A Breath of Fresh Air for America's Abandoned Mine Lands: Alternative Energy Provides a Second Wind

This report provides information about the development of wind energy at former mining sites for communities, including local governments, residents, and organizations, interested in creating renewable energy resources and new economic opportunities at these sites. The report describes the mechanics of wind energy, explores wind energy's environmental, economic, and social impacts at former mining sites, and provides case studies and next steps to get you started.

Introduction

Wind Turbines at the Somerset Wind Farm

Atop Buffalo Mountain, a former mining site twenty-five miles west of Knoxville, Tennessee, stand three 200-foot tall wind turbines. The white rotor-topped towers, with blades that weigh 14,000 pounds each, convert wind into electricity. The turbines at the Buffalo Mountain wind farm generate 4,000 megawatt hours of electricity annually, enough to supply approximately 400 homes.

Five hundred miles north, in Somerset County, Pennsylvania, six 1.5-megawatt wind turbines have been placed on a former mining site adjacent to the Pennsylvania Turnpike. The turbines at the Somerset wind farm generate 25,000 megawatt hours of electricity annually, enough to supply approximately 2,500 homes.

The Buffalo Mountain and Somerset wind farms are not simply examples of new wind power projects; they are examples of innovative reuse opportunities for former mining sites. Many communities across the United States are located in areas that once supported active mining operations. While mining has been an important economic engine and part of these communities' history and heritage, many mines have closed, leaving communities with vacant properties. According to the U.S. General Accounting Office, there are between 80,000 and 250,000 abandoned mine lands (AMLs) across the United States. AMLs include abandoned mines and the areas adjacent to or affected by the mines. Because of safety or environmental concerns, the majority of these sites have never been considered for any type of reuse and have long lain idle.

Wind energy may provide a significant opportunity to change this situation. Wind power, which is a renewable energy resource that does not generate pollution, has made wind energy an increasingly attractive way to diversify the nation's energy options. Spurred by technological advances and falling costs, wind is the world's fastest growing energy source.[1]

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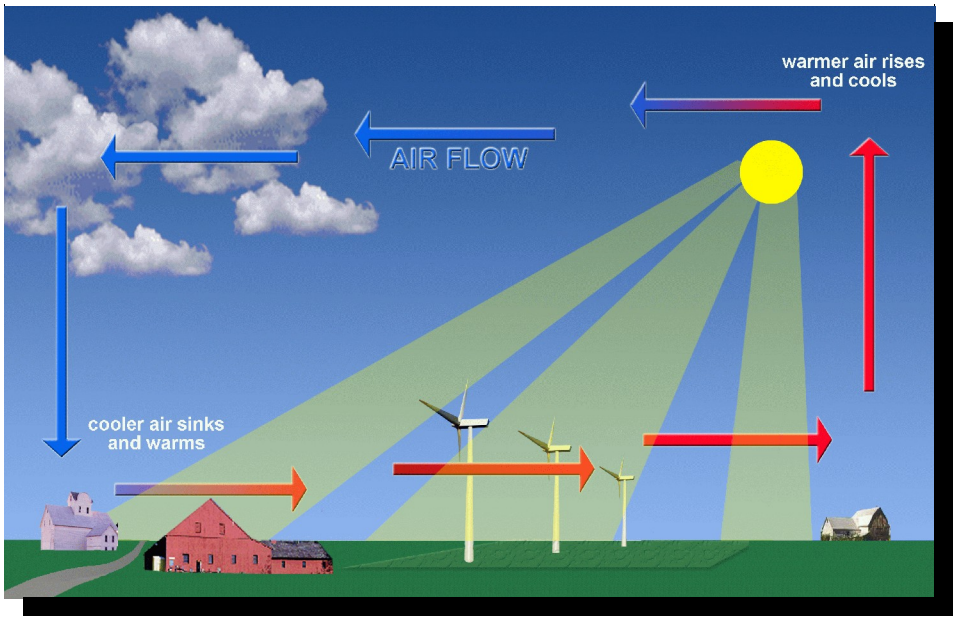
[1] Worldwide, there are an estimated 50,000 wind turbines in operation. While wind power currently makes up less than one percent of energy generated annually in the United States, about $3 billion worth of wind power projects are being proposed or planned for the next several years.

AMLs may serve as excellent locations for wind farms, as the requirements for a suitably-placed wind farm and the characteristics of abandoned mine lands may be well-suited to each other. First, wind farms require one critical element: a consistent and sufficient supply of wind. AMLs are often located in mountainous areas that receive consistent wind flows. Second, wind energy projects require access to large, open sites. The size of many AMLs means that large-scale wind turbines can be accommodated in one location. Third, many AMLs are located near existing infrastructure, including roads and power transmission lines, due to prior mining activities. In turn, the availability of existing infrastructure can reduce project costs.

What is an AML?

Abandoned Mine Lands (AMLs) are those lands, waters, and surrounding watersheds where extraction, beneficiation, or processing of ores and minerals has occurred. These also include sites where mining and mineral processing waste were disposed of or deposited.



