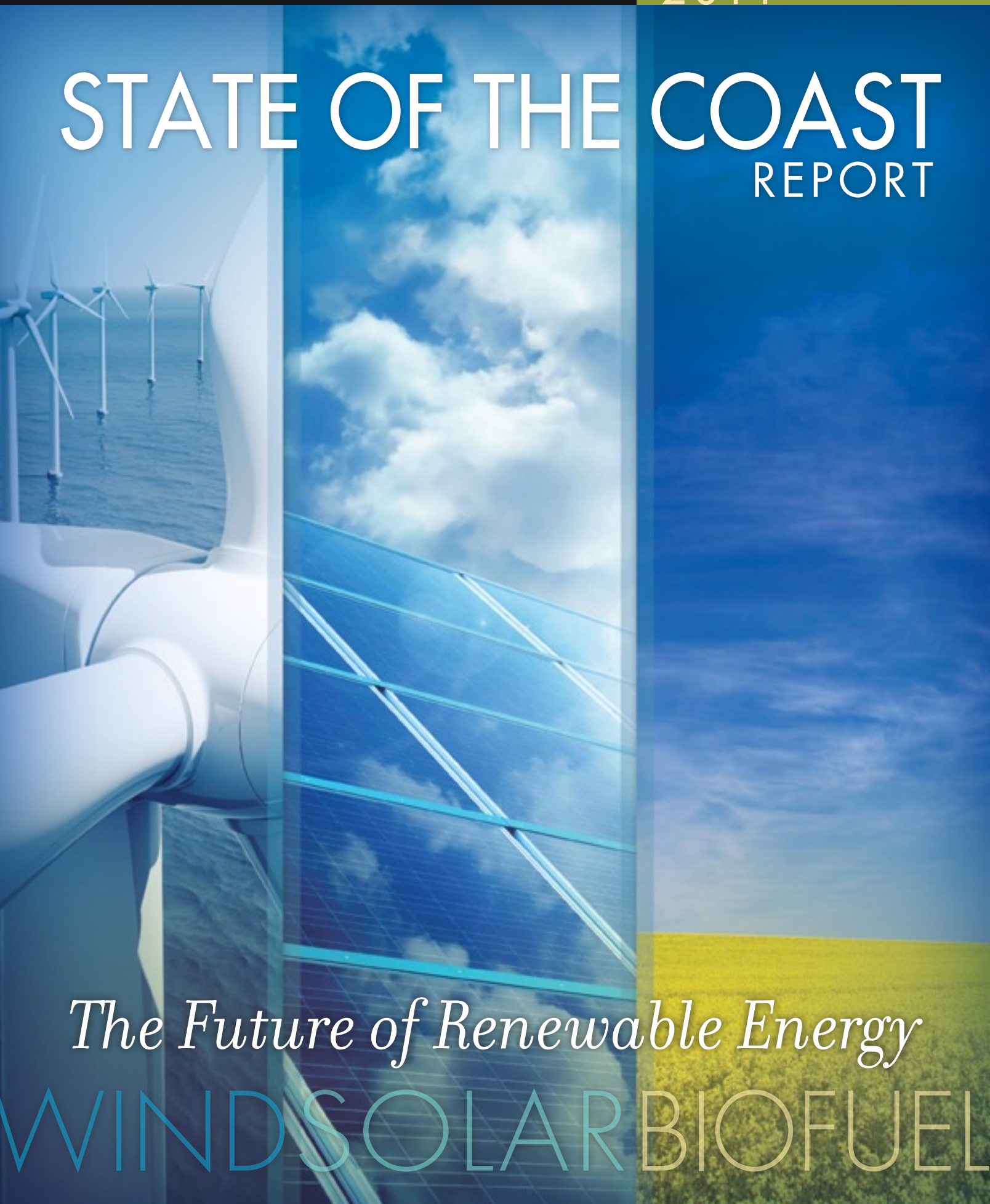
NORTH CAROLINA COASTAL FEDERATION 2011

STATE OF THE COAST REPORT



The Future of Renewable Energy

WIND SOLAR BIOFUEL

STATE OF THE COAST

NCCF is a non-profit tax-exempt organization dedicated to involving citizens in decisions about managing coastal resources. Its aim is to share technical information and resources to better represent current and long-term economic, social and environmental interests of the North Carolina Coast.

North Carolina Coastal Federation

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The North Carolina Coastal Federation is located on Highway 24 in Ocean, N.C., between Swansboro and Morehead City. Our offices, nature library and shop are open Monday through Friday, 8:30 a.m. to 5 p.m.

LAYOUT/DESIGN: 8 Dot Graphics
COVER: wind turbines, solar panels and a field of canola for biofuels.

Setting the Course for a New Energy Future

In this year's *State of the Coast Report*, I thought about having fun using Reddy Kilowatt to help illustrate the need for green energy alternatives. I suggested that we give Reddy new ears and a new nose and put him on surfboard as he rode the wave of alternative energy options that will engulf our coast and reduce our reliance on fossil fuels.

Reddy helped power companies promote the use of electricity as a new technology that would light, heat and cool our homes. He was first created by the Alabama Power Company in 1926 and was soon used by 300 other electric companies to sell electric homes. In the 1970s Reddy had a midlife crisis as the environmental movement took hold. He faded from promotional ads much like a burned-out light bulb when we all decided to try to conserve electricity.

But, alas, I'm only the boss around here and was overruled by my staff and board, who thought the "new" Reddy was sort of goofy-looking and worried we would be infringing on his copyright.

I still think he was a fitting metaphor for our changing times. Before Reddy none of us used much energy in our daily lives. I'm still amazed when I go into an old house that has not been remodeled, and see a few old light switches, screw-in circuit breakers, hanging incandescent light bulb fixtures and perhaps an electric socket or two used to power a handful of "modern" appliances. That all changed dramatically over the past 70 years as per capita energy consumption rose astronomically.

We have all benefited by modern energy use. Among many good uses of energy, this *State of the Coast Report* could not have been written, designed, printed and distributed back when Reddy was still a baby.

However, there are negative consequences of our big thirst for energy. We pollute and warm our earth by burning fossil fuels and depend too much on energy that comes from highly unstable parts of the world. A warmer earth means that sea level is rising, and valuable coastal waterfront properties erode. Over the past few decades, scientists have documented that more than 30 species of fish have moved northward off our coast from southern areas, while there has been no similar shift in colder water species south.

Here on our coast we continue to resist efforts to explore and develop offshore oil and gas. We don't want to degrade our fragile coastal ecosystem with such a polluting industry. That leads folks to ask us, "If not oil, then what?"

Over the years, the N.C. Coastal Federation has attempted to stay focused on coastal issues over which our communities have some local control. When we think about energy policy and use, it's easy to feel that we're at the mercy of big power companies and OPEC, and don't have much choice about how to power our homes, offices and cars.

This *State of the Coast Report* explores renewable energy options and evaluates the economic and environmental implications of future energy production along our coast. The report also tells us how we can all be part of the solution to our energy needs and not simply pawns in a worldwide energy chess game. What we promote here on the coast in terms of energy policy and use won't solve all the world's energy woes, but it will move us toward a greener and more sustainable energy future. It took decades to develop our current system of energy production and use, and it will take as much time to chart a new course. We think that coastal North Carolina can set this new course if there's public support and energized leadership to make that happen.

We have abundant resources of wind and solar energy, and with good environmental standards and pricing policies, those sources can be tapped. We also have the potential to produce power through careful use of biomass and biofuels that can help run our military and farm economies. Our responsibility as an environmental organization is to ensure that we thoroughly address the potential environmental effects of these options and participate in the development of sound policy as we transition into an age of renewables. Energy conservation remains key as well, since every kilowatt saved is one that doesn't have to be generated. Expect innovation as gas prices skyrocket. For example, electric cars will become much more common not only for transportation, but as way to store electricity generated by wind and solar for use later.

As the old adage goes, "Think Globally, Act Locally." This *State of the Coast Report* should help you do just that when it comes to your use of energy.

Todd Miller

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NCCF'S 16TH ANNUAL *State of the Coast Report*

The intent of the *State of the Coast Report* is to provide citizens who care about our coast with a tool to better understand the issues, challenges and solutions that are keys to our coast's health. We hope this publication will move you to participate in the restoration and protection of our coast. To learn more, call the N.C. Coastal Federation at 252-393-8185. The opinions expressed in the *State of the Coast Report* represent the views of the N.C. Coastal Federation.

ACKNOWLEDGEMENTS

This publication required a major effort that combined the expertise of many people. Frank Tursi, an assistant director for the federation, was the report's editor and lead author. Jan DeBlieu, who leads the federation's Northeast Region, contributed stories about onshore wind, solar and geothermal energy. Christine Miller, the federation's assistant director copyedited the publication and oversaw design, printing and distribution. Sara Birkemeier and George Scott at 8 Dot Graphics in Raleigh designed the publication.

We want to thank the following people who agreed to be interviewed or whose help was instrumental in helping us understand the issues: Emily Felt, director, Renewable Strategy and Compliance, Duke Energy Corporation; Bob Leker, program manager for renewable energy, State Energy Office, N.C. Department of Commerce; Glenn Mauney, Carolinas energy policy manager, Southern Alliance for Clean Energy; Will McDow, Environmental Defense Fund, Raleigh; Brownie Newman, vice president and finance director, FLS Energy; Brian O'Hara, executive director, Offshore Wind Coalition; Dr. Charles "Pete" Peterson, distinguished professor, Institute of Marine Sciences, University of North Carolina-Chapel Hill; Craig Poff, senior development director, Iberdrola Renewables; Rob Propes, development manager, Apex Wind Energy Holdings LLC; Paul Quinlan, deputy director, N.C. Sustainable Energy Association; Dr. Harvey Seim, professor, Department of Marine Sciences, University of North Carolina-Chapel Hill; John Stanton , migratory bird coordinator, U.S. Fish and Wildlife Service; Jennifer Stutzman, outreach coordinator, N.C. Solar Center, N.C. State University; Steve Wall, director of Policy and Environmental Issues, Biofuels Center of North Carolina; Dr. Mike Williams, professor, Department of Poultry Science, N.C. State University; and Andy Wood, director of education, Audubon North Carolina.

RUSH TO TAP WIND IS JUST BEGINNING OFF N.C. COAST

BY FRANK TURSI

Pioneers are beginning to stake out America's next energy frontier because they know what every kid with a kite knows: It's breezy at the beach. They also know what every landlubber on a Gulfstream fishing charter surely finds out: It can get right windy 20 miles from shore.

And nowhere along the east coast does that wind blow steadier and stronger than off the shores of North Carolina, which may soon find itself at the center of the rush to harness the wind.

So much wind blows off the country's shorelines that the U.S. Department of Energy estimates that, if it were put to work making electricity, offshore wind could theoretically provide four times the electricity of all the power plants in America. Offshore wind in North Carolina, the department thinks, could in theory supply all of the state's energy needs.

Researchers at the University of North Carolina confirmed that estimate after studying the possibility of wind energy along the N.C. coast. "It is concluded that North Carolina is well-positioned to develop utility-scale wind energy production, and it is the opinion of the project team that the State should pursue it aggressively," the researchers noted in their 2009 report.

