

# *Harnessing the Power of the Wind*

**A CONTEMPORARY  
USE FOR A HISTORIC  
ENERGY SOURCE**

*Kenneth C. Wolensky with photographs by Don Giles*

**M**uch like the oil farms of the last century were for drillers and riggers, Pennsylvania's wind farms are proving grounds for engineers and technicians as they harness wind power. The long-standing use of wind power that for centuries propelled sailing vessels has been transformed throughout the world to produce electricity. Farmers used wind power in the late nineteenth and early twentieth centuries to pump water, grind grain, and, sometimes, generate electricity. And Pennsylvania was no exception.

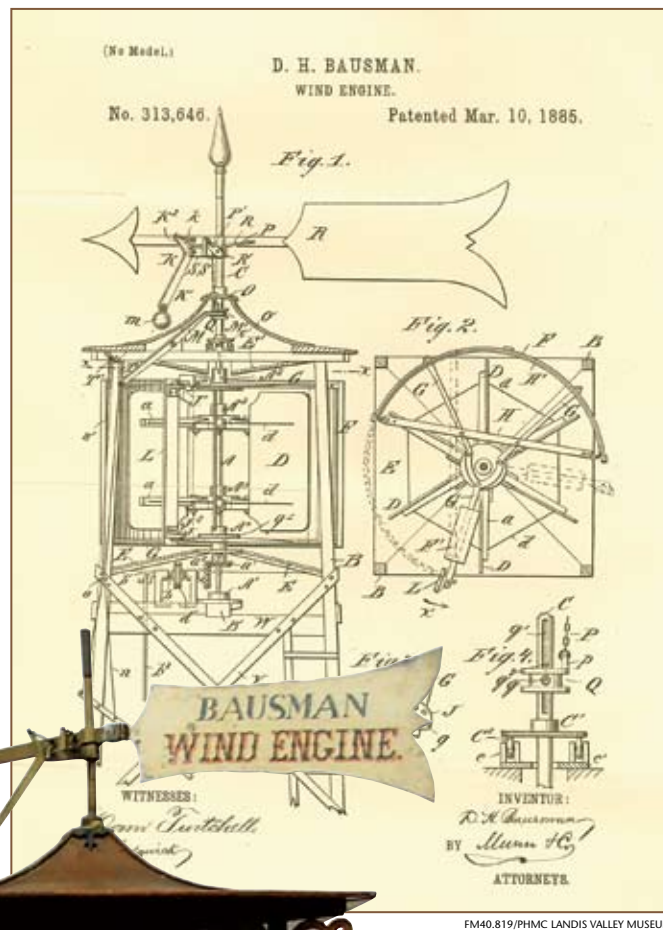
PHMC staff photographer Don Giles captured both the symmetrical beauty and implications for Pennsylvania's energy future at Locust Ridge Wind Farm, straddling Schuylkill and Columbia counties.

PHMC STATE MUSEUM OF PENNSYLVANIA/PHOTO BY DON GILES

Lancaster County inventor David Herr Bausman (1864–1911) patented a windmill in March 1885 and designed four models between 1884 and 1900, which were erected on farms in Pennsylvania. The son of a Pennsylvania German farmer, Bausman was twenty-one when he submitted his first drawings for what he called a “Wind Engine” to the United States Patent Office (now the United States Patent and Trademark office). “The most interesting thing about Bausman,” says Bruce D. Bomberger, curator at PHMC’s Landis Valley Museum in Lancaster, “is that he had a lifelong interest in wind power. He began making models and testing applications on his workbench—which we have at the museum—when he was sixteen years old.” Bomberger explains that Bausman “was unusually diverse for an inventor, making his own drawings and three-dimensional working models, manufacturing his products, and handling marketing, sales, and advertising. Inventors generally don’t tackle or excel at all aspects of taking the idea from the bench to the consumer.” When he couldn’t be competitive with other windmill makers, he diversified by adding other agricultural inventions to his repertoire and making outdoor benches and lawn swings, one of which is in the museum’s collections. He made the original steel and wood benches for Milton S. Hershey’s amusement park in 1908. Not much else is known about the Millersville resident, who was the subject of an exhibit at the museum in 2007, which Bomberger curated with objects, artifacts, and ephemera acquired through four unrelated donations over a period of forty years. Landis Valley Museum also owns a detailed traveling model of a windmill made by Bausman, complete with its traveling case that bears express labels. “From boyhood he was a mechanical genius and built up a very successful business,” the Lancaster County Historical Society remarked upon Bausman’s death at the age of forty-eight in 1911.