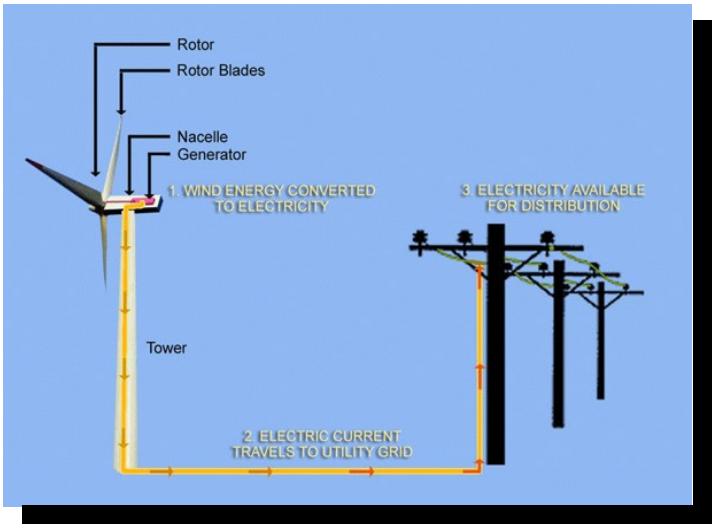
Wind Flow Diagram: The Creation of a Renewable Energy Resource

As a result, while AMLs may be located in areas that are ill-suited for other commercial or industrial reuses, wind farms can be built and operated in these areas. Wind farms can provide a local renewable energy source, enhancing economic growth, generating tax revenue, and returning lands to productive reuse, providing communities across the United States with reuse opportunities for former mining lands.

Wind Energy: What is It and How Does It Work?

Wind is created by the unequal heating of the earth's surface by the sun. Wind's kinetic energy can turn the rotor blades of wind turbines, generating electricity.

Wind turbines have four primary parts: a tower, a rotor, a generator, and a nacelle. The turbine's tower extends from its base on the ground into the air and supports the turbine's rotor. Towers can range in height from 120 feet to 400 feet – a tower's height dictates the maximum possible length of the turbine blades. Generally speaking, the taller the turbine, the greater the amount of electricity it will produce, due to the turbine's longer rotor blades and potential exposure to uninterrupted, higher-velocity winds at higher altitudes.



Wind Turbine Components & Energy Transmission

At the top of a turbine's tower, a rotor is connected by a shaft to a generator. The rotor's glass- and carbon fiber-reinforced plastic blades can be more than 100 feet long and are designed like airplane wings, producing lift that causes their rotation at 16-30 revolutions per minute. As the rotor is turned by the wind, the rotor's shaft turns the generator, producing electricity. The amount of energy that a wind turbine will produce is a function of two factors: the diameter of the rotor's blades, which determines its "swept area," and the amount of wind intercepted by the rotor blades. Cables carry the electricity generated by the turbine's rotor down the turbine tower to the ground, where equipment connects the turbine to the utility grid. The nacelle, the fourth primary part of a wind turbine, is the streamlined casing that encloses the rotor and generator.

While there are small-scale wind turbines designed to meet the needs of individual homes and businesses, utility-scale (750-kilowatt to two-megawatt) wind turbines are required to support commercially viable wind farms. A wind farm is a collection of large wind turbines used to produce electricity. A wind farm can include a handful – or more than 100 – wind turbines. According to the American Wind Energy Association, one 1.5-megawatt wind turbine can produce 4,600 megawatt hours of energy per year, enough to provide electricity for approximately 460 American homes.

Wind farms need to be located in areas with adequate wind resources, as a stronger wind means more power. Wind resources are characterized by wind-power density classes, ranging from class 1 (the lowest) to class 7 (the highest). In the United States, good wind resources (class 3 and above), which have an average annual wind speed of 11-13 miles per hour when the wind is blowing, are found across the country. Areas of the United States with wind resources that can support wind farms

include the Pacific coast, the Great Plains, and the Appalachian Mountains. These areas are home to significant numbers of former mining sites. Colorado, for example, a state with an extensive coal and hard rock mining history, has more than 1,500 AMLs. The state receives enough energy from class 4 and higher winds to supply 14% of the electricity required by the lower 48 states.

Making the Connection: Wind Farms on Abandoned Mine Lands

The reuse of abandoned mine lands as wind farms is not a new idea. There are several of these projects in operation, both in the United States and around the world. Wind farms on AMLs in European countries, for example, have been providing electricity for several years. A wind farm located on a former coal mine in Kilronan, Ireland generates 14,000 megawatt hours of electricity annually, enough to supply approximately 2,300 homes. The Klettwitz wind farm, located on the site of a former open-cast coal pit in eastern Germany, is the largest wind farm in Europe. In operation since June 2000, 38 turbines at the 680-acre site generate 100,000 megawatt hours of electricity annually, enough to supply approximately 16,400 homes. Plans for an abandoned coal mine in Forth, Scotland, call for the construction of 67 turbines on the 2,400-acre site that could provide electricity to 80,000 homes.

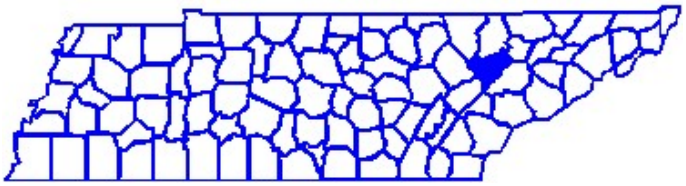
In the United States, plans for the largest wind farm in the eastern half of the country are being developed. Mount Storm Wind Force, a subsidiary of the U.S. Wind Force company, is planning to locate a 166-turbine farm on a site honeycombed by former coal and hard rock mining activities. Located on 10,000 acres of land between the Potomac River, Mount Storm Lake, and the Town of Mount Storm in West Virginia's Tucker and Grant counties, the farm will have the capacity to provide power for 65,000 homes. In addition, 99 percent of the land would continue to be usable for other activities, including farming.