Brian O'Hara certainly is. The former oil and gas man is among the growing group of promoters who are increasingly eyeing the state's vast untapped promise of offshore wind energy. O'Hara heads the Offshore Wind Coalition, a non-profit group that, as the name implies, promotes wind energy off the N.C. coast.

"When you stack up states against each other, you realize that the easiest places to do this are New York and New Jersey because of really high electricity rates there," he said. "After that North Carolina is next in line."

THE PROMISE OF WIND

It's easy to like wind as a power source. It's free and, unlike coal or other fossil fuels, generating electricity with it doesn't foul the air with pollutants or worsen global warming by emitting tons of carbon dioxide. If an offshore wind turbine fails, blackened birds won't be landing on our beaches. Strung along the Atlantic coast, wind farms could supply the country's major cities with electricity without offending too many people's sensibilities. The "visual impacts" of the giant windmills are one of the major obstacles of wind farms on shore, but no one on land will see them if they're 10 or more miles off the beach.

Attend a presentation on wind energy and you'll hear a lot about another of wind's purported benefits – jobs. Developing offshore wind energy, promoters are quick to note, will provide good-paying jobs to a good number of people. Federal estimates suggest that building enough wind turbines off the N.C. coast during the next 20 years to equal the generating capacity of 10 nuclear plants the size of the Shearon Harris plant near Raleigh would create 50,000 local jobs and provide about $22 billion in local economic benefits.

"Politically, this will come down to an economic decision," O'Hara said. "It has to be in the interest of the state to make this economically possible. This is not about getting the first turbine in the water. The race is over the manufacturing facilities."

North Carolina is well-positioned in the field of contenders, said Rob Propes. He's the development manager of Apex Wind Energy Holdings LLC, a company based in Charlottesville, Va., that has submitted the only proposal for a wind farm off the N.C. coast.

LINING UP FOR THE PRIZE

Propes notes that almost every state on the east coast is lining up to allow offshore wind turbines – Apex also has proposals off Virginia, Pennsylvania and New York. The companies that make the turbines or the foundation poles that they sit on will want manufacturing plants and staging areas near this new market, he said.

"There are 8,000 parts in one of these turbines, so there are plenty of manufacturing opportunities," Propes said. "North Carolina is well suited to take advantage of that."

"Companies will need land with access to the water and a deep-water port, he said. A place like Morehead City could be ideal", Propes continues. "North Carolina offers other

attractions: a largely non-unionized workforce to keep labor costs down and a state tax credit for manufacturers."

The manufacturing jobs are what everyone wants, O'Hara said. "Construction jobs to build the wind farms come and go with the projects," he said. "The manufacturing jobs stay."

Despite the promise, the state and federal governments have been slow to embrace the winds that blow offshore. The United States leads the world in wind energy on land, yet we have nothing in the water. Since Denmark's first offshore project in 1991, Europe has held the lead in offshore wind. There, the heavily subsidized industry has more than 830 turbines in the water, generating 2,300 megawatts (MW) that is sent to nine countries.

In his State of the Union Address in February, President Obama signaled this country's desire to finally get in the game. He called for 80 percent of the nation's electricity to be generated from clean energy sources, including wind, by the year 2035. The Department of Energy soon followed by announcing a strategy to deploy 10 gigawatts (GW) of offshore wind-generating capacity by 2020 and 54 GW by 2030.

THE REALITY OF WIND

That will be expensive. The cost of building all those turbines could – pardon the expression – take the wind out of the plan's sails. "The biggest obstacle will always be cost because in the near term the rates for wind-generated electricity will be higher than what consumers pay today," O'Hara said. "The challenge that every state legislature has to get through is cost. Can you justify the near-term cost?"

From a distance they may look like pinwheels, but wind turbines are massive structures that sweep a vertical airspace equal to or greater than a Boeing 747. Towers usually range 200-300 feet tall. Three blades extend another 100 feet up from the hub. A 260-foot tower with a 142-foot blade tops out at 400 feet.

Filled with surprisingly high-tech components, the turbines aren't cheap. Erecting them in the water increases the cost by as much as 50 percent because of the expense of transporting them and installing them at sea. The specialized barges and cranes, for instance, can cost $200,000 a day.

The higher cost is partially offset by higher energy yields. Offshore turbines can produce as much as 30 percent more electricity than

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What Is the Real Cost of That Kilowatt Hour?

Electricity in North Carolina seems cheap. Dirt cheap.

Thanks in large measure to old power plants – some of World War II vintage – that burn abundant and cheap coal, North Carolinians pay less than 10 cents a kilowatt-hour (kWh) for their electricity. That's one of the lowest rates in the country.

Now, compare that to electricity generated by an offshore wind farm. There really is no good comparison because no power is yet produced that way in the United States. Two proposed projects that are the closest to going into the water – one off Rhode Island and the other off Massachusetts – give some indication of what the initial price might be. The first costs out at about 24 cents a kWh and the latter at 19 cents. Maryland officials have estimated that initial offshore wind will likely cost 24-25 cents a kWh.

The first projects will be relatively small and their customers will pay for a learning curve. The costs of offshore wind power will certainly decrease as technology improves, the industry matures and the projects get larger and take advantage of economies of scale. But even at its most robust, wind generation will probably never be as cheap as coal.

That's if we use our monthly electric bills as our only guides.

There are other, hidden costs in producing power with coal that don't appear on our bills. We pay them, though, primarily through higher taxes and health insurance premiums, lost productivity and a compromised environment.

Economists call such costs "externalities". With fossil fuels, like coal, these external costs come in three main categories: social harms, subsidies and environmental degradation. Burning coal produces a variety of emissions. Some cause acid rain that damages buildings, kills trees and reduces farmers' crop yield. Others create smog that triggers attacks of asthma and bronchitis that land sufferers in their doctors' offices or worse, in the hospital. The particulates in coal emissions can lead to respiratory problems and congestive heart failure. The mercury poisons rivers and fish, while the carbon dioxide is the primary cause of global warming.

In West Virginia, coal companies strip away mountaintops, forever destroying whole ecosystems in the process. The ponds where power companies dump the ash from the burned coal can burst or overflow, as they did in the Tennessee Valley last year, and do incalculable damage. In North Carolina, selenium leaching from coal ash from a power plant sterilized fish in a nearby lake for almost two decades.

How do we put dollar amounts on such costs? The National Research Council gave it a good shot. At the request of Congress, the council put together a diverse committee of experts to try to estimate the hidden costs of fossil fuels to the U.S. public. They looked mainly at the damage that air emissions from utility plants and motor vehicles had on human health, grain crops and timber yields, buildings and recreation. Such damages, the committee determined in its 2009 report, were costing the public about $120 billion a year. The country's 406 coal-fired power plants accounted for more than half the total – $62 billion.

Those figures don't include damages from climate change, harm to ecosystems, effects of some air pollutants such as mercury and risks to national security.

Robert Williams, a Princeton University professor, estimated the external cost of air pollution from coal-fired power plants using a model that the Europeans have used since 1991 to determine the hidden costs of fossil fuels. Williams concluded that the average U.S. coal plant creates about 13.5 cents of "harm" for every kWh it produces.

Harvard Medical School noted in a study that just the human-health costs of burning coal adds 9-27 cents to every kWh, depending on the age of the power plant, the level of emission controls at the plants and the type of coal burned.

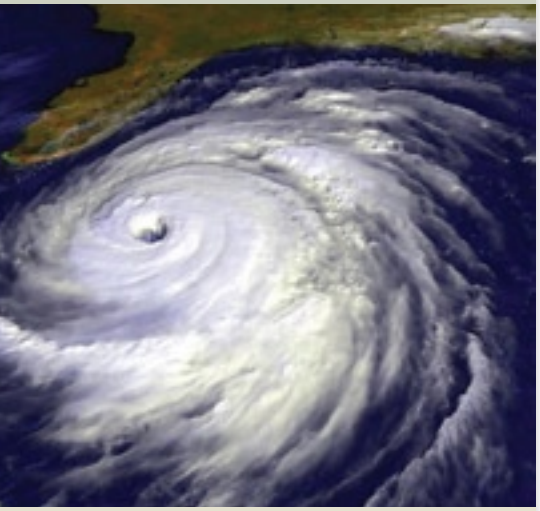
If any of those estimates are accurate, the "real" cost of that kilowatt-hour of electricity in North Carolina then is closer to 25 cents, not 10.

At that price, offshore wind is competitive, notes Brian O'Hara. He heads the Offshore Wind Coalition, a non-profit group that is promoting wind power off the N.C. coast. "I'm in favor of treating all energy sources in a free market," he said. "But we don't do that today. Until we acknowledge that there are public health costs and environmental costs in burning coal, we don't have a free market."

The N.C. Utilities Commission, which regulates electricity generation, doesn't consider external costs when deciding on rates that utilities can charge their customers. It requires that the companies produce that power at the lowest cost. In North Carolina, that means burning coal, noted Emily Felt, the director of Duke Energy's Renewable Strategy and Compliance section.

"The regulations require least-cost generation. Until the rules change, that's what we have to do," she said. "If legislation on the national or state level requires us to include external costs, we will and our power mix will change."

–By Frank Tursi



What About Hurricanes?

No one really knows if offshore wind turbines can withstand the fury of a hurricane.

"The potential damage to turbines from hurricanes should not be overlooked," researchers from the University of North Carolina warned in their 2009 report on wind energy along the N.C. coast.

Manufacturers say their turbines can withstand winds of 150 mph. In high winds, sophisticated microprocessors automatically stop the turbine and position the blades so that they can safely ride out the storm. Once the strongest winds have passed, the wind farm resumes operation.

Wind farms in Europe are in some rough waters, like the North Sea, but they have not been subjected to the extreme high winds and storm surge of a hurricane.

The developers of a fledgling wind project in the Gulf of Mexico weren't comfortable with the single towers used to support most European offshore wind turbines. They proposed support towers with three legs, which would be buried more than 100 feet below the underwater mud line.

—By Frank Tursi

Above: Hurricane Floyd, 1999.
Data from NOAA GOES satellite. Image produced by Hal Pierce, Laboratory for Atmospheres, NASA Goddard Space Flight Center

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similar-sized land-based windmills simply because the wind is stronger and more consistent offshore.

Capital costs will certainly decrease, as they did with land-based wind, as the industry matures and technology improves. For instance, bigger turbines are being developed that will produce more electricity than current models. They will cut costs dramatically by reducing the number of foundation poles that have to be sunk into the ocean floor.

That's in the future, though. The electricity produced by the first generation of offshore wind farms will likely be twice as expensive as what customers in North Carolina pay now.

That makes Emily Felt pause. "Offshore wind is clean," said Felt, the director of Duke Energy's Renewable Strategy and Compliance section. "But is it affordable today? Not for us in the Carolinas."

DON'T BID FAREWELL TO COAL JUST YET

Neither is offshore wind dependable. Unlike other energy sources, we can't control the wind. It blows where and when it wants to. To utility people like Felt that means it won't always be available to produce electricity to meet customers' demands. Peak demand is early in the morning as people start their day and then again in the late afternoon and evening when they return from work. The lights won't come on, the AC will go dead and you'll miss American Idol if the wind isn't blowing during those times. No affordable technology, like giant batteries, currently exists to store the excess electricity that the turbines might generate during off-peak times.