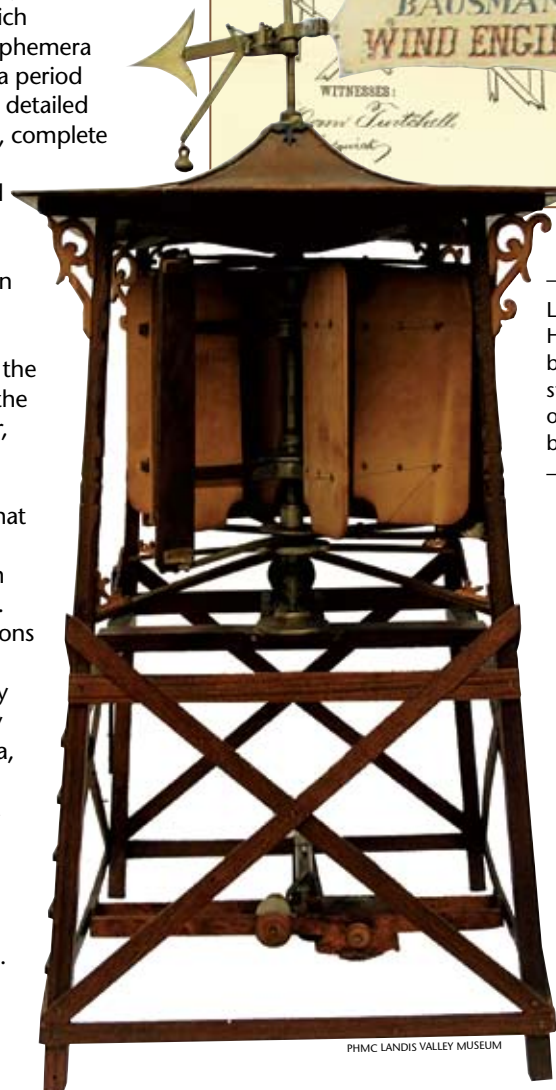
This year marks the 155th anniversary of the invention and patenting, on August 29, 1854, of the first commercial fully self-governing windmill in the United States, the Halladay Standard. Its inventor, Daniel Halladay (1826–1916), a machinist in Ellington, Connecticut, established the Halladay Windmill Company to manufacture a windmill that allowed it to pivot into the wind. A crankshaft transformed the rotary motion of the mill into an up-and-down action needed to operate a pump. Halladay’s windmill could move hundreds of gallons of water each day to irrigate fields and supply livestock. Because his windmills were aggressively marketed in the Midwest and the West, Halladay moved his operation from Connecticut to Batavia, Illinois, just west of Chicago, in 1863. With John Burnham, the company’s sales agent in Chicago, he organized the U.S. Wind Engine and Pump Company. Of the more than one thousand windmill factories in the country, the U.S. Wind Engine and Pump Company was for a time the largest, with more than two hundred employees.

Both Bausman’s and Halladay’s inventions proved visionary in the twentieth century as growing demand for alternatives to expensive, environmentally unfriendly, and limited fossil



FM40.819/PHMC LANDIS VALLEY MUSEUM

Lancaster County inventor David H. Bausman understood the benefits of wind energy for farmsteads with his 1885 wind engine, one of four patents he received between 1884 and 1900.



PHMC LANDIS VALLEY MUSEUM

fuels led to advancements in wind technology and turbines, particularly in the western world. In 2008, the United States generated more electricity from wind turbines than Germany: a total of 25,000 megawatts (MW). (A megawatt is equal to one million watts; a watt is equal to one joule of energy per second.) Wind turbines in the United States produce enough energy to power 5.3 million homes, a number that will continue to grow as electricity consumption is expected to increase by 25 percent in the next fifteen years nationwide. More commercial wind farms have emerged in the United States in the past two decades than at any other time. Wind farms are producing electricity in thirty-eight states, including Pennsylvania. States leading with installed wind power capacity are Texas (6,297 MW), California (2,439 MW), Iowa (1,394 MW), Minnesota (1,377 MW), and Washington (1,367 MW). Pennsylvania, the third largest producer of electricity in the United States, mainly from coal-fired and nuclear power plants, ranks sixteenth nationally in wind capacity with 400 MW.