> "You could not pick a more disturbed area," said Tom Matthews, President of U.S. Wind Force, referring to the company's proposed wind farm site in West Virginia. "It is primarily made up of reclaimed and active strip mines, as well as abandoned deep mines. It is an area of West Virginia from which many of the natural resources have already been extracted."
>
> - *Charleston Gazette*, December 28, 2001

There are also wind farms located on abandoned mine lands in the United States that have already moved beyond the planning stages, including the Buffalo Mountain wind farm, located in Tennessee, and the Somerset wind farm, located in Pennsylvania.

These two wind farms illustrate that the reuse of AMLs requires sustained dedication, community outreach and involvement, and strong working relationships. The wind farms also illustrate that the benefits provided by the reuse of these former mining lands can be substantial. Benefits include local job creation and economic growth, increased tax revenues from project-related spending, the development of a local renewable energy resource, and the return of previously vacant mining lands to productive reuse. Below, the project highlights and lessons learned at the Buffalo Mountain and Somerset wind farms are described in greater detail.

Buffalo Mountain Wind Farm



Anderson County, Tennessee

In October 2000, Anderson County, Tennessee became home to the first commercial wind generation facility in the southeastern United States. The Tennessee Valley Authority (TVA), a federal corporation and the nation's largest public power company, built a three-turbine wind farm on a former strip mine site on Buffalo Mountain, a high ridge located just outside the municipality of Oak Ridge. The 660-kilowatt capacity turbines generate 4,000 megawatt hours of electricity annually, enough to supply approximately 400 homes.

The two-acre Buffalo Mountain wind farm is located on a former strip mine operated during the 1980s by the Coal Creek Mining and Manufacturing Company. When the mine ceased operations in 1990, the company completed reclamation activities, including backfilling and revegetating the strip-mined areas. When TVA approached the Coal Creek Mining company about the possibility of siting wind turbines on the property, the company was provided an opportunity to explore an innovative reuse and generate revenue from an idle property.

The development of the Buffalo Mountain wind farm by TVA relied on extensive site research and community involvement, effective corporate and community partnerships and working relationships, and an emphasis on the importance of renewable energy. The following project highlights illustrate some of the lessons learned during the development of the wind farm.

- ***The importance of effective community outreach and communication.***

Wind Turbines at the Buffalo Mountain Wind Farm

The local community, as well as other agencies and organizations, was significantly involved throughout the project's development. A steering committee composed of TVA staff, community representatives, environmental organizations, and participating power distributors oversaw the project's development, providing input on site design and technical issues, and held a series of public meetings to incorporate community input and share project information. According to Rick Carson, TVA's Renewable Energy Program Manager, community involvement in the project's development led to community support for the Buffalo Mountain wind farm. "The community," he said, "including local residents who had

worked in the coal mining industry, was enthusiastic about the reuse of the property."

- ***The importance of strong working relationships that can provide the funding and technical expertise necessary for wind projects.***

Before TVA could build the wind park, the agency first had to work in close coordination with several public and private entities. TVA negotiated with the Coal Creek Mining and Manufacturing Company to be able to lease and site the wind farm on their property, while the energy consulting company, AWS Scientific, was hired to assess potential turbine sites. Lowe Excavating, a construction company, provided road improvement and site clearance services, while Tennessee Communications, a communications company, installed two miles of power lines connecting the wind turbines to the local power grid. Enxco, Inc., an energy company specializing in renewable energy, was hired to develop the wind farm and provide ongoing operations and maintenance services. Clinton Utility Board, the local power distributor, agreed to maintain the wind farm's connection to the local power distribution network.

- ***The financial and timing benefits provided by the site's remediation and the site's proximity to existing infrastructure.***

Site History

1980s	Buffalo Mountain wind farm site mined by Coal Creek Mining and Manufacturing Company
1990	Mining operations at the site cease
1990	Reclamation of land from mining activities at the site begins
1999	TVA conducts wind resource and environmental assessments of the mine site
1999	Site prepared for wind turbines: gravel roads upgraded for site access, vegetation cleared, power lines upgraded
2000	Turbines installed at the site; turbines tested and connected to distribution system
2000	Buffalo Mountain wind farm in operation

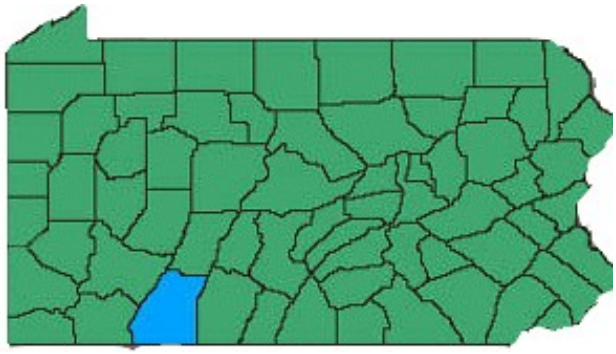
TVA was able to move rapidly from design to implementation of the wind farm in little more than a year for two reasons. Prior remediation work completed by the Coal Creek Mining and Manufacturing Company, which included capping open mine shafts and using vegetation to reduce soil erosion, meant that TVA did not need to pursue additional cleanup activities. Second, the site's close, two-mile proximity to existing infrastructure, including roads and power transmission lines, meant that site preparation costs for the Buffalo Mountain wind farm were reduced.