The wind's fickleness also means that offshore turbines will never generate electricity continuously, like a coal-fired plant does. Experts estimate that they'll operate about a third of the time, maybe a little higher off the N.C. coast because of the better winds.

"That means we can't use the resource without coupling it with another technology to meet our load requirements throughout the day," Felt said.

Because of the realities of the way we use and generate electricity, offshore wind farms aren't likely to soon replace the old, polluting coal-fired power plants that now generate more than half of the electricity used in North Carolina. The turbines may also have to be paired with small generators fueled by natural gas that could be fired up to meet the peak demand.

That then brings us to a central question: Does wind energy really reduce carbon emissions? Some would argue that the ultimate goal of any "renewable" energy source is to reduce CO_2, a potent greenhouse gas. While wind turbines clearly don't spew carbon dioxide, neither do they seem to be immediate replacements for coal-fired power plants, which are the largest source of man-made CO_2.

Andy Wood is skeptical about promoters' claims that wind energy will reduce CO_2 emissions. He's the education director for

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KILOWATTS, MEGAWATTS, GIGAWATTS, OH MY

You don't have to poke around in the world of wind farms and solar arrays for long before bumping into watts, kilowatts, megawatts and gigawatts. They're confusing enough without throwing in "kilowatt-hours," a term you'll readily find on your monthly electric bill.

A short primer seems to be in order.

The ability to generate electricity is measured in watts. Because they are very small units of power, kilowatt (kW, 1,000 watts), megawatt (MW, 1 million watts), and gigawatt (pronounced "gig-a-watt," GW, 1 billion watts) are most commonly used to describe the capacity of generating units like wind turbines or other power plants.

That's how power is measured. How we consume the electricity produced by that power is most commonly measured in kilowatt-hours (kWh). A kilowatt-hour means one kilowatt (1,000 watts) of electricity produced or consumed for one hour. One 50-watt light bulb left on for 20 hours, for instance, consumes one kilowatt-hour of electricity (50 watts x 20 hours = 1,000 watt-hours = 1 kilowatt-hour). Moving up in scale, a house in North Carolina, according to the U.S. Energy Information Administration, consumes on average about 1,400 kWh in a month.

The output of a wind turbine depends on the turbine's size and the wind's speed through the rotor. Wind turbines being manufactured now have power ratings ranging from 250 watts to 5 megawatts (MW).

So, a 10-kW wind turbine can generate about 10,000 kWh annually at a site with wind speeds averaging 12 miles an hour. That's not enough to power our typical N.C. house for a year. A 5-MW turbine, on the other hand, can produce more than 15 million kWh in a year – enough to power more than 890 average N.C. houses.

—By Frank Tursi

Offshore Turbines May Have Fewer Effects Than Wind Farms on Land

While no one is quite ready yet to give them a clean bill of health, when it comes to birds, bats and other potential environmental conflicts, offshore wind turbines seem to do less harm than those built on land.

"That would be the general conclusion but we really don't have a good handle on it," said Dr. Charles "Pete" Peterson, a researcher and distinguished professor at the UNC Institute of Marine Sciences in Morehead City. "Most of the studies to date have been done on land."

That was a problem for Peterson and the other researchers who tried to assess the environmental effects of offshore wind farms in N.C. waters as part of a study that the University of North Carolina at Chapel Hill completed in 2009. They found little to go on. No studies have been done in the United States because no offshore turbines have been built here. They found a few bird studies from Europe, where turbines have been in the water for about two decades, but nothing comprehensive.

He had hoped that the three turbines that Duke Energy planned to build in eastern Pamlico Sound would provide some clear answers, but Duke pulled the plug after determining that the project was too expensive.

"That was a real disappointment to researchers, because we really won't know what some of the impacts will be until we get a few in the water," Peterson said.

But here's rundown of what we know about the main environmental risks, or to put it more accurately, what we can deduce:

BIRDS AND BATS

These are the most well-known casualties of onshore wind turbines. They collide with the giant blades or are killed by the drop in air pressure caused by the spinning blades. The U.S. Fish and Wildlife Service in 2009 said onshore turbines in the United States kill about 400,000 birds annually. The American Bird Conservancy worries that the build-out of wind energy proposed by the federal government could kill a million birds a year by 2030. Wind promoters, though, point out that cats kill millions of birds each year. Another 60 million are thought to be hit by cars and 90 million more collide into buildings and die.

Offshore turbines should be less of a threat than all of those simply because there are fewer birds flying over water. Peterson points out that even in Pamlico Sound where many species of birds actively forage the average density of birds is about one or two a square mile. "Compare that to the number of birds you see in your backyard," he said.

Wind farms built in the ocean 12 or so miles off the beach may offer the least threat to birds because even fewer birds venture that far from shore. Bird density increases again at the western edge of the Gulf Stream where pelagic birds, like petrels, concentrate. But the water there is too deep to make wind farms profitable using current technology.

Neo-tropical songbirds, though, worry Peterson. These are the warblers, thrushes, tanagers and vireos that are prized by backyard birders but whose populations are declining in North America. Wind farms built in the ocean far from shore shouldn't normally threaten the birds, which usually don't fly too far from land on their nocturnal migrations. Storms could push them farther from shore, Peterson said, and force them to fly at lower altitudes where they could fall prey to a turbine's blades.

"These are the legends of ornithology," he said. "Even relatively small losses from wind farms may be unacceptable. We just don't know."

Bats have been surprising casualties of onshore turbines, especially tree-roosting, migratory bats in the eastern United States. But all bats on the East Coast eat insects. Presumably then, the risk from offshore turbines declines rapidly the farther the turbines are from land. There are exceptions, of course.

To protect bats and birds, the UNC study recommends banning turbines within two miles off shore and maybe farther around areas where birds are known to congregate, such as capes and inlets. Turbine platforms should be designed without areas that birds could use as perches, the study suggests, and lights should be used that don't attract birds or insects.

MARINE MAMMALS, SEA TURTLES, FISHERIES, MARINE HABITATS

Construction noise and boat collisions are the clearest risks to bottlenose dolphin, the most common marine mammal in N.C. waters, and to right and humpback whales, which migrate along the coast. Softly ramping up noise during construction and restricting vessel speeds, the UNC study notes, could lessen the threats.

Sea turtles aren't likely to be injured by offshore wind farms, but Peterson said that electromagnetic fields produced by buried transmission cables could disorient turtles and other animals that use internal magnetic compasses to navigate.

For fisheries and marine habitats, the potential conflicts here are many: fish nursery areas, oyster reef sanctuaries, shell bottom, live bottom, shipwrecks, underwater grass beds, navigation channels and other important transportation routes, all inlets. They would put most of the state's inshore sounds, bays and rivers and waters close to the beach and around inlets and capes off limits to wind farms.

VISUAL

Some people think the huge wind towers and blades are just plain ugly. The visual intrusiveness of these giants is a major obstacle to wind power development on land. It may be on the water as well.

Wind farms in either of the state's major sounds or close to the beach would almost certainly be visible from shore and probably elicit much gnashing of teeth among tourists and beach town mayors.

The National Park Service may not like it either, given that about half of the state's ocean shoreline is part of Cape Hatteras or Cape Lookout national seashores. The park service, which runs the seashores, hasn't established any strict definitions of what an adverse visual impact might be, but sticking a wind farm within sight of the seashores' beaches might be considered akin to dropping one in Yellowstone or Yosemite.

To allay fears at the seashores and to protect the valuable coastal tourism and retirement industries, the UNC study notes that it might be prudent to require that wind farms be placed at some distance, perhaps at least two miles, from shore.

— By Frank Tursi

Marines Nix State's First Offshore Wind Proposal

In a swath of Onslow Bay almost the size of Charlotte, a company that taps the wind for electricity had hoped to build North Carolina's first offshore wind farm. Then, the U.S. Marines defended their territory.

Apex Wind Energy formally applied to the U.S. government in July to lease a 213-square-mile chunk of ocean bottom more than 20 miles from shore. The company thought that the area could support as many as 300 turbines that could generate 1,700 MW of electricity, or enough to power more than 350,000 houses.

In choosing Onslow Bay, developers relied largely on a study of offshore wind in the state that the University of North Carolina in Chapel Hill completed in 2009, explained Robert Propes, development manager for Apex. The winds there are strong enough to produce utility-scale electricity, the study found. The turbines would be far enough from land that residents and tourists at places like Surf City wouldn't complain about sullied views of the ocean. Yet they'd be close enough to Morehead City, southern Onslow County and Wilmington to tap into some of the few electrical substations on the coast large enough to transmit the additional power.

"We were very excited about the site," Propes said. "The state has the best wind resource on the Eastern Seaboard, and Onslow Bay has some of the best wind on the N.C. coast."

Now it's likely back to the drawing board for Apex after a federal task force put all of Onslow Bay off limits to wind farms because of extensive military training that goes on there.

"The proposed area that we put forth is in conflict with the military uses," Propes said. "We're already looking at other alternate sites that have equal prospects for a viable wind farm. Onslow Bay was good for offshore wind, but it's certainly not the only good area off the coast."

BOEMRE TASK FORCE

The task force is mapping the N.C. coast looking for the best sites for offshore wind farms that don't conflict with other uses. The Bureau of Ocean Energy, Management, Regulation and Enforcement, or BOEMRE, is responsible for developing offshore energy resources beyond the states' three-mile limit. The agency was rearranged and renamed after the disastrous oil spill in the Gulf of Mexico last year.

BOEMRE leases ocean bottom in nine-square-mile blocks to those who want drill for oil or natural gas or to erect giant turbines to catch the wind. That last responsibility is a novel one for the agency. Congress in 2005 rewrote the law to give BOEMRE sway over the wind. It took four more years to come up with regulations. No company has yet gone through the process to build a wind farm anywhere in U.S. waters.

Then along comes Apex with an unsolicited bid to lease 24 blocks in Onslow Bay. Based in Charlottesville, Va., the company has been directly involved in developing, procuring or financing 28 land-based wind projects in 16 states that are now producing almost 4,500 MW of power. Along with its

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Audubon North Carolina, and he wants to make it perfectly clear that his opinion here is his own and doesn't necessarily reflect the stance of his employer.

"It is important to remember that electricity from wind power is unreliable and requires us to maintain base load production from traditional sources (coal, nuclear, hydro and some gas)…" Wood wrote in an e-mail. "As regards air pollution reduction from wind power, we have to keep the coal plants running in order to meet base load. Wind is too fickle to count on for light switch delivery needs… Wind farms may actually make us more polluting because we have to depend on small gas-powered units to fill the up-and-down fluctuations in electricity delivery from wind."

CONQUERING THE FRONTIER

That may be true, but only for the time being. Consider Willett Kempton's visionary plan. He's a professor at the University of Delaware's School of Marine Science and Policy and he's been thinking about offshore wind for an awfully long time. In a study published in the Proceedings of the National Academy of Sciences in April 2010, Kempton described a chain of 11 offshore wind farms – each made up of 100 wind turbines – along the East Coast. They'd be connected by a transmission cable buried beneath the ocean, so if one wind farm falls idle, the other farms would transmit their excess energy to it. The wind would always be blowing somewhere, giving utilities the flexibility they need to start shutting down the coal plants.

