

WINDPOWER OUTLOOK 2009

Wind: A leading source of new electricity generation

Wind power is now one of the country's largest sources of new power generation of any kind

In 2008, with over 8,500 megawatts (MW) installed, wind power provided 42% of all the new generating capacity added in the U.S., according to initial estimates, up from less than 2% of new capacity added in 2004 (see chart below). The fact that wind power is now mainstream is good news for our economy, our environment, and our energy security.

An economic and job dynamo for the 21st century

The new wind projects installed in 2008 represent an investment of \$17 billion – the largest capital investment in the U.S. electricity sector that year. Hundreds of billions of dollars in investment – in wind project installations, wind turbine component manufacturing facilities, and transmission infrastructure to bring the new electricity to market – are poised to flow into the economy as wind power production ramps up.

Wind power is also a job creation dynamo, creating 35,000 jobs in 2008 alone despite the economic downturn and providing a broad range of business and employment opportunities in different regions of the country. About 85,000 people worked in

the wind energy industry as of the end of December 2008, up from 50,000 in 2007. Many of those new jobs are in manufacturing.

Protecting our environment

Wind power is a powerful climate change solution, ready to deliver emissions reductions that are (a) large in scale, (b) effective immediately, and (c) affordable. A 2008 report by the U.S. Department of Energy (DOE) found that wind energy could generate 20% of the nation's electricity – what nuclear power generates today – by 2030 – nor is that a ceiling. Rapid deployment is urgently needed from an environmental point of view alone: the power generation sector is the largest contributor of CO₂ emissions in the U.S. economy, accounting for close to 40% of U.S. emissions each year. As concerns about climate change become more urgent, wind power is an excellent option for rapidly and cost-effectively reducing emissions.

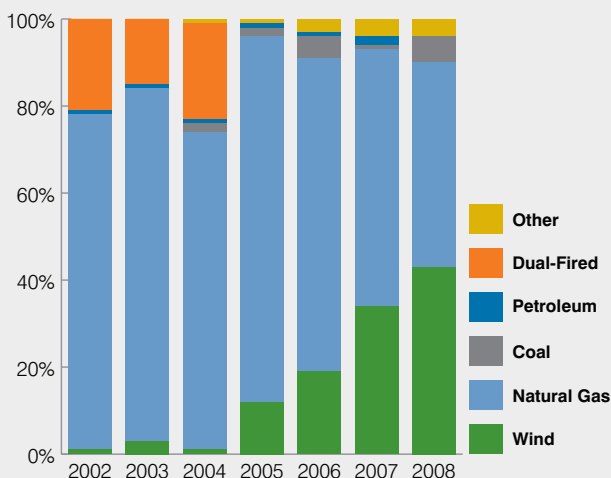
Strengthening our energy security

Wind is a domestic, inexhaustible source of energy, and is free from fuel price volatility. U.S. wind resources are also vast enough to supply the electricity needs of the entire country several times over, according to DOE. This domestic and infinite source of energy can be used not only for conventional power generation, but also for plug-in hybrids or electric vehicles, helping reduce dependence on a variety of fuel imports and conserve strategic national supplies.

Key: long-term federal policy commitment

Wind power now needs a large U.S.-wide market in which to grow and provide these benefits. With the right policies to sustain renewable energy's momentum – including a national renewable electricity standard to create a stable market for capital investment, an interstate network of transmission lines or "green power superhighways" to bring renewable energy to market, and strong climate legislation with early and aggressive emissions reductions targets – the U.S. wind energy industry is ready to deliver on President Obama's call to double production in three years and on track to generate 20% of electricity and more, leveraging billions in investment and creating tens of thousands of jobs.

New U.S. Generating Capacity by Energy Source



Strong renewable energy policy = Strong economic benefits

President Obama has outlined as a candidate a range of policies to encourage investments in wind and other renewable energy sources, including (www.newwindagenda.org):

- ▶ A national renewable electricity standard (RES) with a target of generating at least 25% of the nation's electricity from renewables by 2025, and a near-term target of 10% by 2012 (a *Washington Post* poll in December 2008 found that 84% of Americans support such a standard);
- ▶ A high-voltage interstate transmission "superhighway" to tap the nation's vast renewable energy sources; and
- ▶ National climate change legislation that recognizes the value of wind power in reducing greenhouse gas emissions.

