The Questions are

BY MADELINE BODIN

What fraction of a degree of global warming is a view from the Appalachian Trail worth? How many pounds of carbon dioxide is a golden eagle's life worth? How about a blue jay? When do privately owned ridgelines become part of the commons? Is it better to lose access and habitat on ridgelines now or lose it to climate change in 50 years? What if our best efforts at stalling climate change don't work?

These are crazy questions. Questions with no clear answers. But they are also questions that demand answers in the face of 22 commercial (that is, utility-grade) wind power projects that are either planned or have been built recently in the Northeast. It's commercial wind power that we'll talk about here: wind energy reaped so it can be sold to paying customers. Sometimes commercial wind power projects are welcomed by local residents and are built quietly without public debate. But often, there is a fight – debates, forums, legislation, editorials, letters to the editor.

The wind power controversy as found in these public arenas starts out at the level of a graduate school philosophy seminar. It can all be confusing if you haven't taken Wind Power 101, so here's some basic information. Let's start with a history lesson.

It might seem that wind power has come late to the northeastern United States, but commercial wind power actually got its start in Castleton, Vermont, in 1941, when Central Vermont Public Service (CVPS) built the world's first electricity-producing commercial wind project on Grandpa's Knob. The single turbine blew down a few years later, and commercial wind power disappeared from the northeastern United States along with it.

Of course, wind power has been big in Europe for years. Denmark grabs headlines and tugs heartstrings by generating 20 percent of its electricity through wind power.

But it's not Denmark that we should be impressed with, says Tom Gray, director of communications for the American Wind Energy Association (AWEA), which is based in Washington, D.C. It's Germany's wind power that is truly impressive. Germany generates five percent of its electricity through wind power, but it has the highest installed wind power capacity in the world.

"That's a big deal," he says. "They are not a pipsqueak economy."

The U.S., on the other hand, even with the world's third-highest installed capacity, generates four-tenths of one percent of its electricity needs with wind. And that's a number that has tripled since 1999.

Almost all of the action in wind power in the U.S. has been in

This painting by B. Mitchell shows the Northeast's first wind turbine on Grandpa's Knob in Castleton, Vermont.

Blowing in the Wind

the West. According to AWEA statistics, nearly a third of the installed wind power capacity in the U.S. is in California. Twenty percent is in Texas. Minnesota runs a distant third, with about eight percent.

The western states have a more appealing combination of strong winds near population centers. Government incentives and mandates have helped too. In Texas, a combination of wind-swept plains and a state mandate for utilities to increase their use of renewable energy has made the Lone Star State the place to be for wind power.

Today, wind power developers build in anticipation of the return of the federal government's production tax credit (PTC) for renewable energy sources, including wind power. This tax credit, which has been intermittent and expired again in 2003, gave renewable energy producers 1.7 cents per kilowatt hour of electricity produced. With the new, more efficient wind turbines now available, that amount was just enough to make wind power a profitable enterprise. The tax incentive has been renewed in the past and is expected to be included in Congress's next comprehensive energy bill.

This tax credit sounds farsighted and practical until you compare it with the tax incentives and fuel subsidies given to companies that produce electricity with gas and coal. Those companies receive tax credits and fuel subsidies worth about 2.5 cents per kilowatt hour of electricity generated – almost 50 percent more than the wind credits – according to an April 20, 2003 article in the business section of the *Denver Post*.

Mostly, it is larger turbines that produce electricity at lower wind speeds that have made wind power commercially viable in the Northeast. The fact that these new turbines are quieter than the older ones makes them, in theory anyway, more palatable in areas that are sure to be more densely populated than a Texas cattle ranch.

These new turbines generally have towers 200 or more feet tall and have blades from 100 to 170 feet long, whirling in a circle 200 to 340 feet in diameter. The combination of tower and blades can make them as high as 370 feet.

The new turbines are built on tubular towers that don't use guy wires for support. They have that futuristic pinwheel look. Their blades are much larger and turn more slowly – from 10 to 20 revolutions per minute. Older wind turbines often used lattice towers. It's that farm-windmill look built large. Their smaller blades turned faster and required higher windspeeds to generate power

A modern wind turbine generates power more than 80 percent of the time in locations with "commercial quality" wind. However, it is very often generating less power than it is capable of – because of low wind speed, changing wind direction, and other factors. Overall, wind turbines in our region are expected to run at about 30 percent capacity. That means the overall power they generate is 30 percent of what they are capable of creating if the wind were always blowing in just the right direction at just the right speed.