Getting there, though, will take time, O'Hara said. Significant technical challenges to improve the electrical grid first have to be overcome. We have to better understand where the best wind blows offshore, and the cost of building wind farms will have to come down.

But you have to start somewhere, he said.

"It doesn't need to take decades if the political will is there," O'Hara said. "It's not going to change fast. In any scenario I don't think fossil fuels will disappear in my lifetime. But I think wind can produce a large share of our electricity needs in the future."

The state is taking the first cautious steps toward that future. To encourage renewable energy development, including offshore wind, the N.C. General Assembly in 2007 passed a law that requires investor-owned utilities to use renewable energy to meet at least 12.5 percent of their electricity retail sales by 2021. A bill winding its way through the current legislature would allow the N.C. Utilities Commission to require the state's utilities to make long-term contracts for 2,500 megawatts of offshore wind capacity to be built over a period of seven to 10 years. If enacted, the commission would issue a request for proposals by January 1, 2012.

"Energy is a generational challenge for us," O'Hara said. "This is not quite a crusade, but I think it's the right thing to do."

Wind Turbines Could Provide Valuable Habitat

Though they may present some environmental risks, offshore wind turbines might also have positive effects depending on their location:

- **INSHORE ARTIFICIAL REEFS.** About 48,000 square feet of rocks are placed at the base of each turbine foundation pole to protect against scour. In high-salinity inshore waters, the rocks would attract oysters and mussels and would become productive fish habitat. In Pamlico Sound, barnacles and mussels would also grow on the poles, which would attract some diving ducks like scoters and several fish, most notably sheepshead and black drum.
- **ROCKY OCEAN BOTTOM.** In the ocean, the foundation poles of wind farms also have great potential as artificial reefs and could enhance the populations of some bottom fish, such as snappers and groupers, and predatory pelagic fish, such as king mackerel.
- **OFFSHORE MARICULTURE.** The hard surface provided by the wind turbine shafts north of Cape Hatteras will become naturally colonized by blue mussels. That could provide another fishery, similar to the harvests and sales of mussels colonizing pilings of offshore oil platforms in southern California.
- **ENHANCING UPWELLING.** As air flow passes through the spinning blades of the wind turbines, winds diverge over the water surface and the resulting turbulence induces deeper water to the surface. In Pamlico and Albemarle sounds, water along the bottom can become so devoid of oxygen in the summer that fish can die. Wind turbine-induced upwelling and vertical mixing could reintroduce oxygen to the sound bottom. In the ocean, this same phenomenon could bring deeper nutrients to the surface, increasing the phytoplankton population on which the pelagic food chain is based.

NORTHEAST PROJECT COULD BE FIRST MAJOR WIND FARM IN N.C.

It looks nothing like a desert, with its deep black soils, roadside wildflowers and scattered groves of thick woods. After all, it's a cutover portion of the Great Dismal Swamp.

But the Desert is what locals call this seam of farmland along the Perquimans-Pasquotank county line, and Desert Wind is the name of what investors hope will become coastal North Carolina's first utility-scale wind farm.

Officials with Atlantic Winds LCC, a subsidiary of the wind power giant Iberdrola Renewables, say they're on track to begin construction in December of a 300- megawatt facility on 20,000 acres of cleared land. The 150 turbines would produce enough electricity to power between 55,000 and 70,000 homes. Atlantic Winds aims to start feeding power into the grid by December 2012.

To make both December deadlines, they must negotiate a complicated permitting process with state and federal agencies. But so far no major roadblocks have appeared.

"We're not in the bottom of the ninth," says Craig Poff, senior development director for Iberdrola. "But we hope to have the go-ahead late in the third quarter of the year or early in the fourth quarter."

Timing is everything. If it can meet the deadlines, the company will be eligible for either a federal cash grant or tax credits of 30 percent to help offset its hardware investment. If it can't, it's questionable whether there will be a Desert Wind project.

REAPING JOBS FROM THE WIND

County officials and business boosters are optimistic. A May 2010 study by the state Department of Commerce found that the

project would pump $750 million into the local economy, including 590 construction jobs and 19 permanent jobs. Farmers would receive an estimated $6,000 a year in lease fees for each turbine on their land. More than 40 people own land within the project areas. They would be able to farm right up to the structures.

The project would also industrialize what's now a pastoral swath of farmland—a reality that residents who live close to wind farms in other regions say is too often played down.

While studies show that the strongest, most consistent winds blow over the open ocean, supporters of land-based wind energy projects are quick to point out that the U.S. has yet to build a single offshore wind farm. Because of distances, environmental stresses and maintenance demands, developing offshore is more expensive.

The northeast corner of the state has attracted attention from wind energy investors because of its wide swaths of open land—hard to find on the coast. And the region has another unusual feature: Rather than dying down on summer afternoons when the demand for electricity is at its peak, as is typical, the southerly breezes here often blow harder than ever.

Companies like Invenergy and Element Power U.S. have made detailed inquiries about putting up turbines in Currituck, Tyrrell, Washington and Beaufort counties. Hyde County has drawn less interest, presumably because of the large bird populations on the federal wildlife refuges.

But Iberdrola is the first out of the gate. On May 3 the company cleared an important hurdle when the N.C. Utilities Commission certified the Atlantic Wind facility, granting it permission to proceed.

PROJECT BENEFITS EVERYONE

"Atlantic Wind's plan has all the appearances of a win-win arrangement, especially for land that's too far from the waterfront to benefit from tourism," stated Wayne Harris, executive director of the Albemarle Economic Development Commission in Edenton.

"The Desert's proximity to existing power transmission infrastructure adds to its attractiveness for wind power," Harris said. "Perhaps most important, the project has a lot of local support. You don't have the kind of opposition that's plagued projects in the mountains".

Testimony at public hearings in Elizabeth City and Raleigh bears that out. Of 10 speakers, only one opposed the project. Most commented on the need for new industry in the Desert, the benefit to farmers and the excitement of hosting the first major wind farm in the state.

Atlantic Wind must still get approval from the U.S. Army Corps of Engineers regulatory division. But a full review won't be possible until the company submits a plan of where turbines, roads and support infrastructure would be built.

The project does not need a permit under the state Coastal Area Management Act, and the U.S. Fish and Wildlife Service has found no protected or endangered species on the site. Neotropical songbirds do migrate through the region, but they generally stick to more forested areas, says biologist John Stanton of the FWS's South Atlantic Migratory Bird Coordination Office.

Locally, county governments are drafting zoning and safety regulations. But given the widespread support for the project, that hurdle is not expected to be difficult for the company to clear.

– By Jan DeBlieu

ONSHORE WIND FARMS CAN THREATEN BIRDS, BATS

When one of the first onshore wind farms was built in California's Altamount Pass in the late 1970s, it quickly became notorious as a killer of birds, including endangered golden eagles.

Steps have since been taken to make the giant windmills less of a threat to birds by avoiding major bird migration routes when siting wind farms. Turbines are also now designed to be less attractive as roosts and to decrease vibrations and noise that disturb wildlife.

Still, utility-scale wind farms are industrial zones, and those built on land do have environmental consequences, especially for migrating birds and bats.

The U.S. Fish & Wildlife Service (FWS) has issued a draft set of guidelines for siting wind farms and for designing and placing turbines that it hopes will minimize impacts on wildlife. The service is charged with administering the federal Migratory Bird Treaty Act.

But enforcement of the treaty is up to individual law enforcement agencies, notes John Stanton, southeast migratory bird biologist for the FWS.

The American Bird Conservancy and other environmental organizations are pushing for the federal government to enact legislation requiring wind farms to be "bird smart." The conservancy's website claims that if 100,000 turbines are erected on land in the United States by 2030 as expected, they will likely kill at least a million birds a year.

Neotropical migrants are especially at risk, biologists say, because they must negotiate long stretches of unfamiliar terrain. Lights on turbines attract insects, which also draw in bats, flycatchers and other insect-eating birds.

It's unclear how much wildlife is affected by the noise and vibrations from wind farms. But nearby residents have complained about turbines ruining the peacefulness of their communities and their views of natural landscapes.

The aesthetics of wind farms has been a major obstacle to their development on land. Opponents in the state's mountain regions have used a law that the N.C. General Assembly enacted in 1983 in response to public outcry to a high-rise resort marring the view of Sugar Top Mountain in Avery County. The law limits the height of structures to 40 feet on ridges at least 3,000 feet high. Though it exempts "windmills," the law had a chilling effect on wind power in the mountains, an area of high winds.

The chill, however, is thawing on the coast.

—By Jan DeBlieu

Community Wind's Promise Thwarted by State Regulations

Suppose you're the superintendent of a school district with dilapidated heating and cooling systems or a town that needs to replace its street lights. You're approached by an energy services company—a firm that specializes in providing such equipment—with a proposition:

Allow them to install a wind turbine on your property and replace your old system with equipment that's more expensive than you can afford, but much more energy efficient. The contractor sells any electricity your system doesn't use back into the grid. If you save money on future electric bills, you'll use that savings to pay the contractor. If the savings are enough, you pocket the extra money. If for some reason your electric bills rise (they likely won't), the contractor will pay you the difference.

Sound like a sweet deal? It's worked well in Erie and Geneseo, Illinois, and in other states with favorable regulations. In some cases, so-called flip projects allow the contractor to retain primary ownership of the wind turbine for 10 years, long enough to max out the federal tax credit for renewable energy. Primary ownership of the equipment is then turned over or sold at a bargain rate to the owner of the turbine site.

But unless things change, it's unlikely to happen in North Carolina.

N.C. Utilities Commission regulations hold that only utilities are allowed to sell electricity. So a third-party arrangement, where a private contractor sells renewable power to a utility customer, isn't possible here.

What's more, utilities can pay anyone who puts up a private renewable energy system a deeply discounted rate for power sold back into the grid—say, 4.5 cents a kilowatt hour instead of the local retail rate of 9 cents. Illinois and some other states require utilities to pay private producers the going retail rate.

As a result, it's difficult to raise the capital for a community wind project. And the cost—about $500,000 to $600,000 for a 100 kilowatt (kW) turbine and a couple of million dollars for a 1.5 megawatt (MW) turbine—is hardly chump change. A 1.5 MW turbine could provide enough electricity annually for about 300 average homes.

There are three kinds of wind power systems: utility-scale wind farms; small turbines put up at individual businesses or residences (these are also more difficult to put up in North Carolina because of the low price received for power sold back into the grid); and community wind systems, where one or two industrial-size turbines are erected to serve a small group of customers like a town, school district or cluster of residences or farms.

While other states have revised laws and regulations to attract investment in distributed power—energy from small, scattered producers—North Carolina's emphasis continues to favor the traditional energy model, where power is produced at large, centralized plants.

Duke Energy is experimenting with distributed power by installing solar panels on the rooftops and grounds of various homes, schools, office buildings, shopping centers and warehouses – enough to power 1,300 homes. It's

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ELK RIVER:
Project Capacity: 150 MW
Number of Wind Turbines: 100
Project Location: In Butler County, approximately 45 miles east of Wichita, Kansas, near Beaumont

BIG HORN I:
Project Capacity: 199.5 MW
Number of Wind Turbines: 133
Project Location: Approximately five miles south of Bickleton, Washington, in Klickitat County
NOTE: There is also a Big Horn II project which is an additional 49.5MW (33 turbines).