Results

Three wind turbines were installed on Buffalo Mountain in 2000. Today, as part of TVA's Green

Switch Program, developed to provide customers with access to renewable energy resources, the turbines are part of a renewable energy network that provides power to 5,800 residential customers and 300 business customers. As of April 2003, the three turbines had produced 9,500 megawatt hours of electricity. The wind farm's success has resulted in plans for additional turbines to expand the wind farm's capacity from two to 29 megawatts. In January 2003, TVA signed a 20-year purchase agreement with Invenergy, a Chicago-based energy development company, to add 18 1.5-megawatt wind turbines to the wind farm. The turbines will be in place by November 2003.

Somerset Wind Farm



Somerset County, PA

Somerset County, Pennsylvania is located in southwestern Pennsylvania's Laurel Highlands. The county's wind resources and high elevations mean that the county is a potential candidate for the location of wind farms. While the county's traditional manufacturing, coal mining, and agriculture base continues to sustain the area's economy, wind energy has provided a new opportunity for economic diversification and the reclamation and reuse of an AML. In October 2001, Somerset Windpower LLC, a joint venture between power companies Zilka Renewable Energy and Atlantic Renewable Energy, began operating six 1.5-megawatt wind turbines on farmland adjacent to the Pennsylvania Turnpike. The turbines at the Somerset wind farm generate 25,000 megawatt hours of electricity annually, enough to supply approximately 2,500 homes.

The 400-acre Somerset wind farm is located on farmland that was previously used by two different mining operations. In the early 1960s, the land was strip-mined for coal by Svonavec Inc., removing much of the land's surface soil. In the 1980s, PBS Coal Company deep-mined the same area for coal, creating underground shafts. The former coal mines on the wind farm were cleaned up between 1987 and 1990, using funds set aside by the two mining companies. The mined areas were backfilled with soil to recreate the land's original contours.

Students Visiting Somerset Wind Farm

The development of the Somerset wind farm by Somerset Windpower LLC relied on extensive site research, innovative construction approaches, and effective corporate and community partnerships and working relationships. The following project highlights illustrate some of the lessons learned during the development of the wind farm.

- ***The selection of an AML site within an existing community with access to infrastructure.***

The Somerset wind farm illustrates that wind farms can be located on AMLs within existing communities. The site was selected for two reasons: sufficient wind power and the availability of infrastructure. Prior mining activities meant that roads and power transmission lines were already in place, reducing project costs.

- ***The importance of strong working relationships that can provide the funding and technical expertise necessary for wind energy projects.***

Once the site for the Somerset wind farm had been selected, several corporations, including Zilka Renewable Energy, Atlantic Renewable Energy, General Electric, Exelon Powerteam, and Community Energy, Inc., formed working relationships to turn the site into a successful, functioning wind farm. Two power companies, Zilkha Renewable Energy and Atlantic Renewable Energy, entered into a joint venture called Somerset Windpower LLC to design and build the wind farm. General Electric signed on to provide routine operations and maintenance services. Exelon Powerteam, a wholesale power marketing company, signed a 20-year agreement to buy the power produced by the Somerset wind farm. Exelon Powerteam worked with Community Energy, Inc., an energy-sector consulting company, to market the power to universities, corporations and residences under the name "New Wind Energy."

- ***Innovative construction approaches can allow for the presence of wind farms in areas that may be inaccessible or otherwise cost-prohibitive.***

Somerset Wind Farm:
Turbine Siting Preparation

Step 1: Checking the stability of each proposed turbine location

Step 2: Building each turbine's steel-reinforced concrete foundation

Step 3: Checking the stability of each turbine's foundation

Because of the prior mining activities at the Somerset wind farm site, additional analysis and remediation was required to ensure that the site's surface was structurally strong enough to support the weight of the six wind turbines. Sixteen-foot perimeter holes were drilled under each of the turbine sites and 15-ton weights (approximating the weight of the turbines) were then inserted into the holes to identify any structural weaknesses. Steel-reinforced concrete foundations were poured for each of the turbines – each foundation contains 180-200 cubic yards of concrete and 23,000-26,000 pounds of reinforced steel.

Somerset Windpower LLC also developed strategies to address unique on-site situations. One wind turbine, for example, was sited on a tract of land that was formerly deep-mined, potentially compromising the stability of the wind turbine's foundation. The turbine was centered over the mine's stable main heading corridor and concrete was poured into the shaft to stabilize the structure before pouring the turbine's foundation. In addition, a tilt sensor was installed on the turbine to detect subsidence that could compromise the turbine's foundation.

Results

The Somerset wind farm has shown that with careful planning, the use of turbines to harness the power of wind can successfully create clean, usable energy. Penn State University has purchased the output from five of the six turbines at the wind farm for the next five years, the largest retail purchase of wind energy in the United States. As a result, more wind farms are under development. Somerset County is already home to more wind turbines than any other county in Pennsylvania, and two new wind farm projects are under development in the county. One of the projects, a 20-turbine site, is being developed on a former mining area and landfill located adjacent to Somerset wind farm. Across Pennsylvania, construction of up to 50 new turbines is anticipated in 2003.