For wind power to be cost effective, the contradictory ingredients of large open spaces on which to put the turbines and a nearby population that can use the electricity are required. Of course, wind is also required. Away from the coast, commercial-quality wind in the Northeast is found primarily at elevations of 2,500 to 3,500 feet.

Robert Charlesbois, director of development for Catamount Energy, a Rutland, Vermont-based wind power subsidiary of Vermont's CVPS electric utility, looks for several things in a potential wind power site. It must be on a ridgeline, where wind is not blocked from any direction. Similarly, the ridgeline should be the highest around for quite a distance. Ideally, the slope should rise steeply from relatively flat terrain to take advantage of wind shear, the change in wind speed that occurs with greater height above the ground.

Also, the ridgeline should run north-south so that multiple turbines can be strung along it at relatively close intervals without creating a wake effect that will block the next turbine down the line from the westerlies that are the prevailing winds in the Northeast.

Each turbine needs several acres of clearance from people and structures. However, wilderness is not the best place for a wind facility. High-voltage transmission lines are needed to carry the electricity generated away from the site. The closer to suitable existing transmission lines, the lower the cost of building the project will be.

Roads are also needed. Wide roads (about 18 feet of riding surface) are used during construction so that the large trucks can deliver the turbine components to the site. Later, a smaller road is needed to provide access to the turbines for maintenance and repairs. Again, the closer that suitable roads come to the site, the lower the cost of the project.

Charlesbois also takes into account other factors. Building a wind power project in Vermont is more attractive to him than building one in Maine because Vermont's higher electric prices offer a better hope of profit. He's also attracted to sites where wind power can coexist with an existing use of the land, such as a ski resort.

There are other factors that Charlesbois considers, but he protects them as trade secrets. With all the factors considered, and given the existing technology, Charlesbois sees only 46 sites in all of New England that he believes are suitable for commercial wind projects. Of those, he believes 12 have the potential to be profitable, given existing technology.

Of course, Catamount is not the only game in town. Other wind energy companies have slightly different criteria and different financial expectations. But basically, what Charlesbois looks for is what anyone looking to use wind to generate electricity

profitably in the Northeast looks for.

Harley Lee, president of Endless Energy of Yarmouth, Maine, says that these are the basic criteria he considered when deciding on the site for his company's project near Maine's Redington Pond. (This is the controversial wind project that would be visible from the Appalachian Trail.) A site near power lines is vital, he says. His company will spend millions of dollars building transmission lines to the Redington site. There was already a road to the base of the mountain, which was a point in the site's favor, says Lee.

The paper company that owned the site when Lee first became interested in building a wind power project there was not interested in leasing sites for turbines. It was interested in selling the land, so Endless Energy owns instead of rents in Redington.

Charlesbois plans to rent in his company's first project in the Northeast, but he considers the amount a trade secret, too. However, two years ago Iowa farmer Darwin McConkey told the *Christian Science Monitor* that he is paid $2,000 a year (by an unnamed wind power company that is not Catamount) for each of the three wind turbines on his 80-acre corn and soybean farm.

A dozen utility-grade, grid-connected wind power projects are being contemplated in New England, including expansions of existing projects. In New York state, there are 10 such existing and proposed projects.

One of the projects proposed for Massachusetts is the controversial Cape Wind project. Both because of its location offshore between Cape Cod and Martha's Vineyard and its size (130 turbines, mounted on towers 225 feet tall), this project is a different kettle of fish. Off the southern shore of Long Island (near Fire Island), the Long Island Power Authority has proposed its own offshore wind project. A municipal power company turbine in Hull, Massachusetts, has its feet wet near the town dock, and another turbine is planned nearby.

The other projects proposed in the region, the 16 planned for dry land, will be built on ridgelines, and almost all of those ridgelines are forested. These projects will range from 4 to 68 turbines. What impact will those projects have on those ridgelines?

The total amount of space used for a wind power project is called its footprint. This includes not only the wind towers themselves, the various support buildings, and roads, but also an area kept clear of trees around the turbines in case heavy equipment needs to be brought in for repairs or maintenance.

The footprint for the eleven 198-foot-tall turbines at the Green Mountain Power Project at Searsburg, Vermont, is 35 acres. At the Hoosac Wind project in western Massachusetts, the developer plans on clearing 48 acres for the construction of 20 towers on two ridgelines. Eventually, about 24 acres will be kept open.

Sam Bittman, a spokesperson for Hoosac Wind, points out that the cleared space is long and narrow – consisting of the 16-foot-wide access road and a 36-foot-wide cleared strip next to the towers along the ridgeline. He also says that because the project is "a full-fledged electrical generating plant," a snowmobile trail and a hiking trail will be rerouted from the area for the sake of public safety. Hunting will not be allowed near the turbines for the same reason, he says.

