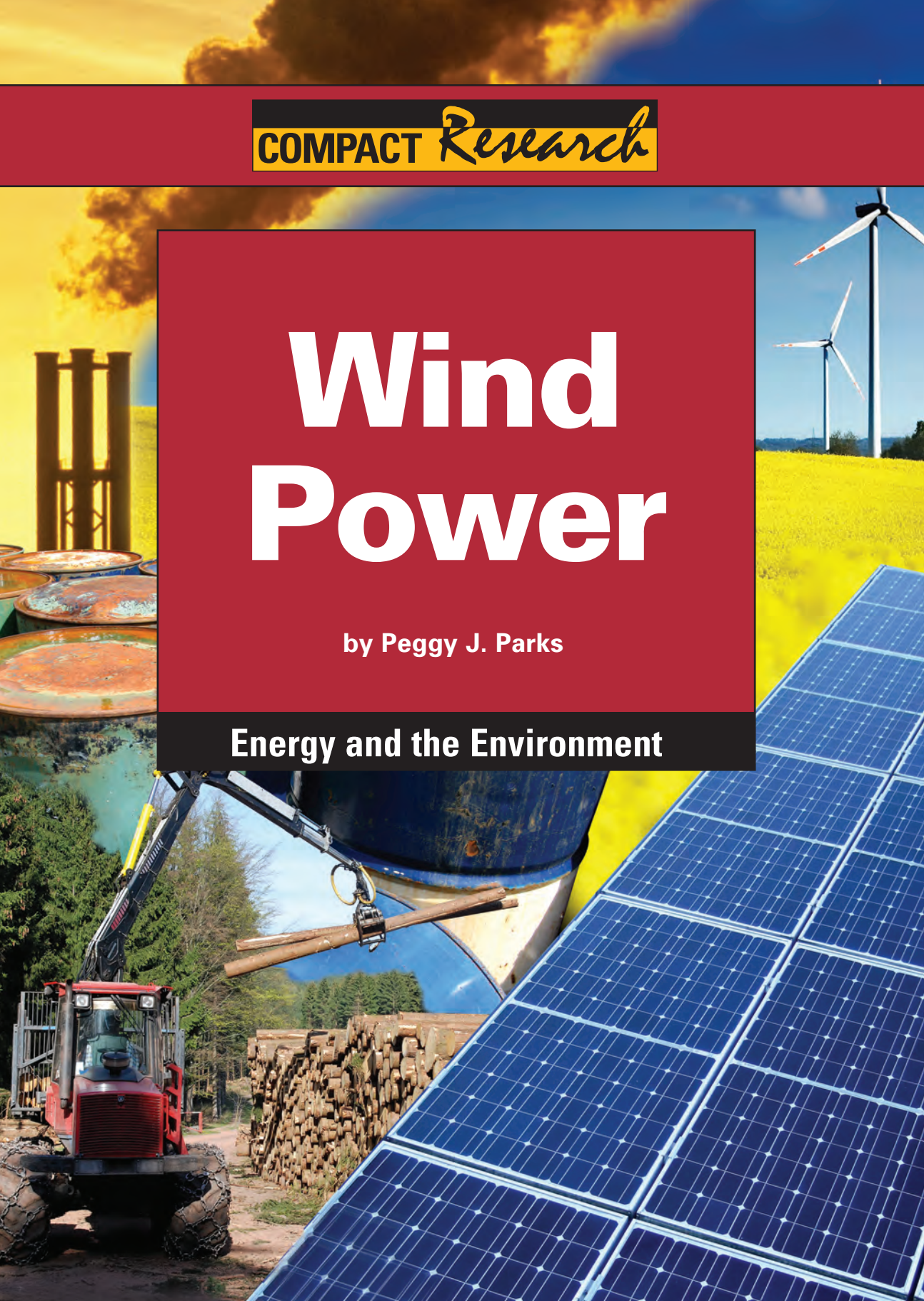


COMPACT *Research*

Wind Power

by Peggy J. Parks

Energy and the Environment



Contents

Foreword	4
Wind Power at a Glance	6
Overview	8
Can Wind Power Supply the World's Energy Needs?	20
Primary Source Quotes	28
Facts and Illustrations	31
Can Wind Power Reduce Dependence on Fossil Fuels?	36
Primary Source Quotes	43
Facts and Illustrations	46
How Does Wind Power Affect the Environment?	51
Primary Source Quotes	58
Facts and Illustrations	61
What Is the Future of Wind Power?	65
Primary Source Quotes	72
Facts and Illustrations	75
Key People and Advocacy Groups	80
Chronology	82
Related Organizations	84
For Further Research	88
Source Notes	90
List of Illustrations	92
Index	93
About the Author	96

Wind Power at a Glance

Wind Power and the Obama Energy Agenda

In February 2009, President Barack Obama signed the American Recovery and Reinvestment Act, a \$787 billion economic stimulus bill that includes \$14 billion in tax incentives for wind energy facilities and other renewable energy sources. Additionally, the Obama administration's "New Energy for America" plan sets out long-term energy goals such as ensuring that 25 percent of America's electricity comes from renewable sources by 2025 and investing \$150 billion over 10 years to stimulate private clean energy projects. The how, what, and when of such spending has prompted considerable debate.

How Wind Is Harnessed

Wind turbines are highly sophisticated machines with blades that capture the wind's kinetic energy, or the energy of motion.

Wind Farms

Huge groupings of tall turbines are clustered together to form installations known as wind farms, which may be located on land or in the ocean.

Benefits of Wind Power

Wind power is a form of renewable energy, meaning it will be available as long as the sun shines. Another benefit is that wind power allows countries to produce their own electricity, rather than being dependent on foreign sources for fuels that run power plants.

Can Wind Power Supply the World's Energy Needs?

“Wind energy is the most attractive solution to the world’s energy challenges. It is clean and fuel-free. Moreover, wind is indigenous and enough wind blows across the globe to cope with the ever increasing electricity demand.”

—Global Wind Energy Council, an organization dedicated to the worldwide expansion of wind power, and Greenpeace, an international environmental organization.