National and state public policy has spurred rapid growth of wind power as an energy source. The U.S. Department of Energy advocates that 20 percent of electricity produced in the country by 2030 should be generated by wind power. Recently enacted federal economic stimulus measures provide financial incentives for the development of commercial wind farms. In 2004, Governor Edward G. Rendell and the General Assembly of Pennsylvania agreed on a law, Act 213, commonly called the Alternative Energy Portfolio Standards, requiring that nearly 20 percent of electricity generated by 2020 be from alternative sources. Today, the Commonwealth’s Energy Harvest, a program



FM40.848/PHMC LANDIS VALLEY MUSEUM



IRON MAN WINDMILL COMPANY HISTORIC WINDMILL ARCHIVE

Early manufacturers Daniel Halladay and Daniel Herr Bausman (above and below) realized the importance of marketing their windmills with colorful placards and trade cards.



FM40.821/PHMC LANDIS VALLEY MUSEUM

Windmills, including a Bausman Wind Engine (left) erected on a Lancaster County farm in 1900, pumped well water vital to farm families, stops for steam locomotives, and elevated community water towers.



IRON MAN WINDMILL COMPANY HISTORIC WINDMILL ARCHIVE

Common on Pennsylvania farms between 1865 and the 1920s, windmills still pump well water for families living in rural and remote areas of the country.

Local governments regulate building permits, height and noise ordinances, and collect fees and taxes associated with wind farms. State government regulates environmental resource issues such as erosion and sediment controls and wildlife impact. The development of wind farms is not without opponents. Several ecological issues have surfaced, such as noise level, visual impact, and avian and bat mortality, among others. Wind farms appear to have minimally impacted wildlife and the migratory patterns of birds, but bat deaths have been reported at several wind farms in the United States, including Pennsylvania. To ensure limited environmental and wildlife impact in the Keystone State, the Pennsylvania Game Commission's Wind Energy Voluntary Cooperative Agreement requires operators to collect two years of post-construction wildlife impact data. All wind farms are subject to review by the Pennsylvania Natural Diversity Index comprised of the U.S. Fish and Wildlife Service, the Pennsylvania Game Commission, the Pennsylvania Fish and Boat Commission, the Pennsylvania Department of Conservation and Natural Resources, and the Pennsylvania Department of Environmental Protection. The Pennsylvania Wind and Wildlife Collaborative, a consortium of these state agencies, environmental interest groups, and wind energy companies, analyzes potential and real impacts of wind farms on wildlife habitat and provides policy recommendations.

The effects of wind farm development on historic, cultural, and archaeological resources is a topic of great debate. Pennsylvania's State Historic Preservation Office (SHPO), assigned to PHMC, reviews the impact of proposed wind farms on historic and archaeological resources pursuant to statutes such as the Pennsylvania History Code and the National Historic Preservation Act of 1966. The public has, likewise, taken an interest in this issue. Save Our Allegheny Ridges (SOAR) has emerged in western Pennsylvania to raise awareness about wind farm siting issues and to protect historic resources from development, such as the picturesque Dutch Corner area of Bedford County. SOAR's goal is to preserve the viewshed, character, and natural beauty of the county.

From concept to full operation often takes several years. Ten wind farms currently exist in Pennsylvania. Four are located in Somerset County and one each in Fayette, Schuylkill and Columbia, Luzerne, Wayne, and Cambria and Blair counties. The largest wind farm in the

Commonwealth is Locust Ridge I in Schuylkill and Columbia counties. Visible to the north from Interstate 81, the impressive wind farm boasts seventy-two turbines along the thirteen-mile long Locust Ridge that generate 120 MW of electricity, more than one-quarter of Pennsylvania's total output of energy from wind power.

A marked feature of Locust Ridge is that it represents a new energy technology against a backdrop of a familiar Pennsylvania fuel source—anthracite, or hard coal, which dominated the region for decades. To explain the development of Locust Ridge and its context within Pennsylvania's historic contributions to the nation's demand for energy, its developer Joe Green, Orwigsburg, Schuylkill County, explained the importance of harnessing the power of wind on Thursday, April 30, 2009, at Locust Ridge.