Job creation, climate change and public health, and energy security imperatives are the main drivers for renewable energy policy. It's also important to note that renewable energy policies pay for themselves over time on a macroeconomic basis even without factoring in the value of these job creation, environmental and other benefits.

Wind helps drive down the cost of electricity and protects against fuel price risk

Wind power does not need any fuel for its operations. Wind power therefore "backs down" more expensive sources of generation—that is, those that are the most expensive at the margin because of variable fuel costs. In large, competitive markets, this lowers the electricity market price for all generators. Renewable energy protects customers when they need it the most: when gas or other fossil fuel prices rise.

Studies confirm that renewable energy protects consumers:

- ▶ A 2009 Union of Concerned Scientists (UCS) study estimates that under a 25% national renewable electricity standard, all other things being equal, average consumer electricity prices would be 7.6% lower, with an average annual reduction of 4.3% through 2030.
- ▶ A 2007 U.S. Energy Information Administration (EIA) study on 25% renewables by 2025 also shows a reduction in consumer expenditures.
- ▶ A 2007 study by global energy consulting firm Wood Mackenzie on a 15% national RES found that electricity prices would decrease by 7%-11%.

Transmission lines for renewable energy pay for themselves

Studies by regional authorities in Texas, the Midwest and Eastern U.S., Southwest Power Pool, and elsewhere show that, thanks to fuel savings, lower congestion costs and other benefits, investment in transmission lines for renewable energy more than pays for itself on a macroeconomic basis (see chart).

Wind helps drive down the cost of natural gas

Using wind power on a large scale means that less fuel (mainly natural gas and coal) is used for electricity generation. This in turn applies downward pressure on the price of fuel itself. If wind were to generate 20% of U.S. electricity by 2030, nationwide use of natural gas use would decline by an estimated 11% and natural gas consumers (home heating, industrial use) could see savings of \$86 billion to \$214 billion. This saving alone offsets the incremental investment of \$43 billion in wind turbines and additional transmission lines, according to the DOE report on 20% wind by 2030.

It is not expensive to balance wind power

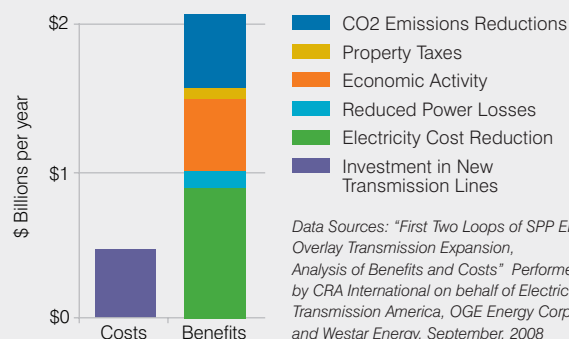
With flexible power on the electricity system (such as natural gas-fired plants that can easily be turned down or up), with large regional balancing areas, and with wind forecasting techniques, large amounts of wind energy and other variable renewable energy sources can be integrated onto the grid. The DOE report on 20% wind by 2030 confirmed that level of wind power could reliably and cost-effectively be integrated into the nation's electricity supply, while reducing fossil fuel use in power plants across the U.S.

Wind wealth accrues nationwide

Wind power development creates economic opportunity across the country and across sectors. Wind projects in windy rural areas generate local construction and wind technician jobs, increase landowner and farmer income, and revitalize the rural communities in which they are located. Wind power also creates manufacturing jobs across the country, often in the Southeast or in rust belt states. Last but not least, wind turbines operate without pollution and with minimal impacts, helping maintain natural wealth.

Investing in Transmission for Renewable Energy Leverages Multiple Benefits

Costs and benefits of a new high-voltage electric grid in the Southwest Power Pool, per year



Market Trends

Growth rate for wind power: from red-hot in 2008...

In 2008, wind installations increased by an even larger rate (50% with 8,545 MW added) than they did in 2007 (45%, with 5,249 MW added), bumping up wind power's five-year average annual growth rate (2004-2008) to 32%. The previous five-year average annual growth rate (2003-2007) was 29%.

... to hot in 2009, depending on economic and policy developments

AWEA estimates that wind power installations will grow by 5,000 MW (20%) or more this year. The outlook will depend on how effectively stimulus measures for wind power are implemented, and how quickly and effectively renewable energy policies are put in place for the long term. On that front, hopes run high, as President Obama has signaled a dramatic and welcome shift in favor of renewable energy technologies.