“Wind power cannot, by itself, totally satisfy the electrical needs of a city, state, or nation. It is at best a supplemental source, used in conjunction with fossil fuels, nuclear fission, and hydropower.”

—Stan Gibilisco, electronics engineer, mathematician, and author.

The mid-1800s was a time of rapid settlement and growth in the United States. People throughout the country, especially those living in rural areas, became interested in harnessing wind for pumping water from the ground, and inventors aggressively sought patents either to develop new windmills or to improve on existing models. An American businessman named John Burnham envisioned a machine that was based on European designs but would overcome their shortcomings, such as automatically turning to face changing wind directions without human intervention. In addition, it would have the ability to control its own

Primary Source Quotes*

Can Wind Power Supply the World's Energy Needs?

“The generation of electricity by wind turbines is dependent on the strength of the wind at any given moment. It is therefore variable, but not unpredictable.”

—European Wind Energy Association, “Debunking the Myths,” *Wind Directions*, March/April 2007. www.ewea.org.

The European Wind Energy Association refers to itself as the “voice of the wind industry,” for actively promoting the utilization of wind power in Europe and throughout the world.

“The viability of wind power depends on where, when and how strong the wind blows—none of which is predictable.”

—Steven Milloy, “Junk Science: The Wind Cries ‘Bailout!’” Fox News, July 10, 2008. www.foxnews.com.

Milloy is the publisher of JunkScience.com and DemandDebate.com and is an adjunct scholar at the Competitive Enterprise Institute.

Bracketed quotes indicate conflicting positions.

* Editor’s Note: While the definition of a primary source can be narrowly or broadly defined, for the purposes of Compact Research, a primary source consists of: 1) results of original research presented by an organization or researcher; 2) eyewitness accounts of events, personal experience, or work experience; 3) first-person editorials offering pundits’ opinions; 4) government officials presenting political plans and/or policies; 5) representatives of organizations presenting testimony or policy.