The Many Faces of Bioenergetics

BY FRANK TURSI

Using North Carolina's forests and farm fields to fuel our future offers great promise, but it also raises disturbing questions. What might it do to coastal landscapes and their rich natural diversity? Plants and trees are, of course, made of carbon. Will burning them actually reduce carbon dioxide emissions?

In other words: Is bioenergy *really green?*

"It's a shade of green," said Will McDow of the Environmental Defense Fund in Raleigh. "It's a very challenging subject. You have a lot of cheerleaders out there and you have the naysayers. It depends on how you collect it, what you use and how you use it."

Bioenergy refers to renewable energy contained in living or recently living biological organisms. Organic material, such as plants, contain bioenergy that is known as biomass, and we might be using a lot of it in the future.

State policy and law will encourage us to put our farm fields and forests to work growing plants and trees to fuel our vehicles and power our homes and businesses. One state initiative calls for producing more than 500 million gallons of fuels, such as ethanol and diesel, from plants grown in the state by 2017. Military bases in the state are actively promoting the use of those fuels. Utility companies are seeking permits to use small trees and tree limbs – so-called woody biomass – to generate electricity in order to meet state-mandated renewable energy goals.

It may be worth stopping a moment to assess these new fuels before we rush into the forest with chainsaws roaring.

WOODY BIOMASS

This is the fuel state legislators had in mind in 2007 when they passed a law to require investor-owned utilities to provide some of their electricity from "renewable" sources, such as wood waste, notes Steve Wall. He's the director of Policy and Environmental Issues for the Biofuels Center of North Carolina, which the legislature created that same year to study and promote the fuels.

"In the short term I see woody biomass playing a pretty significant role, especially in the state's renewable electricity law," he said. "While the legislature debated that bill, there was an understanding that power from woody biomass was more available and cheaper when compared to solar and wind."

The reason is simple: Trees are everywhere. To Emily Felt, director of Duke Energy's Renewable Strategy and Compliance section, the trees are an abundant resource that can be turned into electricity. "As the sun is to the western states and the wind is to the Midwest, biopower is to southeastern states," she said. "We have a lot of trees. The wind doesn't blow hard enough, at least on land, in the Southeast, and the sun is good but not as good as it is in Arizona. What we have that Arizona doesn't have are trees."

Using those trees as sources of energy could lead to healthier forests over time, Wall said. Landowners, for instance, might be encouraged to better manage endangered longleaf pine forests if the woody understory could be sold for fuel.

The potential demand for wood from the forests could create new sources of income that could entice landowners to hold onto their land. The N.C. Department of Agriculture and Consumer Services reports that since 2002 the state has lost more than 600,000 acres of farmland, mainly to urban development. "The greatest threats to our state's forests are called housing developments," Wall said.

THE RISKS OF TREES AS FUEL

But turning forests into fuel depots could have severe effects on the 18 million acres of wood land in North Carolina, noted the state's Environmental Management Commission in a 2010 report. It found that "the use of woody biomass for energy production has a broad range of potential impacts that, without adequate safeguards, could be harmful for the environment, public health and culture of the State."

Converting natural forests to plantations to grow trees as fuel could severely affect biodiversity and wildlife, the report noted. Water quality could also suffer. The National Wildlife Federation in a March 2010 report echoed many of the same fears from a nationwide perspective.

Eastern North Carolina would seem most vulnerable since that's where most of the large tracts of privately owned woodland are.

Wall noted that companies are already contracting with landowners east of I-95 to remove wood that would be burned in European power plants.

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OAK ISLAND COMPANY

EXPERIMENTS WITH GREEN CRUDE

We all know about Big Oil. How about Microscopic Oil?

We're talking here about pond scum. Yes, algae, that yucky green stuff that we see clogging roadside ditches. To Kim Jones, the tiny, single-celled plants are the future, the green crude that may, one day, power that Mercedes E350 that you've had your eye on.

Jones is a chemistry professor at Brunswick Community College and the founder and CEO of Alganomics, a small company in Oak Island that is culturing algae with the hopes of converting it into a fuel to run diesel and even jet engines.

"It is a wonderful biofuel," she says. "Algae grow everywhere and we're not using a food source to make the fuel."

This isn't as far-fetched as it sounds. In fact, algae have a long pedigree as a fuel source. The crude oil used today to create gasoline, jet fuel, plastics and other substances began as, yes, pond scum – albeit 500 million years ago. The Earth's atmosphere then contained 18 times more carbon dioxide than it does today, which triggered a giant algal bloom. The algae grew for 100 million years and then died. After time, temperature and pressure worked their magic, algae became crude oil and the Saudis became billionaires.

"We're just speeding up the process," Jones explained.

Experts in such matters predict that the production of algae biofuel could reach 61 million gallons a year and a market value of $1.3 billion over the next decade. It's not surprising then that a number of oil companies, including BP and ExxonMobil, are working to turn algae into fuel.

Jones is no Chevron. Her small operation adjacent to the Oak Island sewer plant consists of clear acrylic tubes, called "photobioreactors," that continuously circulate as much as 10,000 gallons of water from the sewer plant in a closed loop.

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These Plants Could Be Fueling Your Car

Here are some of the plants that can be used to make ethanol or biodiesel fuel in North Carolina:

ALGAE: Algae is perhaps the most promising of all the plants for biofuels because of the sheer volume of oil it could produce. If research proves true, the volume of oil it could produce dwarfs that of other plants – 4,000 gallons of oil per acre. Other oil crops produce no more than 100 gallons per acre. But algae has yet to move out of the lab.

CANOLA: Canola can be grown in the winter in North Carolina to produce seeds with high oil content. The oil is suitable for biodiesel or food-grade vegetable oil.

DUCKWEED: A tiny aquatic plant, duckweed grown in the hog lagoons can be used to make ethanol.

GIANT MISCANTHUS: A native of Japan, this perennial grass is related to sugarcane. In Europe, it is used primarily for combustion in power plants. It has considerable potential in North Carolina for ethanol production and for gasification to gasoline processing.

GRAIN SORGHUM: This summer grass, which is sometimes called milo, looks like corn. The high starch content of the seed makes it a potential crop for fermentation into ethanol.

INDUSTRIAL SWEET POTATO: Industrial sweet potatoes grow similarly to edible sweet potatoes, but their roots have much higher starch content. The higher starch makes this kind of sweet potato a crop of interest for bioethanol production.

SOYBEANS: Soybeans have been grown in North Carolina for decades. They were once the standard for biodiesel production and the benchmark against which other oil-producing crops were judged. Now, though, soybean oil is too expensive for regular conversion to biodiesel.

SUGARBEETS: Hybrid sugarbeets are being designed to produce the maximum amount of sugar, which can then be used to make ethanol.

SUNFLOWERS: The N.C. Biofuels Center and the state Department of Agriculture are working jointly on testing one type of sunflower that produces seeds with high oil content. The oil could be used for biodiesel.

SWEET SORGHUM: The juice extracted from the stalks of this summer annual grass is a source of aqueous sugar that is easier to convert into ethanol than it is to convert starch and cellulose into ethanol.

SWITCHGRASS: This giant, warm-season perennial grass native to North America is high in cellulose, making it attractive ethanol for production in North Carolina.

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Those risks would presumably increase if the legislature approves a bill that was introduced this session that would make a one-word change to the 2007 law. Only "wood waste" now qualifies as being "renewable" under the law. That's defined as small trees, limbs, tree tops and other woody material left on the forest floor after trees have been cut. The proposed change would delete "waste" from the definition. Every wood product, then, would be considered "renewable" and every tree would be fair game for use as fuel in power plants.

Whether in the form of tree limbs or whole trees, wood produces various emissions that would have to be controlled and, like coal, creates carbon dioxide, a powerful greenhouse gas, when burned. Promoters like to claim that wood is "carbon neutral" because the trees soak up carbon dioxide from the atmosphere as they grow, and that balances out the CO_2 they produce when burned. It's not that simple, though. It all depends on where the wood comes from, how it's harvested, whether whole trees or actual wood waste is used and if the land is replanted with trees afterward.

THE CARBON 'DEBT'

There's also the "debt" that has to be repaid. The Massachusetts Department of Energy Resources commissioned a landmark study on biomass that blew a hole in the carbon-neutral theory. It noted that there's a carbon "debt" when biomass is burned for energy and that burning trees or other types of biomass often releases more carbon at the time of combustion than an equivalent amount of fossil fuel. It then takes a certain amount of time to repay that debt by recovering that additional carbon. In other words, the CO_2 released from burning a large pine tree, say, would exceed what's emitted by an equal amount of burned coal. The extra CO_2 wouldn't be recovered for years, until a new pine tree grows large enough to take up the extra carbon through photosynthesis. The study's researchers concluded that it takes about 42 years to begin to create a net carbon dividend compared to coal when biomass is used to make electricity.

Wall concedes that the carbon issue needs to be examined more closely. "The study certainly sends out the signal that we need to take a closer look and not just assume that if you're burning wood you're necessarily reducing greenhouse gases," he said.

"Carbon emissions are woody biomasses' Achilles' heel," Felt said.

Clearly, forests used for fuel would have to be replanted and managed sustainably to achieve a net reduction of those emissions over time, she said. "We're used to buying fuel," she said. "One of the ideas we're talking about internally is can we buy the fuel and make it contingent on replanting and other sustainable practices."

The state will have to devise policies to protect its forests, McDow said. "It's not perfect," he said of woody biomass. "It's not carbon-free in the way wind or solar is, but it's better than coal. We're going to need every tool we have. Getting biomass right is going to critical."

So will winning over a skeptical public. Proposed bioenergy power projects in Florida and Michigan were cancelled after facing stiff public opposition. A 2010 poll conducted by Elon University found that a majority of North Carolinians surveyed oppose using forests to produce energy fuels.

SOME TERMS TO KNOW

BIODIESEL: A liquid biofuel produced from a variety of feedstocks, such as vegetable oil or animal fats, with a similar composition to petroleum diesel fuel.

BIOFUELS: A wide range of liquid fuels derived from some form of biomass. Used to power vehicles.

BIOMASS: A catch-all word for renewable energy sources comprised of biological material, including wood, crops and municipal solid waste.

CELLULOSIC ETHANOL: A biofuel produced from cellulose that is found in plants and wood.

CORN ETHANOL: This is the most common biofuel and is produced by fermenting and distilling corn.

ETHANOL: A liquid biofuel blended into gasoline, including E10 (10% ethanol and 90% gasoline), E15 (15% ethanol and 85% gasoline), and E85 (85% ethanol and 15% gasoline). Only E10 is sold in North Carolina.

FEEDSTOCKS: Raw materials, including wood or crops, used by an industrial process to create products, such as biofuels.

FLEX-FUEL VEHICLES: Automobiles that run on gasoline or a blend of up to 85% ethanol and, except for a few engine and fuel system modifications, are identical to gasoline-only models.

RENEWABLE TRANSPORTATION FUEL: A broad term often used interchangeably with biofuels.

WOODY BIOMASS: Trees and forest residues, such as tops and branches collected from a traditional timber harvest.

BIOFUELS

We all know about ethanol. It's the most common fuel made from plants, and a gasoline blend containing 10 percent of it is sold at most gas stations in the state. That ethanol comes from corn grown in the Midwest.