After graduating from North Schuylkill High School, he immediately joined the U.S. Navy. Shortly after completing technical training, Green received an NROTC scholarship to Carnegie Mellon University, Pittsburgh, where he earned a degree in polymer chemistry and a commission in the Navy. He served in the U.S. Atlantic Fleet as a destroyer weapons officer. He left the Navy to work as a product engineer and, later, as a sales manager for a large printed circuit board manufacturer.

**You are originally from the anthracite region. Tell us about your background.**

I was born in Ashland, Schuylkill County, and raised in Shenandoah. My family lived in Shenandoah and Mahanoy City. Most still reside in the area. Like most people around here, coal mining has touched their lives. My grandfather was a miner and a black lung victim like so many others. My father was involved in the industry. It was the main source of employment and we have seen its decline over the last thirty years or so. In the 1970s, when I was young, Shenandoah was still a booming town. By the 1980s, the decline was apparent as oil started to become cheap and people converted from burning anthracite to installing oil furnaces in their homes. Energy is something on everyone's mind around here.

My father was born in 1929 so he grew up in the Great Depression and times were very, very tough. The people relied on anything, whatever it took to continue to survive. That was passed down to my generation. We hunted. We fished. We did all of that, and that was an important part of our diets and our ability to survive. Everyone worked hard and—God forbid if you were lazy—that was just absolutely unacceptable, not just in my house but in anyone's. You had to be a hard worker and apply yourself to succeed and be respected.

I lived out of the area for many years and went to Carnegie Mellon University and earned a degree in polymer chemistry, then was in the Navy for nine years in its nuclear power program. I then worked for a circuit board manufacturer on Long Island. My sales territory was Pennsylvania. I never thought I would come back to Shenandoah, however. But I met my wife-to-be here and we settled down.

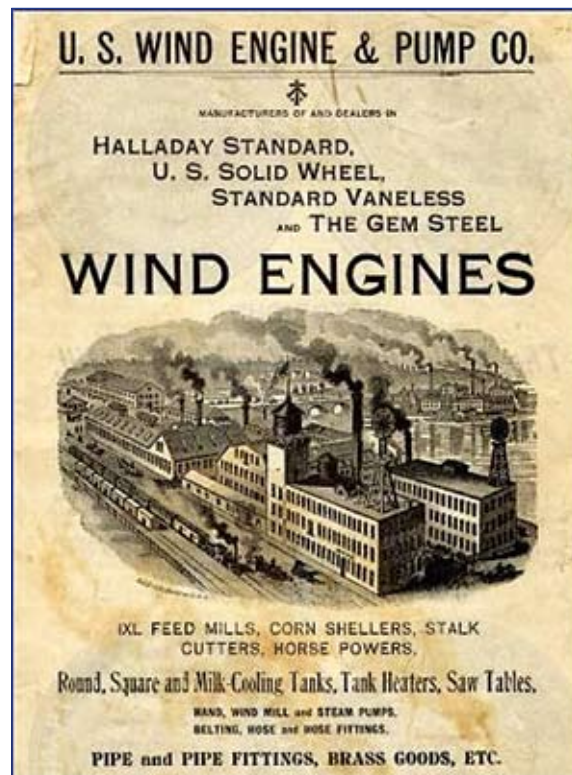
Pennsylvania, with a record of advancements in wood, coal, oil, gas, and nuclear energies, is adding wind power to the list, evidenced by the Locust Ridge Wind Farm, the first phase of which was completed in 2006.

PHMC STATE MUSEUM OF PENNSYLVANIA PHOTO BY DON GILES



administered by the Pennsylvania Department of Environmental Protection (DEP), provides grants to public and private entities—ranging from school districts to utility companies—for the implementation of clean and renewable energy technologies, including wind power. Since its inception in 2003, Energy Harvest has awarded \$33.5 million for innovative projects and leveraged another \$109.7 million in private funding. In 2006, according to DEP, the Commonwealth became the leading green energy customer when it began purchasing 20 percent of its electricity from renewable sources, making it the largest government purchaser in the nation. DEP also recently reported that the Commonwealth now purchases 28 percent of state government's electricity from renewable wind and hydroelectric sources.

