respective areas.

Wind Power in Power Systems Routledge

This book is intended for academics and engineers working in universities, research institutes, and industry sectors wishing to acquire new information and enhance their knowledge of the current trends in wind turbine technology. Readers will gain new ideas and special experience with in-depth information about modeling, stability control, assessment, reliability, and future prospects of wind turbines. This book contains a number of problems and solutions that can be integrated into larger research findings and projects. The book enhances studies concerning the state of the art of wind turbines, modeling and intelligent control of wind turbines, power quality of wind turbines, robust controllers for wind turbines in cold weather, etc. The book also looks at recent developments in wind turbine supporting structures, noise reduction estimation methods, reliability and prospects of wind turbines, etc. As I enjoyed preparing this book, I am sure that it will be valuable for a large sector of readers.

Assessment of Research Needs for Wind Turbine Rotor Materials Technology Elsevier

Wind energy is the great success story of modern renewable energy. Since the industry's rebirth following the energy crisis of the 1970s, thousands of wind energy projects have been installed around the world. The technology today is competitive with traditional fossil-fuelled electricity generation. Wind Energy in the 21st Century explores the current economic, financial, technical, environmental, competitive, and policy considerations facing the wind energy industry. With discussions of the latest electricity industry trends including deregulation, green markets, and tradable renewable credits, this book is a must-read for energy policymakers, researchers, and energy industry professionals.

1999 European Wind Energy Conference John Wiley & Sons

This book provides an overview of floating offshore wind farms and focuses on the economic aspects of this renewable-energy technology. It presents economic maps demonstrating the main costs, and explores various important aspects of floating offshore wind farms. It examines topics including offshore wind turbines, floating offshore wind platforms, mooring and anchoring, as well as offshore electrical systems. It is a particularly useful resource in light of the fact that most water masses are deep and therefore not suitable for fixed offshore wind farms. A valuable reference work for students and researchers interested in naval and ocean engineering and economics, this book provides a new perspective on floating offshore wind farms, and makes a useful contribution to the existing literature.

WEGA Large Wind Turbines National Academies Press

A revolution is ongoing in the field of small-scale energy solutions, which can enable lower impact on the environment, more robust supply and self-determination. Solar power and other forms of renewable energy sources, which you can implement to generate your own electricity, are growing quickly. Electromobility is transforming the car industry and transportation systems and can also play a role in your energy system. Electricity can be used much more efficiently than before, for example by using LED light, variable speed motor drives and efficient home appliances. Smart controls are available, sometimes with free open source software. All this opens up tremendous opportunities for energy independence, which is the focus of this book. The book introduces the reader to a number of renewable energy sources, to different options for storing electricity and to smart use of electricity, particularly in the context of small isolated systems. This is important because many renewable energy sources are weather- and season-dependent and usually require storage and smart control, in order to obtain a system that is completely independent of the electricity grid. In the book, overall system design is explained, including how to combine different sources in a hybrid system. Different system sizes and architectures are also covered. A number of

real cases are described, where homes, businesses and communities have achieved a high level of energy independence or are on their way to achieving it. This book will prove useful in university education in renewable energy at bachelor and master level, and also for companies and private individuals, who want to start or expand activities in the area of renewable energy.

Advances in Wind Power Routledge

Wind energy's bestselling textbook- fully revised. This must-have second edition includes up-to-date data, diagrams, illustrations and thorough new material on: the fundamentals of wind turbine aerodynamics; wind turbine testing and modelling; wind turbine design standards; offshore wind energy; special purpose applications, such as energy storage and fuel production. Fifty additional homework problems and a new appendix on data processing make this comprehensive edition perfect for engineering students. This book offers a complete examination of one of the most promising sources of renewable energy and is a great introduction to this cross-disciplinary field for practising engineers. "provides a wealth of information and is an excellent reference book for people interested in the subject of wind energy." (IEEE Power & Energy Magazine, November/December 2003) "deserves a place in the library of every university and college where renewable energy is taught." (The International Journal of Electrical Engineering Education, Vol.41, No.2 April 2004) "a very comprehensive and well-organized treatment of the current status of wind power." (Choice, Vol. 40, No. 4, December 2002)

WEGA Large Wind Turbines World Scientific

An updated and expanded new edition of this comprehensive guide to innovation in wind turbine design Innovation in Wind Turbine Design, Second Edition comprehensively covers the fundamentals of design, explains the reasons behind design choices, and describes the methodology for evaluating innovative systems and components. This second edition has been substantially expanded and generally updated. New content includes elementary actuator disc theory of the low induction rotor concept, much expanded discussion of offshore issues and of airborne wind energy systems, updated drive train information with basic theory of the epicyclic gears and differential drives, a clarified presentation of the basic theory of energy in the wind and fallacies about ducted rotor design related to theory, lab testing and field testing of the Katru and Wind Lens ducted rotor systems, a short review of LiDAR, latest developments of the multi-rotor concept including the Vestas 4 rotor system and a new chapter on the innovative DeepWind VAWT. The bookis divided into four main sections covering design background, technology evaluation, design themes and innovative technology examples. Key features: Expanded substantially with new content. Comprehensively covers the fundamentals of design, explains the reasons behind design choices, and describes the methodology for evaluating innovative systems and components. Includes innovative examples from working experiences for commercial clients. Updated to cover recent developments in the field. The book is a must-have reference for professional wind engineers, power engineers and turbine designers, as well as consultants, researchers and graduate students.