A state-of-the-art wind turbine generates a whooshing sound that is 40 decibels (dB) at 1,000 feet away. How loud is 40 dB? Catamount says it's the sound of a quiet office. Decibel charts describe it as an average residence or a mosquito buzzing. It is louder than a whisper (30 dB), but quieter than a normal conversation (50 dB). Of course, exactly how loud a 40-decibel whooshing sound is perceived at any location is relative. A normal conversation can be startlingly loud at a remote homestead but is unnoticeable in a supermarket parking lot.

But why put up with any noise at all? Why put up with development of any kind on ridgelines?

Because once the turbine is in place, it generates electricity without creating pollution of any sort. And there will always be more wind. While wind project developers juggle a thousand issues (many of them that begin or end with making money), for most of the rest of us, those two facts – clean and renewable – influence everything else about wind power.

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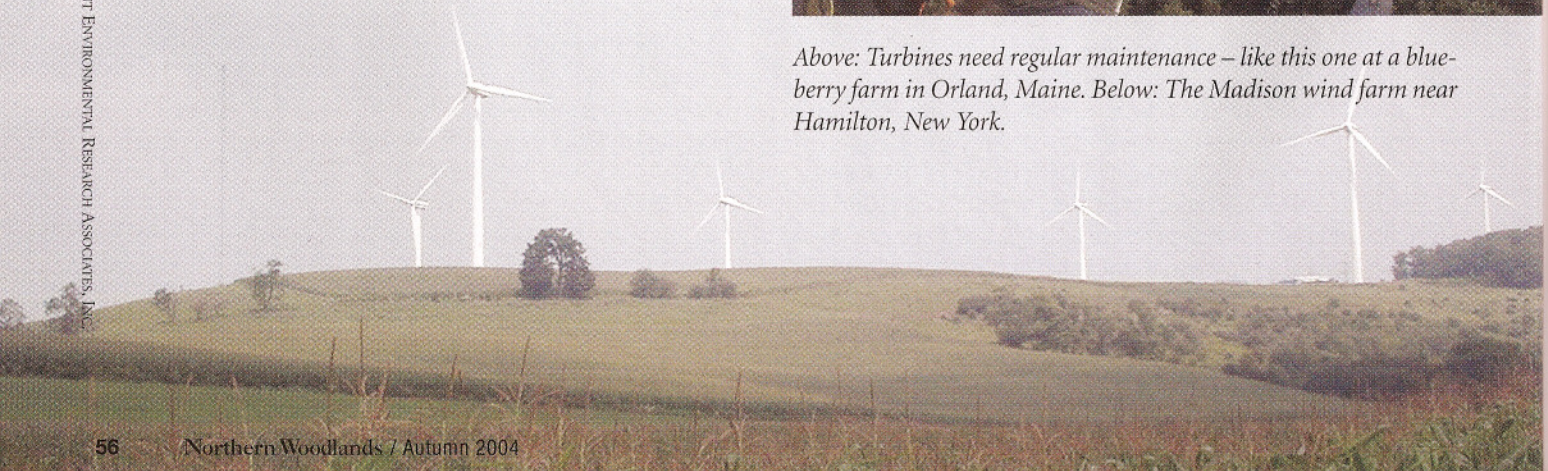