It's also not what we'll be making in North Carolina.

We're shooting for what's known as second-generation biofuels. They're made from non-edible grasses, like switchgrass and giant miscanthus. Even algae can be converted to diesel or jet fuel. Though the state is committed to producing 10 percent of its liquid fuels from such plants grown within the state, we're far from there. Technological breakthroughs will be needed to bring the cost down.

"Biofuels are probably a longer term issue," Wall said. "Its potential is very significant but we're a couple of years away."

An economic boom could await when we get there. A study by the Kenan Institute of Private Enterprise at the University of North Carolina-Chapel Hill estimated that over 3,300 new jobs will be created by meeting the state's goal. Many of those jobs will be in the state's poorest and most rural counties. A developed biofuels industry could also create new markets for farmers and landowners.

Of course, there's a "but" at the end of this rosy scenario. A study done at Princeton in 2007 found that when American farmers convert food crops to fuel crops, farming expands in other parts of the world to make up the difference. Huge tracts of forests and grasslands are burned to convert to food crops. Enormous amounts of carbon are released. Add those global ripple effects and biofuels end up contributing twice as much carbon dioxide to the air as an equal amount of gasoline would over a 30-year span, the study found.

A report in England in 2007 worried that crops such as willow, oil-seed rape and miscanthus grown for fuel could be sown over large areas of the United Kingdom, forming monocultures that provide little sustenance for wildlife. It warned that without proper management, cultivation of crops for fuel, electricity and heat could cause further declines of farmland wildlife, damage the character of landscapes, harm historic and archaeological sites and damage soil and water quality.

"So much of this is about balancing and weighing different facts," Wall said. "None of these energy issues is easy. But when you look at the Gulf spill, maybe you think this is a better way to go."

Tides, Waves Currently Don't Offer Much Promise

The tides and the waves can also be tapped for energy, but neither would seem to hold much promise in coastal North Carolina.

TIDAL ENERGY

Man has been harnessing the tides for energy since the Middle Ages to power huge mills in Europe. Today, tidal energy involves building a huge dam, a fence or even underwater turbines across the mouth of an estuary or wherever the current is strongest. Water flows through the devices at high and low tide to generate electricity.

For those tidal differences to be harnessed into electricity, the difference between high and low tides must be at least 16 feet. There are only about 40 sites on the Earth with tidal ranges of this magnitude. Currently, there are no tidal power plants in the United States.

PROS: A non-polluting, renewable energy source. When compared with other renewable sources, such as solar and wind energy, tidal energy is much more reliable because the tides are predictable. A dam built to harness tidal energy also doubles up as a protective wall during rough weather.

CONS: Dams of any kind aren't good for the environment. They can block the migration of sea life, change the salinity of the estuary by altering the flow of water and fill the estuary with silt. Tidal fences could also disturb migration patterns.

WAVE ENERGY

Wave power systems typically channel the movement of ocean wave energy through a turbine generator. There are a number of interesting approaches to accomplish what, at first glance, would appear to be a deceptively simple-looking task. Some designs are land-based while others use buoys anchored to the sea floor.

PROS: Non-polluting and renewable. Offshore generators need anchors to hold them to the sea floor. These generators may actually be beneficial to sea life because of the subsurface structure they provide for habitat.

CONS: Onshore generators will occupy long lengths of coastline. Most of the coastline in North Carolina that has significant waves is either highly desirable as residential and tourist areas or is in federal or state parks. Onshore systems of any significant size will use miles of coastline and involve massive structures to channel waves and convert ocean wave energy into usable power. Conflicts will certainly arise.

Offshore installations have a different kind of problem. If we expect to harvest significant amounts of energy from offshore waves, we can expect to see thousands of them bobbing around within eyesight of shore. Storms will occasionally dislodge wave generators from their anchors, turning them into serious navigation hazards.

Ambient temperature anaerobic digester for energy and nitrification / de-nitrification and bioresource recovery system

HOG LAGOONS

BY FRANK TURSI

Euphemistically, we call them hog lagoons, and they dot the landscape of eastern North Carolina. Every day, eight million pounds of hog poop are dumped into them. They have poisoned rivers, killed fish, fouled drinking water and dirtied the air. The stench from them can at times make your eyes water.

Instead of being potential environmental time bombs, each of these holes in the ground could be providing power to farms and houses.

Researchers have for years been trying to figure out ways to harness these potential little power plants. Those efforts may soon pay off.

The search for better ways to deal with waste from the state's hog industry began in earnest after Hurricane Floyd in 1999 flooded hundreds of waste pits. The following summer, amid much fanfare, the N.C. Attorney General's office signed an agreement with the state's largest pork producers, Smithfield Foods and Premium Standard Farms. The companies committed more than $17 million to develop treatment technologies that were environmentally safer that simply dumping all that waste into holes and spraying it periodically on crops.

Researchers at N.C. State University were assigned the task. Converting waste to fuel seemed like an approach worth pursuing. Experts estimate that the manure from the state's hogs, cattle and poultry could provide enough electricity to power about 6,000 houses each day.

Since the agreement was signed, 18 different technologies were tested, explained C.M. "Mike" Williams, director of the university's Animal and Poultry Waste Management Center. Most were built and tested on hog farms, while others are limited to research sites at the university. Many revolved around ways to convert the waste into energy.

Anaerobic digesters collected the methane and carbon, which could then be burned to produce electricity. Thermal gasifiers created ethanol. Plasma arc cells separated the hydrogen.

They all worked, but none of the methods is in widespread use on the farms. "They were just too expensive," Williams said.

The agreement with the hog producers required that the new technologies be not only environmentally superior to then-current methods but that they also are cost effective.

Williams had hoped that another bill that the N.C. General Assembly passed would provide some incentive. It required that methods to convert hog waste to electricity be installed on 50 farms and that utility companies could pay as much as 18 cents a kilowatt hour for the power, which is about twice the allowable retail rate.

"I had this false optimism that we would pretty quickly get to 50 projects," Williams said. "We needed to get a few dozen projects in the ground to demonstrate that they would work, and I thought the bill would do that."

To make the projects work financially, though, the utilities would have to pay close to the maximum allowed in the law for the electricity. None was willing to do that.

Another state law, though, may finally be doing the trick. Passed in 2007, it requires investor-owned utilities to start generating a portion of their electricity from various sources of renewable energy, including hog waste. The bill sets a 2012 deadline for the waste projects.

The first ones are beginning to take shape. Duke University and Duke Energy are partnering on a test project on a 9,000-head hog farm in Yadkin County near Winston-Salem. Wastewater from barns will be treated in a device called a digester, which breaks down wastes in an airless environment. Captured methane gas will fuel a small turbine to generate 512 to 639 megawatt-hours a year of electricity. That's enough to supply about 50 typical houses.

Solids separation / nitrification – de-nitrification / phosphorus removal system

Gasification of swine manure solids for energy recovery system

High temperature anaerobic digestion of swine manure solids for energy recovery system

Capturing methane, a powerful greenhouse gas, will create carbon offsets for Duke University, which has set a goal of being carbon-free by 2024. The university would use the offsets if the federal government limits emissions of greenhouse gases.

Making electricity from the methane will produce renewable-energy credits that Duke Energy can apply to meet the state mandate.

Another project, on the 3,000-head High Ridge Farm in Greenville, will use a process that will super-heat the hog waste to create a gas that can then turn a turbine. John O'Hurley, well-known for his portrayal of Jacopo Peterman on the sitcom *Seinfeld*, started the company, Energy-Inc., that is building the project.

SOLAR POWER:
Tap It Wherever Sunlight Falls

BY JAN DEBLIEU

If you happen to drive through the military housing complexes at Camp Lejeune, on many rooftops you'll see solar panels that resemble big blue file folders, propped slightly open.

And if you take a ride through Davidson County in the Piedmont, you might come across fields lined with solar panels—63,000 of them, to be exact.

These two projects, 200-plus miles apart, are on opposite ends of the spectrum when it comes to models for generating renewable energy.

On the coast, the Camp Lejeune project shows the success of distributed energy, tapping the sun's power right where it's used. Halfway across the state, the huge solar farm built by SunEdison marks the rise of centralized, industrial-scale solar power in the mid-Atlantic region.

The two business models could not be more different. They don't even use solar power for the same ends.

On solar farms, arrays of photovoltaic panels generate electricity as the sun shines. Duke Energy buys all the power from the 17-megawatt Davidson County facility and sells it to customers in the Carolinas to fulfill its obligation under the state's Renewable Energy Portfolio Standard, which requires investor-owned utilities in North Carolina to use renewable energy to meet at least 12.5 percent of their electricity retail sales by 2021.

Utilities aren't required to provide their customers with renewable energy generated within North Carolina, and supporters of solar power have applauded Duke's in-state partnership with SunEdison. The farm typically generates enough electricity for 2,600 average-size homes.

Utility-scale solar projects have been slow to catch on, partly because solar energy is more expensive than electricity from fossil fuels, but also because they take up land (see Environmental Problems sidebar).

In contrast, distributed solar energy systems can be mounted on rooftops and alongside existing facilities. Frequently distributed energy systems are installed by individual home or business owners—but not always.

In 2010 Duke Energy mounted photovoltaic panels on the roofs of 10 business facilities in its service area in North Carolina. Most of the sites were industrial facilities. The company has also installed rooftop photovoltaic cells on 20 homes in a community south of Charlotte. The utility owns the panels and the electricity they generate. It rents space for the panels from the site owners.

The Camp Lejeune program makes use of simpler technology for a much simpler task: heating water.

In 2007 Michael Shore, a former staffer at the Environmental Defense Fund, founded FLS Energy to market hardware for thermal solar power hot water systems. Thermal systems don't use photovoltaic cells; they employ copper pipes and thermal transfer fluids. As a result, they're less complicated and less expensive.

FLS wanted to make solar hot water available to consumers "as cheaply and conveniently as the hot water they'd get from burning fossil

SOLAR POWER: THE CLEANEST OF RENEWABLES

When it comes to environmental impacts, solar power is among the cleanest of the renewables. But unlike wind energy farms, where open land can still be cultivated, solar panels make it impossible to use property for anything else.

The solar panels shade the ground, making the growth of vegetation impossible. Although panels are generally angled to the sun, if placed close together they can act as impervious surfaces, potentially creating stormwater runoff.

Converting solar power to electricity requires the use of cadmium, a highly toxic substance, in semiconductors. Sites with large solar power infrastructure should be monitored for cadmium buildup in soils and groundwater. In all cases, old or damaged solar cells should be carefully recycled.

– by Jan DeBlieu

fuels," says Brownie Newman, company vice president and project finance director. But there was a catch. North Carolina regulations stipulate that only utility companies can sell power to customers. Private investors are barred from selling electricity generated from renewable systems.

Shore and his partners set about convincing the N.C. Utilities Commission that solar hot water systems should be regulated differently, because they produce no electricity. "It's a legal gray area," Newman says. "We sell BTUs instead of kilowatt hours." The utilities commission agreed, paving the way for a new in-state industry.

FLS customers include businesses that use large amounts of hot water—hotels, college dorms and agribusinesses like poultry processing plants. But the company also makes small systems for residences.

Shore approached the military housing company Actus Lend Lease about installing rooftop solar hot water systems in new and renovated residences. Officials liked the idea and agreed to use the company in its residences at Camp Lejeune, Cherry Point Marine Corps Air Station and New River Air Station.