“Some call the vast American prairie the Saudi Arabia of wind, capable of producing enough electricity to meet the entire country’s needs—assuming there’s the will to harness it.”

—Steve Hamm, “Wind: The Power. The Promise. The Business,” *BusinessWeek*, July 3, 2008. www.businessweek.com.

Hamm is senior writer in *BusinessWeek*’s information technology section.

“The combined space for windmills and batteries would be just over half the land area of Rhode Island. Sometimes really good ideas have insurmountable troubles when real-world numbers are applied.”

—Ed Hiserodt, “Making Renewable Energy Practical,” *New American*, December 8, 2008.

Hiserodt is president of Controls and Power, Inc., and is involved with the design and development of electrical control systems for industry and municipalities.

“After a decade of trailing Germany and Spain, the United States reestablished itself as the world leader in new wind energy in 2005.”

—U.S. Department of Energy, *20% Wind Energy by 2030*, July 2008. www1.eere.energy.gov.

The Department of Energy’s mission is to advance the national, economic, and energy security of the United States.

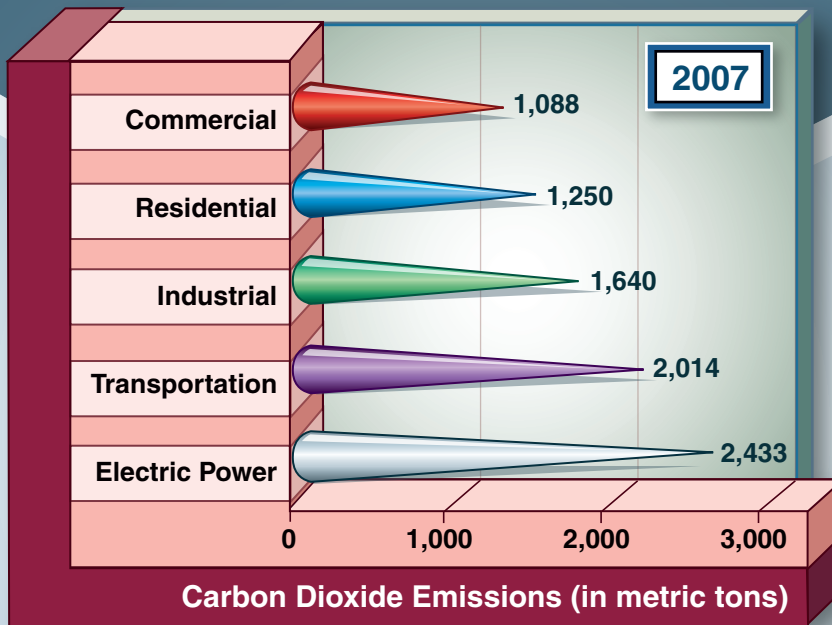
“The U.S. wind industry has been crashed at least three times, quite deliberately, by Congress messing with the tax credits from year to year and in a stop-and-go fashion.”

—Amory Lovins, interviewed by Michael Mechanic, “Power Q & A: Amory Lovins,” *Mother Jones*, May/June 2008. www.motherjones.com.

Lovins is chair and chief scientist at the Rocky Mountain Institute, an organization that is dedicated to the efficient and restorative use of resources.

Carbon Dioxide Emissions by Sector

Many scientists are concerned that Earth is warming more rapidly than at any period in history, a phenomenon known as global warming. They say that this is largely due to the worldwide burning of fossil fuels, which emits heat-trapping (greenhouse) gases such as carbon dioxide into the atmosphere. That is one of the major reasons why wind power is such a promising source of energy: It requires no burning, so it does not pollute the air or water. This graph shows carbon dioxide emissions in the United States during 2007 by sector.