Impact Assessment: Environmental, Economic, and Social Impacts Associated with the Reuse of Abandoned Mine Lands as Wind Farms

The Buffalo Mountain and Somerset County wind farm examples illustrate how wind energy projects at AMLs can generate successful renewable energy resources *and* provide opportunities for communities to return former mining sites to productive reuse. However, while wind farms located at AMLs have proven successful for these localities in Tennessee and Pennsylvania, do they represent a reuse option that might make sense for former mining sites in your community?

To help your community answer this question, this section reviews the range of environmental, economic, and social impacts created by the reuse of abandoned mine lands as wind farms. The section also provides anecdotal evidence describing how other communities have addressed these impacts and determined the degree to which wind energy represented a significant opportunity to reuse local AMLs.

Environmental Impacts

The reuse of abandoned mine lands as wind farms provides two primary environmental benefits. First, the location of wind farms on former mining sites has the potential to provide a market-based incentive to remediate hazardous waste sites and brownfield sites that may be contaminating local streams, groundwater, soils, or even entire watersheds. Without the existence of potential economic returns, many of these properties may otherwise remain vacant or continue to contaminate the local environment until a state or federal cleanup program addresses contamination issues. The location of wind farms on abandoned mine lands can potentially result in remediated properties, restored ecosystems and wildlife habitat, and improved water quality.

The Case for Wind Power

Wind energy is a free, inexhaustible natural resource and a source of clean, non-polluting electricity. The U.S. Department of Energy estimates that using one utility-scale wind turbine prevents the annual emission of 5,000 tons of carbon dioxide, a greenhouse gas that contributes to global warming.

Traditional energy sources like coal and oil, in contrast, generate byproducts at each stage of the generation process. Mining depletes natural resources, degrades the environment, and destroys wildlife habitat. Acid mine drainage destroys stream and river ecosystems and threatens the health of people and wildlife. Power plants that generate electricity from oil and coal produce heavy metals and greenhouse gases as byproducts.

Second, wind farms represent a renewable energy resource that can provide an inexhaustible source of clean, non-polluting electricity. Unlike conventional power plants, wind plants emit no air pollutants or greenhouse gases. In 1990, according to the U.S. Department of Energy, California's wind farms – which generate approximately two percent of the state's total energy output – offset the emission of more than 2.5 billion pounds of carbon dioxide, and 15 million pounds of other pollutants that would have otherwise been produced. It would take a forest of 90 million to 175 million trees to provide the same air quality. The Department of Energy estimates that using one utility-scale wind turbine prevents the annual emission of 5,000 tons of carbon dioxide, a greenhouse gas that contributes to global warming. Energy produced from traditional sources like coal and oil, in contrast, generates byproducts at each stage of the generation process, leading to increased air pollution, and, in the case of coal mining, acid mine drainage.[2]

The environmental limitations associated with wind farms – at abandoned mine lands and in general – revolve around the turbines' potential threat to wildlife, primarily bats and local and migratory bird

[2] Recognizing these benefits, the Department of Energy has developed grant- and incentive-based programs to promote the development of wind energy resources. The *Resources* section of this report and Attachment A provide additional information.

populations. These concerns have arisen largely in response to the high number of bird kills at one wind farm located in Altamont Pass in California, where 183 birds, including five bald eagles, were killed by turbine rotor blades between 1990 and 1992. Changes in turbine technology – including additional lighting, the redesign of turbine nacelles to eliminate bird nesting opportunities, and slower blade rotations, which make the turbines easier for birds to see and avoid – have reduced their potential threat to wildlife. A 2001 National Wind Coordinating Committee (NWCC) study, indicated that, on average, approximately two birds are killed per turbine per year.

In some states, companies considering new locations for wind farms must also submit environmental impact statements before proceeding with projects. At the Buffalo Mountain Wind Farm, an environmental assessment was conducted to ensure that the wind farm would not negatively impact the natural environment.

Economic Impacts

The potential economic benefits provided by wind energy at AMLs include local job creation, economic growth and diversification, and increased tax revenues.[3] Wind energy can help revitalize economies by creating new businesses and jobs, and by keeping energy dollars circulating within local economies. Several recent studies have analyzed wind energy data to quantify these benefits. A nationwide 2001 study by the Center for Renewable Energy and Sustainable Technology concluded that wind farms create 40 percent more jobs per dollar invested than coal plants. The European Wind Energy Association estimates that every megawatt of wind capacity creates about 15-19 jobs, or about five times more jobs per dollar invested than coal or nuclear power.

Locating a wind farm at an AML can also benefit the local economy through the purchase of local goods and services. During the construction of the wind farm, companies and contractors require equipment and support services, while their employees require services like food and lodging. Following construction of a wind farm, companies and contractors and their employees continue to require local goods and services as the farms are maintained, repaired, and upgraded over time. Studies that have assessed the scale of local economic benefits provided by wind farms have reached different conclusions. One study for a wind developer cited by the NWCC concluded that the operation of a 100-megawatt wind farm would generate approximately $500,000 in annual local purchases. A 1995 report from California's Kern County Wind Energy Association, in contrast, concluded that the county's local economy gains $11 million annually from the purchase of goods and

[3] Additional tax revenues are generated from increased local spending on goods and services during the construction and operation of a wind farm.

services for wind energy projects. The county's total economic gain includes new tax revenues generated by the purchases. Kern County, which contains 4,600 wind turbines with a total generation capacity of 1,400 megawatts, is home to the largest cluster of wind farms in the United States.