Emerging green energy technologies of solar, bio-fuels, and wind are gradually transforming traditional energy markets. Wind farms require substantial capital investment—turbines alone cost about \$2 million each (but the fuel is free). Wind turbine manufacturing facilities in Pennsylvania supply most of the needs of wind farms built in the Commonwealth, such as plants in Ebensburg, Cambria County, and Fairless Hills, Bucks County. Other facilities that manufacture wind farm components include the Hodge Foundry in Greenville, Mercer County, Elwood Forge in Irvine, Warren County, and GE Wind Energy in Forest City, Susquehanna County.



IRON MAN WINDMILL COMPANY HISTORIC WINDMILL ARCHIVE



PHMC STATE MUSEUM OF PENNSYLVANIA/PHOTO BY DON GILES

Schuylkill County wind farm developer Joe Green, photographed in Locust Ridge's control and communications center, and his wife Angel took a financial risk on the future of wind energy.

### How did you become interested in wind energy?

It's in my blood to build things. Yet, the only windmill I ever saw in my younger years was probably in a picture from somewhere in Holland. With my job I was traveling through this part of the state and in Schuylkill County and especially in the wintertime I would practically get blown off the road on Interstate 81. Winds are very strong here. In 2001 the tech bubble burst and of course I was in the tech industry and realized that a career change would be necessary. I had lived on top of Locust Ridge and knew it was windy. I hunted there for years and did not want to be up on top of the mountain in the wintertime because we would freeze to death. We knew that it was probably going to be a good site for a wind farm. It was far from homes. There was not very good use for the land that was here so it seemed like a pretty good fit.

One day my wife Angel and I were driving on the Pennsylvania Turnpike and we stopped in Somerset to observe the wind turbines located there. I said to her, "I just have to build one of those turbines." She said, "I love your ideas—you just never follow through with them." "Well buckle up," I said, "this is going to be a bumpy ride." We committed all of our savings, maxed out our credit cards, mortgaged our house, and took a big gamble on what is now Locust Ridge Wind Farm.

Locust Ridge Wind Farm is a beautiful site. It is about as good as it gets with good winds, access to transmission lines, and distance from the homes. The land owner, the Girard Estate, was interested.

### Can you explain the many issues involved in developing a wind farm?

We began development in late 2003. We named it Locust Ridge Wind Farm, LLC. There are actually two wind farms: Locust Ridge I and II. From early 2004 into the very beginning of 2006 was the development cycle for Locust Ridge I. A company by the name of Community Energy acquired the project then and in very short order Iberdrola Renewables acquired Community Energy. Iberdrola Renewables is the world's largest renewable energy company based in Madrid, Spain. The company was looking for an entrée into the United States and its first acquisition in the United States was Community Energy. The company's first Wind Farm constructed in the United States was Locust Ridge Wind Farm.

Meanwhile, we went through the development process. Consultants were hired to help with site selection. Initially, we had to lease the site from the land owner and we had to test the winds. A test tower was installed to examine wind velocity, direction, and frequency, and we gathered data for about a year. We had to evaluate the interconnection to the grid, because we have to be able to send our power somewhere, and, fortunately, there is a power transmission line very close to Locust Ridge. We also had to comply with all local zoning codes, land development issues, and permits, including all of the related environmental work, which was very extensive.

I am very serious about the environment and making sure that there is nothing we do that might be a problem. We certainly do not want to kill any animals or disturb any endangered plants or species. Then we did all of the design work for the layout of the facility, the erosion sedimentation controls, and related matters that are permitted by the Pennsylvania Department of Environmental Protection in order to actually move earth up here and make sure that we are not going to cause problems for adjoining land owners. The last piece we worked on was the power purchase agreement, to actually have someone buy the power. So we began those initial discussions with PPL [Pennsylvania Power and Light Corporation, headquartered in Allentown, Lehigh County]. When I finished the Locust Ridge I project at the end of 2006, I immediately focused on Locust Ridge II, which came on-line in early 2009.

### What is the size of Locust Ridge, and how does it compare to other wind farms?

Locust Ridge I consists of thirteen turbines of two megawatts each, totaling twenty-six megawatts. Locust Ridge II has an additional fifty-one turbines for a total of 102 MW. Combined, that's 128 MW and comprises the largest wind farm in Pennsylvania. We estimate the Locust Ridge projects will supply power for about 40,000 homes annually. In the United States, very large wind farms, such as one in Texas, generate about 740 MW. In the West, where there are lots of land and good winds, you can build wind farms that are much larger than anything you would find east of the Mississippi. Of course, our topography is so different here and the constraints of development are different. We will not see a very large Texas-like wind farm here. About 100 to 150 megawatts is probably about as big as you are going to get on the East Coast.