FLS now has contracts to install private solar hot water systems in 2,200 homes at the military bases. With 750 units installed so far, the program has worked out well, according to Matt Lynn, a deputy project director for Lend Lease. "We're still watching the data and looking at what's being produced," Lynn says. "But we're excited."

A subsidiary company of Lend Lease owns the buildings, and FLS owns the hot water heating components. It's the biggest residential solar hot water project in the country outside Hawaii, Newman says.

FLS sells the hot water to Lend Lease for supplying the residences at a savings of about 20 percent over electric hot water heaters, Newman says. Residences need a backup system for periods without sunshine. But Lynn says the company estimates residents use solar-heated water about 75 percent of the time.

"A hot water heater's about 25 percent of a home's energy use," Lynn says. "With the solar systems, we're saving 20 to 25 percent in actual dollars." More important, he says, they're not using electricity from traditional sources. "To be able to do that with no capital expenditures up front is pretty exciting."

In designing solar systems for the coast, FLS engineers had to consider how the region's strong winds would affect the panels. "Uplift can be a problem," Newman says, "so figuring the wind load on the structure is part of every design." While durable, the panels are not indestructible. In April 2011, when a tornado struck the base, five houses with panels were demolished, and the roofs of 20 houses with panels were badly damaged.

What about cost? FLS has a residential division called First Light Solar that sells thermal hot water systems to homeowners in the Asheville region, but not on the coast.

On average, Newman says, a homeowner can expect to pay around $7,000 for a solar thermal hot water system—but there's a great variety in price. With the current 30 percent federal investment tax credit and the 35 percent state tax credit, homeowners can expect the system to pay for itself in five to seven years, he says. Maintained equipment should last 20 to 30 years. "If you think you'll be in your home for a while, it's a reasonable payback," he said.

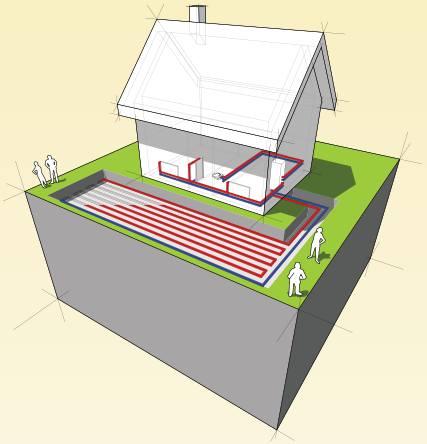
TAPPING THE EARTH'S HEAT ON THE N.C. COAST

When we scraped together the money to buy property in 1986, my husband and I settled on a house on a densely wooded lot with something called a geothermal heat pump. We'd never heard of such a thing.

In volcanic regions, geothermal energy refers to tapping steam from thermal vents to heat buildings or turn turbines to produce electricity. Outside of Iceland or Hawaii, the process is much more subtle. It takes advantage of the near-constant temperature of groundwater.

Heat pumps harvest warm or cool molecules by moving air or water in a loop system over a heat transfer fluid like Freon. It's a complex process, but essentially the passage of the air or water causes the fluid to undergo a state change—from gas to liquid in the heating process or from liquid to gas in the cooling process. The excess hot or cool air is funneled into the building.

Air source heat pumps begin the process by pulling in air at the outside temperature, which can differ by many degrees from the desired temperature inside. In contrast, the temperature of groundwater tends to stay between 50 and 60 degrees in our climate zone, regardless of the weather.



As a result, it takes much less energy to heat or cool ground molecules to the desired temperature. The N.C. Solar Center reports that geothermal pumps are 1.5 to 2 times as efficient as air-source heat pumps. Based on our conversations about electric bills with friends, it appears to be true.

Our geothermal unit came with a well that pulled water out of the ground and discharged it in a little gully in the front yard, creating an artificial brook that disappeared when the system was off. It's much more common now for geothermal heat pumps to come with closed-loop systems, in which the same water (mixed with stabilizing chemicals) circulates through buried pipes. Closed-loop systems are more efficient, and they don't contain minerals that can build up in the unit.

Geothermal systems can be sized for industrial buildings or small homes. They're often more expensive than air-source heat pumps. But in the salty air of the coast, they also last longer.

Since a geothermal heat pump requires electricity to run, it's not technically a renewable energy system, notes Bob Leker, program manager for renewable energy at the State Energy Office. It's just more efficient.

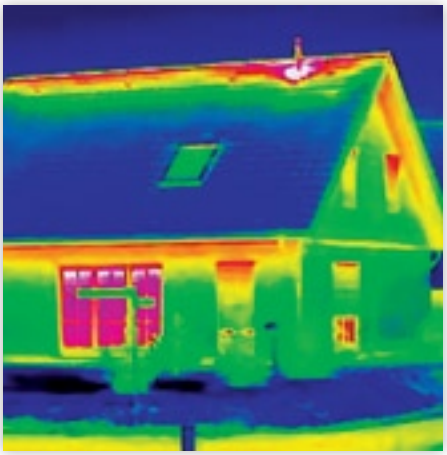
On the other hand, says Jennifer Stutzman, an outreach coordinator for N.C. State University's N.C. Solar Center. "It's so renewable it doesn't ever go away. It's the constant temperature of the ground."

– By Jan DeBlieu

Smart Energy Checklist

Conserving energy by weather stripping your home, buying high-efficiency appliances or simply tuning off the lights is usually the smartest, most economical and most potent environmental action you can take. While greener energy sources, like wind and solar, may in the future provide clean supplies of needed electricity, minimizing the energy we need is still the cheapest first step.

Here are 21 things we can all do to reduce our energy demand:



THE LITTLE THINGS

1. Get a home energy audit. Knowing how you use energy is the first step. Many utilities and electric co-ops offer free home energy audits to find where your home is poorly insulated or energy inefficient.
2. Turn down your water heater thermostat. Thermostats are often set to 140 degrees when 120 is usually fine. For each 10-degree reduction in water temperature, you can save between 3 and 5 percent in energy costs. Wrapping the heater in an insulation blanket will save even more.
3. Set your clothes washer to the warm or cold water setting, not hot. Switching from hot to warm for two loads a week can save nearly 500 pounds of CO2 a year if you have an electric water heater, or 150 pounds for a gas heater.
4. Use the washing machine or dishwasher only when they are full. If you need to use them when they're half full, then use the half-load or economy setting.
5. Clean the lint filter on your dryer after each use. A dirty filter will increase the dryer's energy use by 30 percent.
6. Set your house thermostat down two degrees in the winter and up two degrees in the summer.
7. Change the filters on your central air conditioner at least once a month.
8. Your mother was right. If you're not using a room, turn off the lights.
9. Also turn off the TV when no one is watching it. The same goes for computers, radios and stereos - if no one is using them, turn them off.
10. Put lamps in corners. Light can reflect off of two walls instead of one flat wall. That way you'll get more usable light.
11. Use your drapes. Open them on sunny winter days to let the warmth in, but keep them closed during the hot dog days of July and August.
12. If you need to warm up or defrost small amounts of food, use a microwave instead of the stove. Microwaves use about half the energy than conventional ovens. For large meals, however, the stove is usually more efficient.
13. Don't preheat the oven unless you're making bread or pastry. Just turn it on when you put the dish in.

THE BIGGER STUFF

14. Replace most incandescent light bulbs with compact fluorescent bulbs. Although they cost more initially, the fluorescent bulbs save money in the long run by using only a quarter of the energy of an ordinary bulb, and they last 8-12 times longer.

15. Plant native trees in your yard. They trap CO2 emissions, cool your home, reduce stormwater runoff and capture dust particles from the air.

16. Weatherize your home or apartment, using caulk and weather stripping to plug air leaks around doors and windows. Caulking costs less than $1 a window, and weather stripping is under $10 a door. These steps can save up to 1,100 pounds of CO2 a year for a typical home.

17. Insulate air conditioning and heating ducts. You can save up to 20 percent of your heating and cooling costs by insulating and tightening up ducts.
18. Select the most energy-efficient models when you replace your old appliances. Look for the Energy Star Label. Buy the product that is sized to your typical needs - not the biggest one available. Front loading washing machines will usually cut hot water use by 60 to 70 percent compared to typical machines.
19. Replace your old single-glazed windows with double-glazing. This requires a bit of upfront investment, but will halve the energy lost through windows and pay off in the long term.

NOW WE'RE TALKING

20. Consider installing solar panels to heat water or supply some of your electricity. Geothermal systems might also be more efficient than your heat pump. Federal and state tax credits ease some of the bite of installation costs.
21. Pass this list around. Be an advocate for conserving energy.

continued from page 8...

MARINES NIX STATE'S FIRST OFFSHORE WIND PROPOSAL

	Blocks	Area in Sq. Miles
Total Available Blocks (-40m)	1266	10564
– Military Exclusion	*871*	*6808*
– Low Foundation	*682*	*5014*
– High Level Fish Habitat	*565*	*3989*
– High Level Bird Habitat	*522*	*3713*
Final Number	**506***	**3679**

plans in North Carolina, Apex has proposed offshore projects in Virginia, New York and Pennsylvania.

"Because BOEMRE didn't formally call for nominations in Onslow Bay, they didn't come back to us and say 'Let's do this,'" Propes said. "They basically thanked us for our interest and set up a state task force to formally identify areas that make sense for the state."

That task force is made up of 50 or so federal and state officials, military representatives and elected leaders along the coast. Its job is to work with BOEMRE to identify preferred offshore sites for wind development. The task force met for the first time in Wilmington in late January and then in Raleigh in May.

MAPS DEVELOPED

At its last meeting, the task force developed some preliminary maps that showed areas that could be off limits to wind farms because of bird or fish habitats, military training or an unstable seafloor. Of the 1,226 blocks that could be available for wind farms, only 506, or about 40 percent, survived the initial cut. At 871 blocks, or 68 percent, the military exclusions were by far the largest. Still to weigh in is the National Park Service, which manages two national seashores along the coast. It will likely want wind farms built far enough from the seashore so that they can't be seen from the beach, taking even more blocks off the map.

That more than 500 blocks still remain is evidence of how vast the potential is for wind energy off the coast, Propes said. Maryland went through a similar mapping process and ended up with eight leasable blocks, he said. After Virginia was done, only 25 blocks remained.

"There are still a lot of areas out there," Propes said. "We remain optimistic that there still will be a large viable resource."

The task force is supposed to reach a final decision on the maps this summer. BOEMRE would then ask for bids on what remains.

—By Frank Tursi

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COMMUNITY WIND'S PROMISE THWARTED BY STATE REGULATIONS

among the nation's first and largest demonstrations of distributed generation. By 2011, the company expects the distributed solar program to generate up to 10 megawatts of electricity annually throughout Duke Energy's North Carolina service territory.

But Duke is generating the power, not a third party.

"There needs to be a paradigm shift," says Glenn Mauney, Carolinas Energy Policy Manager for the Southern Alliance for Clean Energy. "Here the utilities aren't incentivized to use distributed systems."

Which means that new electricity infrastructure requires a huge investment, like major wind and solar farms, with possibly large human and environmental impacts.

It also means that the profit and power will continue to lie completely with the utility companies.