The local revenue derived from a parcel of land can be significantly increased by the addition of wind turbines. Wind turbines provide an additional source of revenue, particularly at sites like AMLs where the land is either not in use or is in agricultural use. Wind farms can be integrated with existing agricultural uses. For example, at the Somerset wind farm, property owner Robert Will receives two percent of the turbines' production revenue as payment for allowing the turbines to be sited on his land. In total, each turbine generates $3,000 to $3,500 each year in revenue for the property owner, while Mr. Will retains the ability to farm most of his property.

> "We're the only family in Pennsylvania milking cows next to windmills. It's a way to make a little extra money, and it doesn't take much of your land. It does not disrupt your way of farming."
>
> - Property Owner Robert Will in the *Patriot News*, February 2nd, 2002

Even though the cost of generating wind energy has decreased dramatically in the past ten years, the technology does require a higher initial investment than fossil-fueled generators. Roughly 80 percent of a wind farm's startup cost is its machinery, with the balance being the site's preparation and installation. However, if wind farm systems are compared with fossil-fueled systems on a "life-cycle" cost basis (counting fuel and operating expenses for the life of the generator), wind costs are much more competitive with other generating technologies because there is no fuel to purchase and minimal operating expenses. The construction and operating costs associated with wind energy will also continue to decrease over time. New, utility-scale wind projects are being built in the United States today with energy generation costs ranging from 3.9 cents per kilowatt-hour (at windy sites in Texas) to five cents or more (in the Pacific Northwest), costs that are competitive with the direct operating costs of conventional forms of electricity generation.

Wind energy's remaining major economic limitation is its status as an intermittent power supply. While the wind is an inexhaustible, renewable natural resource, it does not blow all of the time, and cannot be guaranteed to come online during periods of high energy demand. Organizations like the Tennessee Valley Authority at the Buffalo Mountain wind farm are working to develop energy storage facilities for wind farms that would enable the power generated by wind turbines to be stored and released at times of high energy demand.

Social Impacts

Wind farms located on AMLs can provide several social benefits, serving as local landmarks and a source of community pride. At the Somerset wind farm, for example, the striking silhouette of the wind turbines has provided a new local point of reference, and even attracted tourists passing by on

the nearby Pennsylvania Turnpike. Robert Will, the property's landowner, has come to expect a regular flow of visitors on weekends, drawn to look at the turbines.

Wind farms can also generate community concerns about the potential noise levels and aesthetics associated with wind turbines. Turbine noise levels have decreased substantially – a single modern wind turbine is barely audible. The American Wind Energy Association estimates that a wind turbine located 250 meters from a residence generates about as much noise as a kitchen refrigerator. A wind farm with multiple turbines, however, will generate more sound and the appropriate siting of the proposed wind farm in relation to surrounding land uses may need to be considered during the planning and siting process.

Community aesthetic concerns can center around the size, design, and visual prominence of the wind turbines, which may significantly alter a community's skyline. Turbines' shadow patterns and night-lighting can also create a visual nuisance if sited near residences and businesses. Turbines' shadow patterns and night-lighting can be addressed by planting trees or installing screens. Aesthetic concerns, however, can be more difficult to address, as people's preferences can vary. Some people like the profile of wind turbines, for example, while others find them visually disruptive. Community outreach and education efforts can help ensure that all community members are included in the planning process from the outset. During community meetings, community members can express their concerns, learn about wind energy, and work with other community members and interested parties, including local officials, residents, organizations, and energy providers, to ensure that proposed wind farm projects are appropriately designed, well-sited, and ultimately successful.

Getting Started

As your community evaluates its interest in pursuing wind power as a reuse option for local abandoned mine lands, there are several important factors to consider. These factors include:

- *Sustained Community Involvement*

Active, **sustained community involvement** is critically important from the outset of any community planning process, and can help determine the extent to which wind power may be able to meet local environmental, economic, and social needs. Discussion of community priorities can also help to identify potential community concerns, like noise levels or aesthetics, associated with the location of wind turbines on local AMLs.

Community discussions about potential reuse opportunities at local AMLs need to include a diverse range of stakeholders, reflecting the local and regional impact of former mining sites on economies, communities, and ecosystems. Stakeholders in an effective, inclusive process may include local government officials, citizens, and local organizations, previous site landowners and operators, current or future landowners, potential developers, Tribal interests, and state and federal agencies

with potential oversight responsibilities at a site. Additional interested parties may include wind energy corporations and power companies, wildlife organizations, and renewable energy organizations. These organizations may be able to provide key technical support and funding resources.