In terms of acreage, wind farms have a very small footprint. The total land for Locust Ridge I is about 1,038 acres under lease but the turbines use only 38 of those acres. The balance was left to its original use, for wildlife, hunters, hikers. At Locust Ridge II we have 5,700 acres under lease with 150 of those acres used for the wind farm.

### Once a wind farm is operational there are obviously maintenance issues, correct?

The machines are big and complex. They are also expensive. If you were to go and buy an expensive car you would have a very rigorous periodic maintenance program to follow to make sure that it runs well for a long period of time and the machines are no different. A large part of the maintenance effort is going from machine to machine to machine and doing the period maintenance, including periodic maintenance at three-, six-, and nine-month intervals. When you have a lot of turbines, you find that you are always working on at least one because something happens such as a blown fuse, changes in air pressure or temperature impact a turbine's operation, one has to be reset, or there is some other repair issue. So a typical day is pretty varied. We usually have about a dozen people on site—from maintenance contractors to operations staff to keep things running.



PHMC STATE MUSEUM OF PENNSYLVANIA/PHOTO BY DON GILES

Roads to Pennsylvania's energy solutions lead to more windmill generators. This turbine is located on the Allegheny Ridge Wind Farm between Altoona, Blair County, and Ebensburg, Cambria County, where its huge blades are made by Gamesa Energy USA. The wind farm is operated by Babcock and Brown.



PHMC STATE MUSEUM OF PENNSYLVANIA/PHOTO BY DON GILES

More than 8,000 parts go into each wind turbine generator. Gamesa Energy USA, a subsidiary of Gamesa of Spain, manufactures its wind turbine blades (above) in Ebensburg, Cambria County. The company is developing a new generation of longer and lighter blades.

### Why do you think wind energy has become of interest in the United States?

The fuel is free. There are zero emissions. It provides tax revenue to local municipalities. It provides jobs.

Locust Ridge I had about eighty people working here. At Locust Ridge II we had more than 250. These are good jobs with good pay. Plus there are several turbine manufacturing facilities in Pennsylvania that provide very good jobs and a boost to the local communities. Construction does require that a road be built to handle heavy equipment, such as large construction cranes. After the project is completed and the heavy equipment leaves we can make do with a much smaller area so the land is returned to its natural habitat.

### Are there environmental and habitat concerns at Locust Ridge?

We are very concerned about the environment at Locust Ridge. I was a regular on this ridge in my earlier years and wanted to protect the natural environment. Once the construction was completed we cleaned up the site and it looks beautiful. It is clean and safe and the animals are here. There are deer all over the place. Bear, too, along with smaller species. Hunting occurs just off our property all along this ridge. We are part of Pennsylvania's Wind and Wildlife Collaborative and follow its policies and passed the review of Pennsylvania's Wildlife Diversity Index.

### What is the future of wind farms in Pennsylvania?

The U.S. has grown the infrastructure to manufacture turbines and components. We are certainly seeing more and more of these companies in the United States and building here in the United States. The overseas companies work very well with us and they supply a good product. On the economic side, there are huge benefits to switching to renewable energy, including a cleaner environment and zero emissions. Within an hour's drive of this site there are multiple opportunities for wind farms. Development has to be balanced with protecting the environment and habitat as we have done at Locust Ridge. In the long run, there is a great potential in wind energy in Pennsylvania and the United States. We are just seeing the beginning. 🌬️

The relatively new Bear Creek Wind Power Project is visible from the Pennsylvania Turnpike's northeast extension in Luzerne County, less than ten miles from Wilkes-Barre. The Gamesa turbines are expected to generate more than seventy-five million kilowatts of electricity each year.