Besides Illinois, community wind projects have been developed on farms in Minnesota and other Midwest states and in scattered American towns. One of the best known is the Hull Wind project on the south edge of Boston Harbor (www.hullwind.org).

In 1985 the town of Hull put up a 40 kW tower—small by today's standards. Over the tower's 12-year life, its generation of electricity saved the local school district $70,000, officials say.

Hull Wind 1, a 600 kW tower, was erected in 2001, and the 1.8 MW Hull Wind 2 tower went up in 2006. In a three-week period during February and March 2011, the two towers together produced 19.5 million kilowatts. Much of it was sold back into the grid.

Electricity is much more expensive in Massachusetts than North Carolina. So there's more incentive to invest in innovative energy projects.

Experts on wind energy agree that community wind will remain next to impossible unless the N.C. Utilities Commission changes regulations to encourage distributed power. Besides a third-party sales agreement, the state needs a way to guarantee small-scale producers a fair price for power sold back into the grid. That would also encourage individuals to put up turbines at homes and businesses.

"The small projects don't have the benefit of scale, so they're more expensive at the start," Mauney says. "They need a streamlined program in place to make these projects worthwhile."

A bill introduced in the state Senate would legalize third-party electric sales for renewable energy projects of less than 2MW that are built on the customer's property. It would also lock in a fairer price structure for private contractors. "It wouldn't be a panacea," says Paul Quinlan, deputy director of the N.C. Sustainable Energy Association, "but it would increase the chances that these projects could work."

—By Jan DeBlieu

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OAK ISLAND COMPANY EXPERIMENTS WITH GREEN CRUDE

Jones injects the water with carbon dioxide and inoculates it with three native microscopic algae – She's mum on which species. Every trade has its secrets, you understand.

The science is simple: Like all plants, algae are loaded with chloroplasts, which let them create energy using just carbon dioxide, water and sunlight. Algae use this energy to reproduce or they store it for leaner times. Some algae in particular store energy as lipids, or oils. These lipids, in turn, can be readily refined into basically any hydrocarbon you like, from biodiesel to jet fuel, and the whole process is carbon-neutral.

Jones' system does double green duty by further cleaning the wastewater as the system creates fuel. It would work just as well at hog lagoons, Jones said.

"We would like to commercially expand so that we could culture a lot of biomass to really make a difference," she said. "We would like to put the process in place so that we could work with hog farmers to utilize those nutrients."

Algae are among the fastest-growing organisms on Earth. Some species in the Jones' tubes can double their mass overnight. The fast growth rate and the relatively high oil content mean that an acre of algae can produce almost 4,000 gallons of oil. As a comparison, corn produces about 250 gallons and soybeans about 50 gallons.

There are a number of problems that will have to be worked out before Jones or even ExxonMobil can produce commercial quantities of oil. Water is the main one. The United States could produce enough of the algae-derived fuel to eliminate 48 percent of the fuel it currently imports for transportation, according to researchers at the U.S. Department of Energy. Doing so, though, would require 5.5 percent of the land area in the lower 48 states and consume about three times the water currently used to irrigate crops.

Jones is convinced that solutions will be found. Until then, she will continue culturing her algae. She also plans to expand into a center that features several renewable energy technologies. Oak Island recently agreed to allow her to use a portion of Bill Smith Park next to the sewer plant on Fish Factory Road.

"We hope to make a wonderful educational park to teach people about renewable energy," Jones said.

— By Frank Tursi

What States Do to Promote Renewable Energy

The policies that states adopt are among the most important factors in the development of renewable energy. Here are the major policies in place in the 50 states, according to the U.S. Department of Energy.

	AL	AK	AZ	AR	CA	CO	CT	DC	DE	FL	GA	HI	ID	IL	IN	IA	KS	KY	LA	ME	MD	MA	MI	MN	MS	MO	MT	NE	NV	NH	NJ	NM	NY	NC	ND	OH	OK	PA	RI	SC	SD	TN	TX	UT	VT	VA	WA	WV	WI	WY
Contractor Licensing			X		X		X			X		X											X						X														X							
Corporate Tax Incentives			X							X	X	X				X		X	X		X	X				X	X					X	X	X	X	X	X		X	X			X	X	X			X		
Equipment Certification			X							X														X														X												
Generation Disclosure					X	X	X	X	X	X				X						X	X	X	X	X				X		X		X	X		X		X	X				X			X	X			
Grants	X	X			X		X		X	X				X	X	X				X		X	X	X									X			X		X	X			X			X			X	
Green Power Purchasing							X							X	X	X				X	X	X											X	X				X				X						X	
Industry Support						X	X					X										X	X				X					X	X			X	X				X			X	X	X		X	
Interconnection Standards			X	X	X	X	X	X	X	X	X	X		X	X	X		X	X		X	X	X	X		X	X	X	X	X	X	X	X	X		X		X			X	X		X	X	X	X	X
Line Extension Analysis			X			X																											X								X		X					
Loans	X	X			X		X	X				X				X	X		X	X	X	X		X	X	X	X	X		X	X		X			X	X	X	X			X			X			X	
Net-Metering			X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X	X	X	X	X	
Public Benefit Funds					X		X	X						X						X		X	X	X			X				X		X	X				X	X	X					X					
Personal Tax Incentives	X		X								X	X	X			X		X	X		X	X				X					X	X	X	X	X			X			X	X	X			X	X	
Property Tax Incentives			X		X	X	X			X			X	X	X	X	X		X		X	X	X	X		X		X	X	X		X		X	X		X		X	X		X	X		X	X	
RE Access Laws		X	X		X	X				X	X	X	X		X	X	X	X		X	X	X		X		X	X	X	X	X	X	X	X		X				X	X		X		X	X	X		
RE Production Incentives					X																		X							X		X																
Rebates					X		X	X	X	X				X						X	X	X		X					X	X	X		X															X
Required Green Power						X										X							X			X						X														X			
RPS			X		X	X	X	X	X					X		X	X			X	X	X	X	X		X		X	X		X	X	X	X	X		X	X		X		X	X	X	X	X		X	
Sales Tax Incentives			X			X	X			X	X	X	X			X		X		X	X	X		X				X	X		X	X	X	X			X	X				X	X		X		X	X

Source: State of the States: Renewable Energy Development and the Role of Policy, U.S. Department of Energy, Oct. 2010

POLICY DESCRIPTIONS

Contractor licensing: Specific licensing for contractors who want to install renewable energy systems, guaranteeing that the contractors have the experience and knowledge necessary to ensure proper installation and maintenance. Requirements for certification vary by state.

Corporate Tax Incentives: These incentives include corporate tax credits, deductions and exemptions.

Equipment certification: Requires that renewable energy equipment meets set standards, which ensures that quality equipment is sold to consumers and reduces the problems associated with inferior equipment. Requirements can be designed by regulators or modeled off nationally recognized standards.

Generation disclosure: Requires utilities to provide customers with information about their electricity supply. This information, which is often included on the monthly bill, can include an explanation of fuel mix percentages and information on the related emissions.

Grants: States offer an assortment of grant programs designed to foster the development of renewable energy technologies. Most grants are meant to pay down the cost of equipment or systems. A few others are offered to encourage either research or development of renewable technologies or to help commercialize a project.

Green power purchasing: Requires governments at all levels to support renewable energy by buying electricity from renewable resources, or by buying renewable energy credits.

Industry Support: To promote economic development and the creation of jobs, some states offer financial incentives to recruit or cultivate the manufacturing and development of renewable energy systems and equipment. These incentives commonly take the form of tax credits, tax exemptions and grants.

Interconnection: These standards govern the technical and procedural process by which an electric customer connects an electric-generating system to the grid. Well-designed standards ensure a safe, stable and economical connection to the grid for distributed generation systems.

Line-extension analysis: Requires utilities to provide information about renewable energy options when customers request a line extension. Those options are often cheaper for a customer than paying to extend a power line to a building off the grid.

Mandatory Green Power Consumer Option: Typically, utilities offer green power generated from renewable resources owned by the utility or purchased under contract. This policy requires that specific classes of electric utilities offer customers the option of buying electricity generated from other, renewable resources. Indicators show that allowing customers to choose providers stimulate growth in renewable energy supply and demand.

Net metering: Allows electric customers who generate their own electricity to install special meters that measure the flow of electricity both to and from the customer. In effect, the customer uses excess generation to offset electricity that the customer otherwise would have to buy at the utility's full retail rate.

Personal Tax: Personal tax incentives include personal income tax credits and deductions. Many states offer these incentives to reduce the expense of buying and installing renewable energy systems and equipment.

Property Tax: Property tax incentives include exemptions, exclusions and credits. The majority of property tax incentives require excluding the added value of a renewable energy system from the valuation of the property for taxation purposes.

Public benefit funds: Public benefit funds are state-level programs that were typically developed during electric utility restructuring in the late 1990s. Some states used these programs to ensure continued support for renewable energy resources, energy efficiency initiatives, and low-income energy programs.

Rebate programs: Rebates are offered to promote the installation of renewable energy systems. The majority of rebate programs that support renewable energy are administered by states, municipal utilities and electric cooperatives. These programs commonly provide funding for solar water heating and/or photovoltaic systems.

Renewable energy access laws: These typically apply to solar and wind resources. Solar and wind access laws are designed to protect a consumer's right to install and operate a solar or wind energy system at a home or business. In some states, access rights prohibit homeowners associations, neighborhood covenants, or local ordinances from restricting a homeowner's right to use solar energy.

Renewable energy production incentive: Production incentives provide cash payments based on the number of kilowatt-hours a renewable energy system generates.

Renewable energy portfolio standards: Require utilities to own or acquire renewable energy or renewable energy certificates to account for a certain percentage of their retail electricity sales, or a certain amount of generating capacity, within a specified timeframe.

Sales Tax Incentives: Sales tax incentives typically provide an exemption from the state sales tax, or sales and use tax, for the purchase of a renewable energy system.

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Want to Know More?

BIOFUELS/HOG LAGOONS

- Biofuels Center of North Carolina : biofuelscenter.org
- N.C. State University, waste-management programs: www.cals.ncsu.edu/waste_mgt/index.htm

GENERAL

- N.C. Department of Commerce, State Energy Office: www.nccommerce.com/en/AboutDOC/DivisionInformation/#Resource18
- N.C. Solar Center: www.ncsc.ncsu.edu/cleantransportation/
- N.C. Sustainable Energy Association: energync.org
- Southern Alliance for Clean Energy: cleanenergy.org

POLICIES

- U.S. Department of Energy, Database for State Incentives for Renewables and Efficiencies: www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=NC

SOLAR/GEOTHERMAL

- American Solar Energy Society: www.ases.org
- Union of Concerned Scientists, how geothermal energy works: www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-geothermal-energy-works.html
- University of Rochester, history of solar power in the U.S: www.history.rochester.edu/class/solar/solar.htm

WIND

- Bureau of Ocean Energy Management, Regulation and Enforcement, N.C. Task Force: www.boemre.gov/offshore/RenewableEnergy/State-Activities.htm#North_Carolina
- U.S. Dept. of Commerce, N.C. wind maps & resources: www.windpoweringamerica.gov/astate_template.asp?stateab=nc
- University of North Carolina-Chapel Hill, coastal wind study: climate.unc.edu/coastal-wind

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