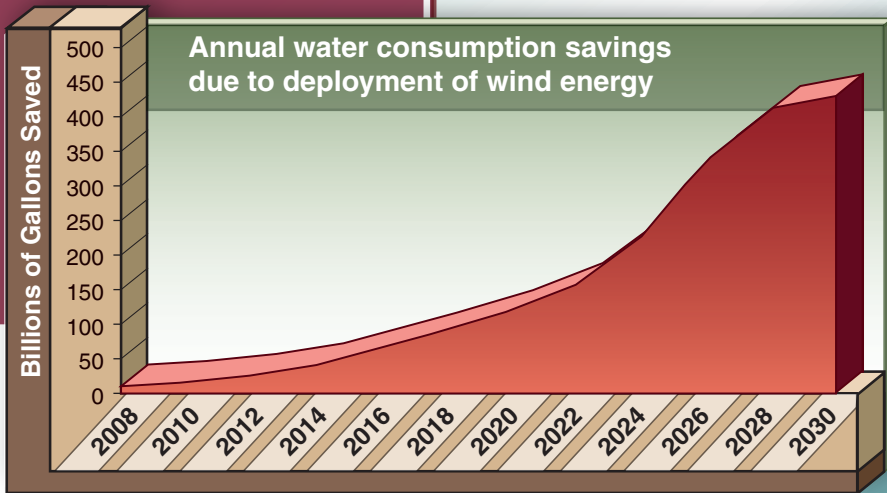


Source: Energy Information Administration, *Annual Energy Outlook 2009*, December 2008. www.eia.doe.gov.

- A March 2007 article in *Christian Science Monitor* stated that at least **37 countries** plan to add coal-fired power plants by the end of 2012, which would pump an additional **9 billion tons** (8.2 billion t) of carbon dioxide into the atmosphere each year.

Wind Power Saves Water

Nuclear power plants and those that generate electricity by burning fossil fuels require a tremendous amount of water for cooling. According to the U.S. Department of Energy, by relying more on wind power and less on fossil fuel power generation, several trillion gallons of water would be saved by 2030. This graph shows the cumulative savings if wind power provides 20 percent of America's power.



Source: U.S. Department of Energy, *20% Wind Energy by 2030*, July 2008. www1.eere.energy.gov.

- Bird mortality studies have shown that for every 10,000 birds killed by human activities, **fewer than 1 of those deaths is caused by a wind turbine.**
- Coal-fired power plants are one of the leading contributors of **carbon dioxide buildup** in the atmosphere, which is believed to be a strong contributor to global warming.

Chronology

500–900

The first windmills are developed in Persia (now Iran) and used for grinding grain and pumping water.

500

1600s

European settlers in America use wind power to grind grain and pump water, as well as to cut wood at sawmills.

1800

1854

Daniel Halladay, a mechanic from Connecticut, develops an innovative windmill that can automatically turn to face changing wind directions and control the speed of its own wheel so it does not spin too fast in high winds.

1859

Edward L. Drake is the first to drill for oil on his land near Titusville, Pennsylvania (which is a radical concept for the time); he strikes oil and successfully pumps it to the surface.

1888

Charles F. Brush, an inventor from Cleveland, Ohio, develops the first large windmill that can generate electricity.

1893

The World's Columbian Exhibition is held in Chicago, Illinois, where 15 windmill companies showcase their goods.

1900

1931

The first vertical-axis windmill is patented by French engineer Georges Darrieus.

1941

The Grandpa's Knob wind turbine, located on a hilltop in Rutland, Vermont, supplies electricity to the local community for several months during World War II.

1973

The Organization of Petroleum Exporting Countries (OPEC) oil embargo causes oil prices to spike, resulting in increased interest in wind power and other renewable energy sources.

1990

More than 2,200 megawatts of wind power is installed in California, representing more than half of the world's estimated capacity at the time.

2004

Worldwide installed wind-generated electricity reaches 30,000 megawatts.

2007

The United States becomes the world leader in new wind power installations.

2003

The United States' total installed wind-generated electricity capacity reaches nearly 5,000 megawatts.

2006

Wind turbines in the United States generate a total of 26.6 billion kilowatt-hours of electricity, enough to power more than 2.4 million households.

2008

British Petroleum reports that worldwide oil and coal consumption is outpacing annual production, with the demand for coal rising for the fifth consecutive year.