Enacting such policies is now the challenge. The key policy that the industry is urging be adopted immediately is a national renewable electricity standard (RES), to provide a U.S.-wide, long-term signal for capital investment.

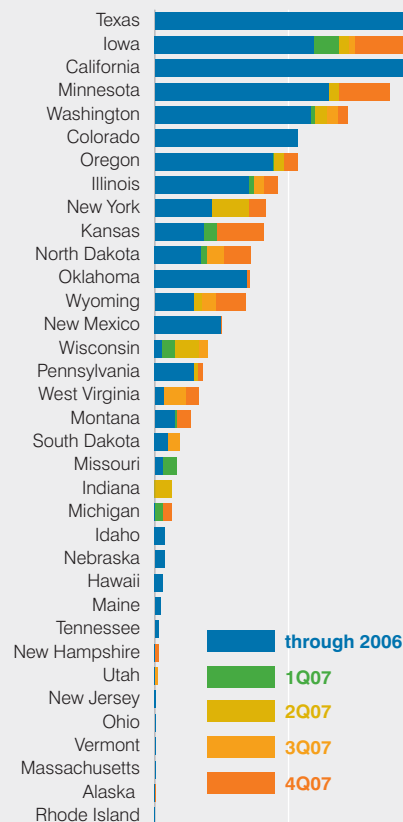
U.S. #1 in the world

With a total of 25,369 MW in operation at the end of 2008, the U.S. pulled ahead of long-time leader Germany (23,902 MW) both inwind energy production and in cumulative wind power generating capacity. The U.S. is also the world's largest market in terms of new installations (8,545 MW) added in 2008, ahead of China (6,300 MW). Next goal: to be among the leaders in wind power as a share of total electricity supply?

"Baseload" plants make way for "flexible & diverse" power mix

Close to 90% of all new U.S. generation capacity added since 2005 has been a combination of natural gas and wind power (see chart on front page). The U.S. electric industry faces dramatic transformations as it wrestles with the challenges of the 21st century. The old paradigm that assumed "baseload" power plants were necessary for reliability is making way for a new trend where demand and supply are managed in tandem, with supply consisting of a diverse, clean mix including a high level of renewable and flexible technologies.

Wind Power Capacity Growth by State



Source: AWEA

Added Most Capacity in 2008

Added Most Capacity in 2008	Capacity Added in 2008
Texas	2671.3 MW
Iowa	1599.8 MW
Minnesota	455.65 MW
Kansas	450.3 MW
New York	407 MW

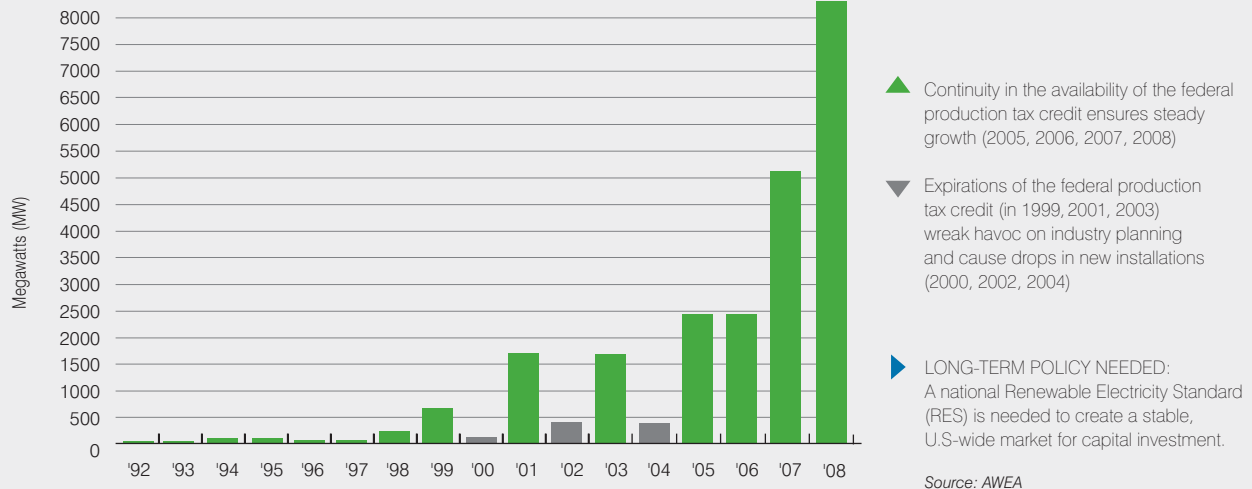
Fastest Growth in 2008

Fastest Growth in 2008	Growth
Indiana	first utility-scale project
Michigan	48x
Utah	21x
New Hampshire	17x
Wisconsin	6x