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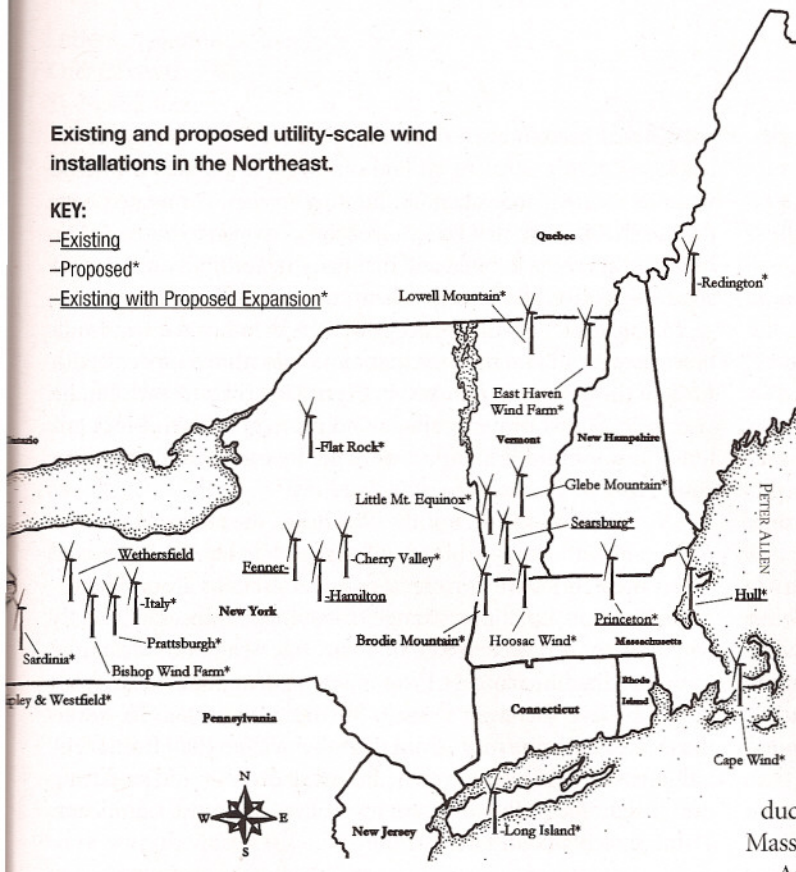
Above: Turbines need regular maintenance – like this one at a blueberry farm in Orland, Maine. Below: The Madison wind farm near Hamilton, New York.



Existing and proposed utility-scale wind installations in the Northeast.

By using the energy potential of wind, wind power does not create air pollution. That means no particulate matter (such as soot), no nitrous oxides (NO_x), no sulfur dioxide (SO_2), no volatile organic compounds (VOCs), no carbon monoxide, no mercury, cadmium, or lead, and no greenhouse gases (such as carbon dioxide). No greenhouse gases means no contribution to global warming.

Colin High, Ph.D., a vice president at Resource Systems Group in White River Junction, Vermont, says that for a 50-megawatt plant (which is what the 33-tower version of the proposed Mars Hill project in Maine would generate, for example), the reduction in CO_2 emissions would be roughly equivalent to taking 20,000 cars off the road. (Mars Hill is the other, less-controversial proposed wind project in Maine.)

Wind power projects may provide electricity that prevents pollution-creating power plants from being built in the future. But power plants last a long time. Wind would offer little immediate help in reducing global warming if it only replaced yet-to-be-built, conventional power plants. However, electricity generated from wind power starts replacing that from conventional power plants as soon as the wind turbines are up and running.

Paul Peterson of Synapse Energy Economics in Cambridge, Massachusetts, and Robert Stein of the Signal Hill Consulting Group in Rutland, Vermont, both energy industry consultants, explained the dynamics in a meeting about a proposed wind project on Glebe Mountain in Londonderry, Vermont.

They said that all of New England's 200-plus utilities (and other power marketers) and the over 350 electric generation facilities swap electric output in a region-wide wholesale electricity market called NEPOOL (New England Power Pool). Because wind power is intermittent and has no fuel costs, it is used by customers whenever it's available, making it a "must-take" resource in the market. Use of wind power displaces the use of other, more flexible generation facilities – particularly those fueled by natural gas, which can be switched on and off rapidly as needed. The owners of those gas plants aren't going to make electricity that no one is buying, so they will slow or cease generation temporarily, reducing the pollution created.

Peterson further explains that the electric grid is managed for both electricity and the money to pay for it, but those two things are managed independently of each other. One side is network engineering; the other side is a commodities market.

So, although the hydroelectric dams on the upper Connecticut River were built to provide energy to Massachusetts, and while the Vermont Yankee nuclear power plant could supply a huge chunk of Vermont's electric needs, the power that those facilities generate goes to the nearest place that needs it at the moment it is produced (and that might be New Hampshire for the dams and Massachusetts for the nuclear plant).

As for the money, a contract means that an electric power consumer, such as a utility, can pay a rate quite different from a daily market rate. Most power in New England is bought and sold through fixed-price contracts (such as the contract between 15 Vermont utilities and Hydro-Quebec), explains Peterson. It's the excess generation, or marginal supply, and the marginal consumption, that drives the market and is bought and sold at the current rate.

It's kind of like a restaurant that buys 25 pounds of coffee beans every week, but occasionally the chef finds herself out of coffee on the weekend. She runs out to the farmers' market to make a deal on what she needs. Sometimes she gets a deal better than the one from her usual supplier, sometimes she pays more. Other weeks she brings her own leftover coffee beans to sell at the market.