Wind Power Curve Modeling Using Statistical Models John Wiley & Sons

Wind Power Today is an annual publication that provides an overview of the wind energy research conducted by the U.S. Department of Energy Wind and Hydropower Technologies Program.

Small-Scale Renewable Energy Systems John Wiley & Sons

He cites improvements in the performance, reliability, and cost effectiveness of modern wind turbines to support his contention that wind energy has come of age as a commercial technology.

WIND POWER TECHNOLOGY, THIRD EDITION PHI Learning Pvt. Ltd.

The 1999 European Wind Energy Conference and Exhibition was organized to review progress, and present and discuss the wind energy business, technology and science for the future. The Proceedings contain a selection of over 300 papers from the conference. They represent a significant update to the understanding of this increasingly important field of energy generation and cover a full range of topics.

Wind Vision John Wiley & Sons

The World Renewable Energy Congress is a key event at the start of the 21st century. It is a vital forum for researchers with an interest in helping renewables to reach their full potential. The effects of global warming and pollution are becoming more apparent for all to see - and the development of renewable solutions to these problems is increasingly important globally. If you were unable to attend the conference, the proceedings will provide an invaluable comprehensive summary of the latest topics and papers.

Nacelle Anemometry on a 1MW Wind Turbine Springer

The DOE-supported project objectives are to: establish a national wind energy center (NWEC) at University of Houston and conduct research to address critical science and engineering issues for the development of future large MW-scale wind energy production systems, especially offshore wind turbines. The goals of the project are to: (1) establish a sound scientific/technical knowledge base of solutions to critical science and engineering issues for developing future MW-scale large wind energy production systems, (2) develop a state-of-the-art wind rotor blade research facility at the University of Houston, and (3) through multi-disciplinary research, introducing technology innovations on advanced wind-turbine materials, processing/manufacturing technology, design and simulation, testing and reliability assessment methods related to future wind turbine systems for cost-effective production of offshore wind energy. To achieve the goals of the project, the following technical tasks were planned and executed during the period from April 15, 2010 to October 31, 2014 at the University of Houston: (1) Basic research on large offshore wind turbine systems (2) Applied research on innovative wind turbine rotors for large offshore wind energy systems (3) Integration of offshore wind-turbine design, advanced materials and manufacturing technologies (4) Integrity and reliability of large offshore wind turbine blades and scaled model testing (5) Education and training of graduate and undergraduate students and post- doctoral researchers (6) Development of a national offshore wind turbine blade research facility The research program addresses both basic science and engineering of current and future large wind turbine systems, especially offshore wind turbines, for MW-scale power generation. The results of the research advance current understanding of many important scientific issues and provide technical information for solving future large wind turbines with advanced design, composite materials, integrated manufacturing, and structural reliability and integrity. The educational program have trained many graduate and undergraduate students and post-doctoral level researchers to learn critical science and engineering of wind energy production systems through graduate-level courses and research, and participating in various projects in center's large multi-disciplinary research. These students and researchers are now

employed by the wind industry, national labs and universities to support the US and international wind energy industry. The national offshore wind turbine blade research facility developed in the project has been used to support the technical and training tasks planned in the program to accomplish their goals, and it is a national asset which is available for used by domestic and international researchers in the wind energy arena.

The Dutch 1 Mw-wind Turbine at Wieringermeer CRC Press

The second edition of the highly acclaimed Wind Power in Power Systems has been thoroughly revised and expanded to reflect the latest challenges associated with increasing wind power penetration levels. Since its first release, practical experiences with high wind power penetration levels have significantly increased. This book presents an overview of the lessons learned in integrating wind power into power systems and provides an outlook of the relevant issues and solutions to allow even higher wind power penetration levels. This includes the development of standard wind turbine simulation models. This extensive update has 23 brand new chapters in cutting-edge areas including offshore wind farms and storage options, performance validation and certification for grid codes, and the provision of reactive power and voltage control from wind power plants. Key features: Offers an international perspective on integrating a high penetration of wind power into the power system, from basic network interconnection to industry deregulation; Outlines the methodology and results of European and North American large-scale grid integration studies; Extensive practical experience from wind power and power system experts and transmission systems operators in Germany, Denmark, Spain, UK, Ireland, USA, China and New Zealand; Presents various wind turbine designs from the electrical perspective and models for their simulation, and discusses industry standards and world-wide grid codes, along with power quality issues; Considers concepts to increase penetration of wind power in power systems, from wind turbine, power plant and power system redesign to smart grid and storage solutions. Carefully edited for a highly coherent structure, this work remains an essential reference for power system engineers, transmission and distribution network operator and planner, wind turbine designers, wind project developers and wind energy consultants dealing with the integration of wind power into the distribution or transmission network. Up-to-date and comprehensive, it is also useful for graduate students, researchers, regulation authorities, and policy makers who work in the area of wind power and need to understand the relevant power system integration issues.

Life Cycle Assessment of Greenhouse Gas Emissions, Traditional Air Pollutants, Water Depletion, and Cumulative Energy Demand from 2-MW Wind Turbines in Texas BoD – Books on Demand

Wind power plants teaches the physical foundations of usage of Wind Power. It includes the areas like Construction of Wind Power Plants, Design, Development of Production Series, Control, and discusses the dynamic forces acting on the systems as well as the power conversion and its connection to the distribution system. The book is written for graduate students, practitioners and inquisitive readers of any kind. It is based on lectures held at several universities. Its German version it already is the standard text book for courses on Wind Energy Engineering but serves also as reference for practising engineers.