Highest share of electricity from wind in 2008

Highest share of electricity from wind in 2008	Percentage
Minnesota	7.48%
Iowa	7.10%
Colorado	5.91%
North Dakota	4.86%
New Mexico	4.41%

Annual Installed U.S. Wind Power Capacity



Turbine size remains stable in 2008, but could leap to next level in year or two

Over 5,000 turbines were brought online in 2008. The average capacity of wind turbines installed in 2008 was 1.67 MW, a slight increase from 2007 (1.60 MW). The most widely installed model (over half of the turbines installed) was 1.5 MW in capacity, and the largest reached 3 MW (in Kansas). With a variety of models in the 2-MW-to 3-MW range now hitting the market, average turbine size could leap up in the next year or two. Larger turbines generate proportionally more power, helping drive down its cost.

“World’s largest operating wind power project” title will be hotly contested this year

At least one new project may surpass Horse Hollow wind farm, which has been the world’s largest for three years running. One project under expansion, by E.ON Climate & Renewables (EC&R) North America, currently scheduled to go online in mid-2009, would have a total capacity of 781.5 megawatts (MW) when it is completed. The Horse Hollow Wind Energy Center, located in Taylor and Nolan counties, Texas, claimed the title in 2006 with a total of 736 MW of capacity. A few gigawatt-size projects (in the thousands of megawatts) are in the pipeline but will take several years to be developed.

Strategic positioning in midst of financial crisis

Financing for wind projects had dried up to a trickle by the beginning of 2009 because of the financial and economic downturn, with thousands of megawatts in the pipeline stalled due to lack of capital. However, because of the industry’s strong fundamentals and the support for renewable energy from the Obama Administration, in spring of 2009 the industry was

beginning to see movement again, and believes it can emerge from the economic and financial crisis in an even stronger comparative position for the long term.

Large, competitive U.S. market attracts new players

The number of utility-scale wind turbine manufacturers with sales in the U.S. increased to 14 in 2008 (GE, Vestas, Siemens, Suzlon, Gamesa, Clipper, Mitsubishi, Acciona, Repower, Fuhrlander, DeWind, AWE, Entegriety, DES), up from 8 in 2007 and 6 in 2005. New companies entering the U.S. wind power market, balance out the recent trend in mergers and acquisitions among wind project owners and developers.

Domestic manufacturing on the rise

Of the top ten global utility-scale wind turbine manufacturers in 2007 (Vestas, GE, Gamesa, Enercon, Suzlon, Siemens, Acciona, Goldwind, Nordex, Sinovel), six (Vestas, GE, Gamesa, Suzlon, Siemens, Acciona) now have a U.S. manufacturing presence, soon to be followed by a seventh (Nordex). Even more dramatic is the rise in domestic wind turbine component manufacturing, the companies that make materials and components for wind turbines. More than 70 manufacturing facilities were opened, expanded or announced in the past two years (2007-2008), including over 55 in 2008 alone.

This domestic job creation is driven by two factors:

- ▶ Growth in the U.S. wind market (over 8,500 MW installed in 2008, up from over 5,200 MW installed in 2007); and
- ▶ Continually increasing share of domestically made components (the U.S. is approaching 50% domestic component production for the average wind turbine installed in the U.S. today, up from under 30% in 2005).