Right now, wind power and conventional oil- and gas-powered plants run neck and neck in the cost of producing electricity. Newly built, highly efficient gas-powered electric plants produce electricity more cheaply than wind, though they are aided, as was noted above, by stronger subsidies.

While wind power doesn't generate pollution, it does have an impact on the environment, both on the ground and in the air. In the air, wind turbines have an impact – a literal one – on birds and bats.

Over 40,000 birds are killed each year by wind turbines in the United States, says Albert Manville of the U.S. Fish and Wildlife Service's (USFWS's) Division of Migratory Bird Management, based in Arlington, Virginia. That number is expected to grow along with the number of wind turbines.

For birds, Altamont Pass is the situation that conservationists would like to avoid duplicating. Altamont Pass is an area east of San Francisco with about 6,500 turbines. (Yes, the speedway there was the site of the infamous Rolling Stones concert in 1969.) By

the early 1990s, it was discovered that hundreds of raptors (hawks, eagles, falcons, and owls) were being killed each year by the turbines. Most disturbing is that the deaths continue, with up to 60 federally endangered golden eagles and hundreds of other raptors, such as kestrels and red-tailed hawks, dying there each year.

Manville suspects that Altamont is unusual in several ways, including the high number of raptors that migrate through the area, which make its duplication as a bird-killer unlikely elsewhere.

Still, lessons from Altamont Pass have been incorporated in the USFWS's guidelines on minimizing wind turbines' impact on wildlife. The guidelines (also called a guidance) recommend several things that have become standard with the new turbine technology: tubular towers rather than lattice-supported towers, slower-moving blades, and avoiding the use of guy wires.

Tower-mounted lights, installed for aviation safety on structures over 199 feet, have contributed to the 4 million to 50 million birds killed each year by communications towers, so the guidance recommends not exceeding the FAA-mandated minimum number of red or white strobe lights on a turbine array. Red incandescent lights, either steady or flashing, are not recommended because they seem to attract night-migrating songbirds.

The guidance advises against placing towers in sites that are attractive to songbirds and raptors, such as cliff edges, mountain passes, and wetlands. It also suggests orienting the turbine strings parallel to migration paths.

When it comes to bats, the example of what's to be avoided is the 44-turbine Mountaineer Wind Energy Center on Backbone Mountain in West Virginia. Until the bodies of 400 bats were found from mid-August through October 2003, no one thought that wind turbines were a threat to bats. The bodies of bats (or birds) found near wind towers are believed to represent only a small part of the number of animals killed. Scavengers quickly carry away the remains, and some bodies are never found to be counted. So the 400 bats found at Mountaineer probably represent thousands of bats that were killed.

"Unfortunately, bats are in serious trouble," says Manville. "All populations are declining, some precipitously."

Little is known about why so many bats were killed at Mountaineer. A 3-year study is underway. The USFWS guidance simply recommends that developers "avoid siting turbines near bat hibernation and breeding colonies, migration corridors, and in flight paths."

Of course, finding out where these important wildlife areas are – for bats, birds, other animals, and even plants – takes time as well as money to pay for trained biologists to conduct studies. Manville believes that most wind project developers go about these important wildlife studies all wrong.

"It's the tail wagging the dog," he says. "They make the purchase agreement with the landowner, then think about wildlife studies. Instead of assessing sites according to our guidelines, then finding some locations that look okay, they only do an assessment once they've selected the site."

There is nothing unique about the on-the-ground impact of a wind power project. It is similar to just about any other development. Areas cleared of trees cause forest fragmentation, alienating species that need forested tracts of a certain size. Roads can cause erosion if poorly constructed and can bring in hunters if the site was previously inaccessible. Or, hunting may be eliminated near the turbines in areas that had previously been open to hunters. The humans that come to build and maintain the turbines can scare off species – such as black bears – that predominantly avoid humans.

Manville isn't against wind power. He'd rather see wind turbines on a mountain than see that mountain mined for coal, with most of the mountain dumped in the nearest river, he says. But he also believes that properly sited wind projects, with turbines tailored to minimize the impact on wildlife, can go a long way in conserving birds, bats, and other wildlife.

Of course, in this part of the Northeast, the choice between a mountain with wind turbines and a mountain leveled for its coal seems theoretical. We don't level entire mountains around here.

But setting up those strange, theoretical choices is exactly what the wind power debate does so well. (Eagles or clean air? View or climate change?) Proponents and opponents of wind power believe there are answers to these questions. However, those answers come more from their own values than from facts. Value-based debates are often the most divisive and enduring our society faces. But they are also often the most significant. Wind power is no different.

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