2009

President Barack Obama announces that he wants to double wind, solar, and geothermal energy production in the United States by 2012.

1970

1990

2000

2010

Related Organizations

American Council on Renewable Energy (ACORE)

1600 K St. NW, Suite 700

Washington, DC 20006

phone: (202) 393-0001 • fax: (202) 393-0606

e-mail: info@acore.org • Web site: www.acore.org

ACORE works to bring all forms of renewable energy into the mainstream of America's economy and lifestyle. Its Web site offers news releases, policy descriptions, reports, and links to articles.

American Wind Energy Association (AWEA)

501 M St. NW, Suite 1000

Washington, DC 20005

phone: (202) 383-2500 • fax: (202) 383-2505

e-mail: windmail@awea.org • Web site: www.awea.org

AWEA promotes wind energy as a clean source of electricity for consumers around the world and refers to itself as the "hub of the wind energy industry." Its Web site offers a collection of fact sheets, the *Wind Energy Weekly* newsletter, articles, policy statements, and news releases.

Energy Efficiency and Renewable Energy (EERE)

Mail Stop EE-1

Department of Energy

Washington, DC 20585

phone: (877) 337-3463

Web site: www.eere.energy.gov

An agency of the U.S. Department of Energy, the EERE seeks to enhance energy efficiency and productivity; bring clean, reliable, and affordable energy technologies to the marketplace; and make a positive difference in Americans' lives by enhancing their energy choices and quality of life. Available on its Web site are speeches, congressional testimonies, news

Index

- acid rain, 52–53
- Alliance for Clean Energy New York, 51
- Altamont Pass Wind Resource Area (CA), 56
- American Wind Energy Association, 35, 76
 - on bird kills, 58
 - on noise from newest turbines, 17
- Appalachia, mountain top coal mining in, 54–55
- Asplund, Richard W., 30, 51

- Baerwald, Erin, 57
- bats, wind turbines and killing of, 7, 17, 57
- bird mortality
 - causes of, 64 (chart)
 - is being reduced, 17, 58
- Bloomberg, Michael, 74
- Blue H Technologies, 68–69
- British Petroleum (BP), 39
- Brush, Charles F., 8, 21
- Burbo Bank offshore wind farm (Irish Sea), 11, 56
- Burnham, John, 20–21

- carbon dioxide (CO₂)
 - atmospheric
 - amount generated by oceangoing ships, 69–70
 - correlation between fossil fuel burning and, 55–56
 - emissions
 - projected cut in, from wind power, 15, 17, 55, 61, 76 (chart)
 - by source, 62 (chart)
- China
 - coal consumption in, 40
 - environmental damage from coal burning in, 53
 - wind power generating capacity in, 75
- Christian Science Monitor* (newspaper), 62
- Clyde wind farm (Scotland), 23–24
- coal, 40
 - consumption of/electricity produced by, 46
 - creation of, 38
 - decline in reserves of, 44
 - as dirtiest fuel, 52–53
 - mountain top removal in mining of, 54
 - percent of world's electricity generated by, 36
 - pollution from, 52–53, 61
 - power plants fueled by
 - number of countries planning to build, 62
 - support for, by country, 79 (chart)
 - worldwide consumption of, 49 (chart)

- Darrieus, Georges, 10
- Denmark
 - offshore wind farms of, 25
 - wind power as percent of total energy, 14
 - wind power goals of, 75
- Department of Energy, U.S. (DOE), 29, 73, 76
 - on benefits of wind power, 60
 - on bird kills from wind turbines, 17
 - on CO₂ reductions from wind power, 15, 17, 55, 61
 - on need for new transmission lines, 41
 - plans for increase in wind power by, 22–23
 - on potential of offshore wind farms, 11
 - on water conservation from wind power deployment, 56
- Department of Homeland Security, U.S., 18

- electricity
 - generating capacity, measurement of, 14
 - global, percent generated by coal, 36
 - global/U.S. generation of, by source, 47 (chart)
 - wind-generated, 12
 - growth in, 31