More Wind, More Jobs

Facilities Opened or Expanded in 2008

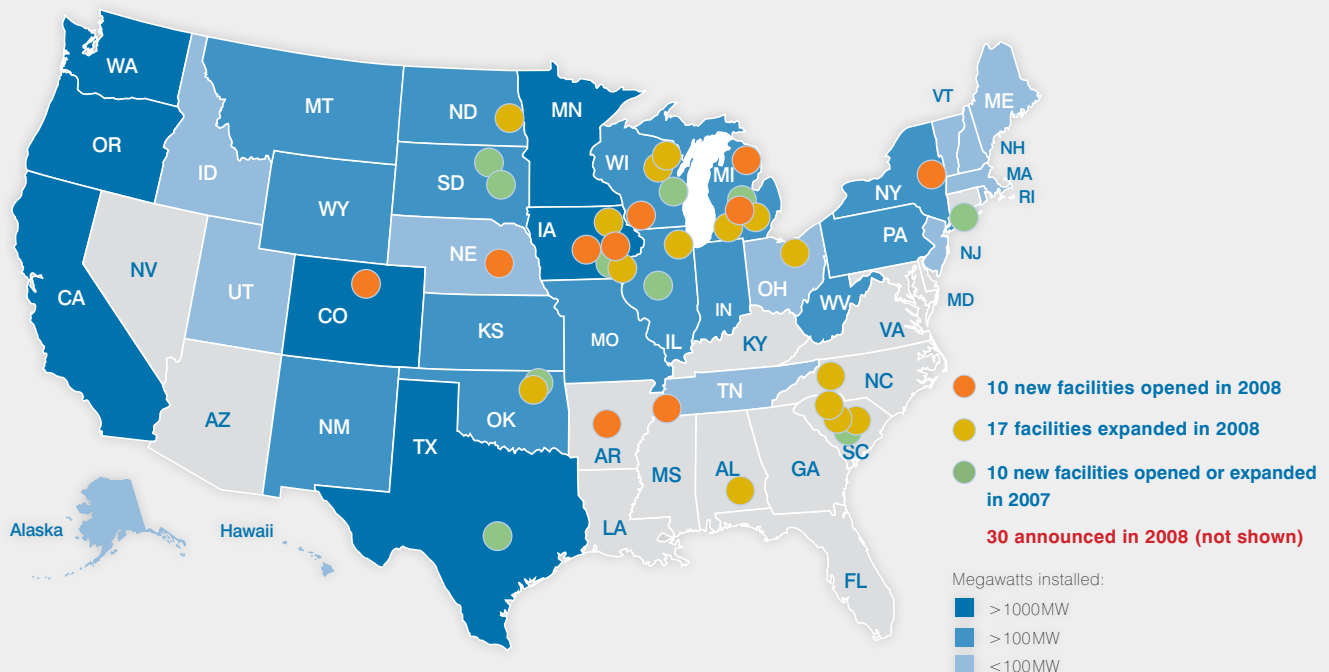
● Acciona Energy, West Branch, IA. Turbines.*	● DMI Industries, Tulsa, OK. Towers.
● ATI Casting Service, Alpena, MI. Castings.	● Finkl and Sons, Chicago, IL. Components.
● E-TM Enterprises, Lansing, MI. Composite Structures.	● Genzink Steel, Holland, MI. Frames.
● GE Energy, Schenectady, NY. Parts Fulfillment Center	● Kaydon, Sumter, SC. Bearings.
● GE Energy, Memphis, TN. Parts Operation Center	● K&M Machine Fabricating, Cassopolis, MI. Hubs and gearbox housings.
● Katana Summit, Columbus, NE. Towers.	● Merit Gear, Antigo, WI. Gears.
● LM Glasfiber, Little Rock, AR. Blades.	● Molded Fiber Glass Alabama, Opp, AL. Housings.
● TPI Composites, Newton, IA. Blades.	● PPG Industries, Shelby, NC. Fiberglass.
● Vestas, Windsor, CO. Blades.	● Rotek, Aurora, OH. Bearings.
● Wausaukee Composites, Cuba City, WI. Nacelles.	● Siemens, Fort Madison, IA. Blades.
● Ahlstrom Specialty Reinforcements, Bishopville, SC. Bearings.	● Timken Company, Union, SC. Bearings.
● Danotek, Ann Arbor, MI. Generators.	● Wausaukee Composites, Wausaukee, WI. Housings.
● DMI Industries, West Fargo, ND. Towers.	● Winergy Drive, Elgin, IL. Gearboxes.

* subsequently expanded in 2008



President Obama on a wind turbine component factory floor in Ohio, before a speech on stimulus for the economy, on January 16, 2009. The company, Cardinal Fastener, makes large nuts and bolts once used in the Statue of Liberty and Golden Gate Bridge, and has expanded to meet orders for wind turbines. Many communities in the midst of economic downturn are holding on to jobs and seeing opportunity return thanks to wind power.