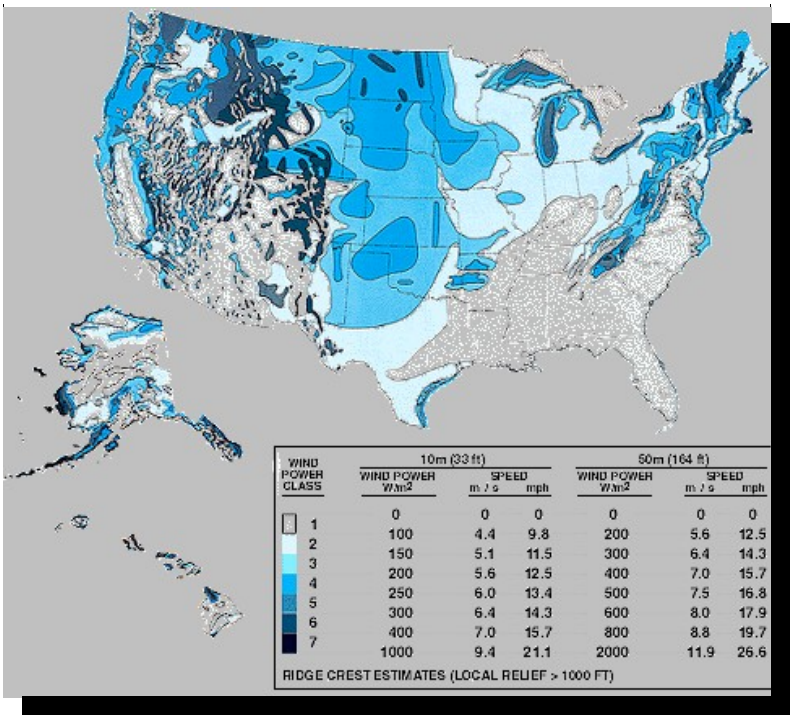
- *Understanding of Land Ownership Issues*

The community's efforts to evaluate local AMLs as potential locations for wind farms will require close coordination with the owners of these former mining sites. Landowners may be aware of the potential benefits provided by wind energy, or may need to work with the community to determine whether a wind farm represents an opportunity to return their property to successful reuse.

The community may also need to clarify and resolve several **land ownership issues**. Former mining sites often have multiple owners, including individuals and mining companies. Outstanding mining claims may need to be resolved. Properties may have separate surface and mining rights that are owned by different entities. In each case, the community will need to contact and develop working relationships with the owners of the properties or mining rights at each AML as early as possible in the planning process.

- *Site Feasibility*

As your community establishes an inclusive community involvement process and addresses site ownership issues, the community can begin to effectively evaluate the feasibility of wind power as a reuse option for local AMLs.



U.S. Wind Energy Resource Map ***(U.S. Department of Energy)***

The **technical feasibility** of locating a wind farm on a local AML depends on the availability of sufficient wind resources, suitable location characteristics, and existing infrastructure. Energy resource maps can help the community determine if the site is located in an area that receives sufficient wind resources. Potential wind farm sites at AMLs must also include adequate space for large-scale turbines and open areas located away from buildings, which obstruct wind flow. Finally, the community will need to determine, using local electric power system maps and general area maps, whether AMLs are located in close proximity (typically within two miles) of existing infrastructure. Sites located adjacent to

existing roads and power transmission lines mean that wind turbines can be installed and connected to the power grid with reduced cost.

Community Considerations: Evaluating the Potential Reuse of a Local AML

Communities considering the potential reuse of a local AML as a wind farm can work through the following evaluative steps. For information about wind energy consultants that can provide the services described below, please refer to the American Wind Energy Association (AWEA)'s web site at www.awea.org/directory.

- *Identify AML sites and their wind energy potential,* based on the availability of wind resources, site location, and the availability of existing infrastructure like roads and power transmission lines, which can reduce costs. Wind resource maps such as the Pacific Northwest Laboratory's *Wind Energy Resource Atlas* (online at rredc.nrel.gov/wind/pubs/atlas) and data from the National Climatic Data Center (online at www.ncdc.noaa.gov) can be used to assess local wind resources. Maps of local electric power systems and general area maps can help determine the availability of existing infrastructure.

- *Secure access to the site.* Work with AML property owners to explore the potential benefits provided by wind energy at each site and determine their level of interest.

- *Explore and address the social and environmental factors* that may affect the project, including raptor activity, endangered species in the area, the site's geology, community concerns about noise and aesthetics, cultural and historical factors, and local air traffic issues.

- *Arrange for a professional appraisal* of the site's wind resources. A professional appraisal of the site's wind resources involves the construction of meteorological towers equipped with anemometers, instruments that measure wind force and speed. Based on one-year's worth of data from these instruments, a meteorologist can prepare a site report that describes the area's wind resources. Companies that provide these services can be found on AWEA's website, listed above.

- *Obtain the services of a professional familiar with the regulatory environment* surrounding wind power development. These services can help ensure that relevant state and federal regulations like environmental impact statements are identified and addressed early in the planning process.

- *Identify a wind energy developer* that would be interested in discussing the possibility of locating a wind farm on the site. Attachment B at the end of this report provides a list of wind energy developers.

- *Identify a reliable power purchaser* and secure tentative commitments from one or more buyers for the wind farm's output. Local, regional, and national utilities, as well as other entities, including universities and businesses, are potential purchasers of a wind farm's output. Local utilities will also need to be contacted to ensure access to the area's existing power transmission network.

- *Establish access to sufficient capital* to support the cost of constructing a wind farm – approximately $1 million per megawatt. National and international lenders, including investment banks, insurance companies, and foreign investors, typically supply 50-90 percent of wind projects' capital costs, with project sponsors providing the remainder of the project's funding.

- *Secure an agreement with a company* to provide operations and maintenance services for the wind turbines. Companies that provide these services can be found on AWEA's website, listed above.