PHMC STATE MUSEUM OF PENNSYLVANIA/PHOTO BY DON GILES



*Kenneth C. Wolensky, a historian with the Pennsylvania Historical and Museum Commission, offers guidance to a variety of the agency's public history programs and annual themes, including "Energy: Innovation and Impact," being observed through 2009. He has written and presented widely on historic preservation and on labor, industrial, political, and social history.*

*Don Giles, a resident of Camp Hill, moved to central Pennsylvania from Cumberland, Maryland, in 1990. He worked for Carl Socolow, an accomplished photographer who was awarded a Guggenheim Fellowship for 2006, and the Pennsylvania Rural Electrification Association. Since joining the staff of The State Museum of Pennsylvania in 1995, his photographs have appeared in numerous brochures, pamphlets, guidebooks, annual reports, Web pages, and Pennsylvania Heritage. An exhibition of his photographs, "Steel: Made in Pennsylvania," debuted at The State Museum in 2006, which has since traveled throughout Pennsylvania. The exhibit is currently on view at the Johnstown Area Heritage Association's Frank & Sylvia Pasquerilla Heritage Discovery Center in Johnstown, Cambria County.*

*The editor thanks Bruce D. Bomberger, curator, Landis Valley Museum, Lancaster, for providing background and illustrations relating to inventor David Herr Bausman (1864–1911), and Tom Conlon, CEO, Iron Man Windmill Company, Hubei, China, for granting permission to use images drawn from the company's Historic Windmill Archive.*



PHMC STATE MUSEUM OF PENNSYLVANIA/PHOTO BY DON GILES

Because Joe Green looked up to the sky for energy solutions, his wind farm dream is now reality.

### FOR FURTHER READING

Baker, T. Lindsay. *A Field Guide to American Windmills*. Norman: University of Oklahoma Press, 1985.

\_\_\_\_\_. *American Windmills: An Album of Historic Photographs*. Norman: University of Oklahoma Press, 2007.

Burton, Tony, et al. *Wind Energy Handbook*. New York: John Wiley and Sons, 2001.

Chiras, Dan, et al. *Power From the Wind: Achieving Energy Independence*. Gabriola Island, British Columbia: New Society Publishers, 2009.

Foster, Robert, ed. *Wind Energy: Renewable Energy and the Environment*. Boca Raton, Fla.: CRC Press, 2009.

Hills, Richard Leslie. *Power from Wind: A History of Windmill Technology*. Cambridge, United Kingdom: Cambridge University Press, 1994.

Righter, Robert W. *Wind Energy in America: A History*. Norman: University of Oklahoma Press, 1996.

### Readers wanting to learn more about wind energy in Pennsylvania and the nation can visit the following Web sites.

U.S. Department of Energy's Wind Powering America, [www.windpoweringamerica.gov](http://www.windpoweringamerica.gov)

Pennsylvania Department of Environmental Protection, [www.depweb.state.pa.us](http://www.depweb.state.pa.us) (Keyword: Wind Energy)

American Wind Energy Association, [www.awea.org](http://www.awea.org)

Pennsylvania Wind and Wildlife Collaborative, [www.dcnr.state.pa.us/wind/](http://www.dcnr.state.pa.us/wind/)

Bats and Wind Energy Cooperative, [www.batsandwind.org/](http://www.batsandwind.org/)

American Wind Wildlife Institute, [www.awwi.org](http://www.awwi.org)

Pennsylvania Wind Working Group, [www.pawindenergynow.org](http://www.pawindenergynow.org)

**O**n Sunday, November 1, The State Museum of Pennsylvania in Harrisburg will open "Wind Titans: A Pennsylvania Photo Essay." Of the more than 500 wind farms in the United States, Pennsylvania claims ten, a number expected to grow exponentially because wind power is the fastest growing energy generation technology in the world.

For the exhibit, PHMC photographer Don Giles traveled throughout the Commonwealth to capture the majesty of the towering wind turbines that have sprung up over the past decade on Pennsylvania's mountain ridges. His stunning photographs not only document the turbines' stately presence on the landscape, but they also capture the ethereal beauty of the gently rotating blades. In addition to large format photographs of wind farms and turbines, the exhibit will also feature images of turbine manufacturing in Pennsylvania. The exhibit is being underwritten by PPL, incorporated as the Pennsylvania Power and Light Company in Allentown, Lehigh County, in 1920.

"Wind Titans: A Pennsylvania Photo Essay" continues through Sunday, May 2, 2010. To learn more, telephone (717) 787-4980 or visit [www.statemuseumpa.org](http://www.statemuseumpa.org) on the Web. Admission to the museum is \$3 for adults, and \$2 for children age twelve or younger and seniors. Members of the Pennsylvania Heritage Society at the Individual level and higher enjoy free admission.