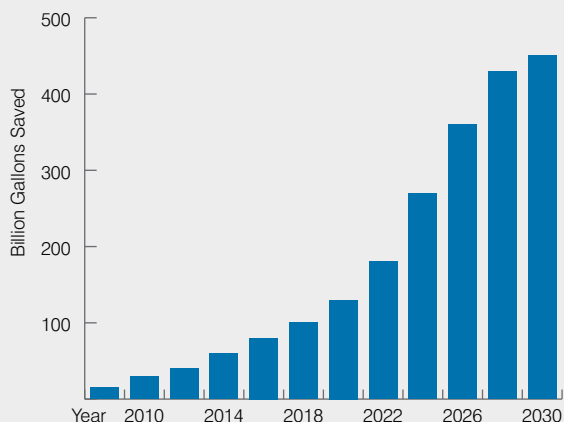
Utility-Scale Wind Turbine Manufacturing: Investment in New Plants



Source: AWEA

Significant Water Use Savings

Generating 20% of electricity from wind by 2030 would cumulatively save 4 trillion gallons through that year.



Source: U.S. Department of Energy – 20% Wind Energy by 2030

Wind power is one of the cleanest and most environmentally benign energy sources in the world today. Using wind as an energy source offers many ecosystem and health benefits, especially compared to conventional forms of electricity production.

More stable climate: Wind power generates electricity without emitting gases that cause global warming, such as carbon dioxide. Increasing our use of wind power to 20% of U.S. electricity supply by 2030 would reduce carbon dioxide emissions from electricity generation by 825 million metric tons or 25 % in 2030, the equivalent of taking 140 million vehicles off the road, and could avoid an estimated \$98 billion in CO2 regulation cost. Wind power also has one of the lowest greenhouse gas lifecycle emissions of any energy technology.

Clean air: Compared to fossil power plants, wind power does not emit pollutants that contribute to acid rain and smog. Almost half of all Americans live in counties where unhealthy levels of smog place them at risk for decreased lung function and aggravation of respiratory illness, according the American Lung Association.

Popular energy source: 82% of Americans support wind projects in their hometown, up from 76% a year ago, according to a 2009 Saint Index survey. Residents in the Midwest showed the greatest support, at 86%. Even though acceptance of all kinds of power plants has risen recently, only 43% of respondents said they support other types of local power projects.

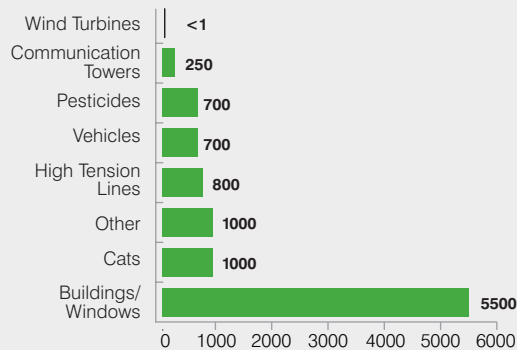
- Find insight on industry issues at AWEA's blog Into the Wind at <http://www.awea.org/blog/>
- Join AWEA on Facebook
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Clean water and more of it: Wind power does not contaminate water with pollutants like mercury, or require water for cooling or for steam to drive turbines. If wind were to provide 20% of our electricity by 2030, water use by the electricity sector would be cut by 17% in that year. Wind power makes it possible to meet our energy needs without further polluting or diminishing valuable water resources.

Light footprint: Wind projects do not cause extraction and transportation of fuels, or production of hazardous or toxic solid wastes, ash or slurry. Most land uses (typically farming or ranching) continue as before below the wind turbines.

Environmental stewardship: Beyond the built-in advantage of its product, the wind energy industry continues to focus on environmental performance. Field studies continue to show relatively low bird mortality. The industry is also addressing issues as they arise, including research on solutions to bat collisions with wind turbines with Bat Conservation International, the U.S. Fish & Wildlife Service and the National Renewable Energy Laboratory through the Bats and Wind Energy Cooperative.

Causes of Bird Fatalities, Number per 10,000 fatalities



Data Sources: Erickson et al., 2002, Summary of Anthropogenic Causes of Bird Mortality.

