CLIMATE DECISION MAKING CENTER
Carnegie Mellon University

How Wind Got its Power

What has brought wind technology so far will help decide its future

Wind energy is the fastest-growing, most popular renewable energy in the world right now. In 1996, about 6200 megawatts (1 megawatt = 1000 kilowatts) of wind power was generated. That number now exceeds 39,000 megawatts, enough to supply electricity to 9 million American households a year.

In the United States alone, there is enough wind energy to power up to 2 million homes a year. That's very small compared to the energy we get from burning coal and natural gas, which releases carbon-dioxide, the main culprit in global warming. But wind is the only renewable source that can compete with coal, and it's share has grown by 25 percent every year in the past ten years in the U.S. because of technological advancements.

"Right now, in the electricity market a renewable energy source needs to be cheap if you want it to compete with traditional fuels like coal and natural gas," says Costa Samaras, a researcher at the Climate Decision Making Center. "Fortunately, wind power is already nearly as cheap." Electricity from wind costs about 4 to 4.5 cents per kilowatt-hour (kWh), while that from coal costs approximately 3 to 4 cents per kWh.

Samaras is investigating the reasons that have paved the way for wind energy's success. By identifying all the technology and public policy related factors that have made wind energy reasonable and popular today, he plans to lay out strategies that could help wind

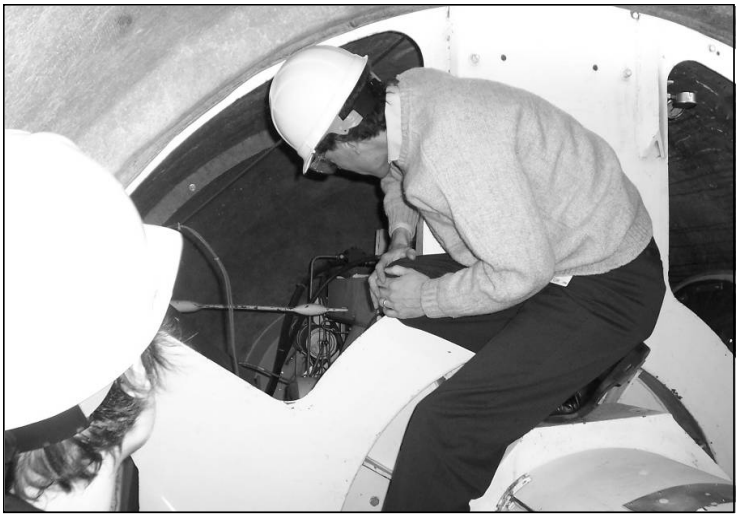
and other low-carbon energy sources continue on their way up. He wants to develop a practical guide that will help policy-makers make better choices for alternative energy in the future.

Wind will play a major role in reducing CO2 emissions in the future. Every kWh of electricity generated by a wind turbine reduces the emission of 2 pounds of carbon dioxide released from burning coal. The U.S. consumes about 3850 billion kWh of electricity every year. If wind supplied 20 percent of that, it would remove more than a third of the carbon dioxide emitted by coal-fired plants.

But we've been dependent on fossil fuels for generations, and it's hard to switch to a completely new technology, in spite of its benefits. A new energy technology becomes popular when its price is similar to what people are used to. This can happen through various public policies, says Samaras—either with basic research funding for relatively immature technologies or strategies like tax breaks for technologies that are nearly ready for the market.

Fortunately for wind energy, technological innovations boosted by private and federal funding have made it mature for production tax credits from the government. And some of these innovations have come from surprising sources. For example, wind turbine designs in the past two decades have improved by borrowing from the shipbuilding, power electronics and oil and gas industries. "Wind was able to capitalize on this and import the technology for its benefit," Samaras says. The bigger, better turbines produce more energy at the same locations as they were as in the past or even in lower wind areas, which reduces the cost of electricity. "It would be more expensive if the wind industry conducted research and development in this area alone," he adds.

Favorable policy decisions such as the federal government's tax credits for wind energy producers and encouragement at the state-level have pushed down costs even further. "We need to look at which of the technological innovations and policy choices were most important in bringing the cost down," Samaras says. For that, he's gathering all the available information on wind energy technology and policy, and is looking at how it has changed over time. He will compare his observed results with the opinions of wind energy experts from the industry and government.



CDMC researcher David Keith looks inside a wind turbine at the National Renewable Energy Laboratory in Boulder, Colo.

The result will be a practical decision maker's guide. It won't be just for the policymakers who are in charge of alternative energy policy, Samaras adds. It will also help the engineers who design, build, operate and maintain the energy infrastructure. "The end goal is to keep increasing wind power's success and keep decreasing its cost," he says.

The Climate Decision Making Center (CDMC) is an interdisciplinary collaboration between scientists at eight research institutions spanning the U.S., Canada and Germany. The center is anchored in the Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA. It is funded by the National Science Foundation and was formed to develop and demonstrate a set of new decision analysis tools for addressing problems which involve high, and often irreducible levels of uncertainty.