Community Resources

For communities interested in pursuing wind energy as a reuse opportunity for a local abandoned mine land, there are a wide range of existing programs and incentives that are available. Types of assistance that are available include grant funding, technical assistance, and tax credits. Some of these incentives, such as tax credits, target the private sector, spurring companies to develop wind farms. However, communities can access most of the resources that are available and receive financial assistance, information, and technical advice from organizations and agencies that specialize in the development of wind energy resources at AMLs.

Two federal agencies, the Department of Energy (DOE) and the Environmental Protection Agency (EPA), have developed programs that can assist communities as they explore wind energy reuse opportunities for AMLs. DOE has programs that provide financial incentive payments to public and non-profit renewable energy producers for the development of renewable energy resources, funding for community-based education, training, and information dissemination activities, and cost-sharing funding for state and industry renewable energy partnerships.

In particular, DOE's Rebuild America program can serve as a valuable resource for communities pursuing reuse opportunities at AMLs. The Rebuild America program is a network of hundreds of community-based partnerships across the nation that are dedicated to improving the quality of life in communities through energy efficiency solutions. The program provides financing and technical assistance to help communities identify, prioritize, and solve energy-related problems.

EPA's AML Team is also an important resource that can provide communities with technical support and resources as they explore reuse opportunities available at AMLs. EPA's AML Team can work in partnership with communities to clarify EPA's interests at former mining sites and address potential obstacles to reuse planning at these sites. In the future, the Team will also be developing databases, case studies, and other tools and resources to help communities pursue wind energy as a dynamic reuse opportunity for local AMLs.

Attachment A provides additional information about available federal and state-level programs and incentives, including the programs described above, as well as a list of additional wind energy resources. Because of the large number of state-level programs, the section provides links to two listings with information about these programs. Each of these programs have been highlighted because they can provide your community with helpful services and funding as it considers wind energy reuse options for local abandoned mine lands. Attachment B provides contact information for wind energy developers and consultants that are members of the American Wind Energy Association (AWEA). Attachment C lists the sources used during the development of this report.

Conclusions

Wind energy provides a significant opportunity for communities to reuse abandoned mine lands. By returning AMLs to productive reuse as wind farms, communities can benefit from the potential cleanup of these vacant, idle properties, as well as from economic benefits that include local job creation, economic growth and diversification, and increased tax revenues. To pursue these benefits, communities will need to evaluate local wind resources and establish strong working relationships with site landowners and wind energy providers. As the Buffalo Mountain and Somerset wind farms illustrate, these projects will also require sustained community interest and innovative financing and design approaches. The end result: AMLs reclaimed as wind farms that can help communities find new answers to long-standing economic and environmental questions. The opportunities await.

Contact Information

Interested in pursuing potential wind energy opportunities for a local AML site? For additional information, there are several federal resources that are available.

- For information about the Department of Energy's Rebuild America Program, please contact Elizabeth Freed at 202-564-5117 or Martha Otto at 703-603-8853.
- For information about EPA's AML Team, please contact Joan Fisk at 703-603-8791 or Shahid Mahmud at 703-603-8789.
- For additional information about the Buffalo Mountain wind farm, contact Rick Carson, TVA's Renewable Energy Program Manager, at 423-751-7461.
- For additional information about the Somerset wind farm, contact Jim Webb, Project Administrator at the Florida Power & Light Company, at (304) 463-3339.

The EPA Superfund Redevelopment Initiative website, at www.epa.gov/superfund/programs/recycle, also provides tools, case studies, and resource information addressing the reuse of Superfund sites, including AMLs.

Attachment A: Federal and State Resources

Program Name	Agency	Program Description	Contact Information
Renewable Energy Prod. Incentive	DOE and IRS	Financial payments for public and non-profit sector renewable energy producers	www.eren.doe.gov www.nrel.gov
Wind Biomass Renewable Electricity Production Credit	IRS	Tax incentives for private sector renewable energy producers	www.irs.gov
Solar, Wind, and Geothermal Modified Accelerated Cost Recovery System	IRS	Corporate depreciation tax deduction for investments in renewable energy technologies	www.irs.gov
Competitive Financial Assistance	DOE, Office of Energy Efficiency Renewable Energy	Grant funding for public outreach, training, and technical assistance related to energy efficiency and renewable energy	www.eren.doe.gov e-center.doe.gov
National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3)	DOE, Golden Field Office	Grant funding for state and industry partnerships that emphasize energy efficiency and clean production technologies	www.golden.doe.gov
Native American Anemometer Loan Program	DOE, National Renewable Energy Laboratory	Provision of anemometers and installation equipment for measurement of wind resources on tribal lands	www.eren.doe.gov/windpoweringamerica/na_anemometer_loan.html
Green Power Partnership	EPA	Technical assistance for institutions that use renewable energy resources	www.epa.gov/greenpower/join/join.htm
Database of State Incentives for Renewable Energy	State programs	Tax credits, loans, and grants for renewable energy resources	www.dsireusa.org
Inventory of State Incentives for Wind Energy in the U.S.	State programs	Wind resource information and wind energy-related financial, economic, and regulatory incentives	www.awea.org/pubs/inventory.html

Program Name	Agency	Program Description	Contact Information
Illinois Renewable Energy Resources Program	Illinois Department of Commerce and Community Affairs	Grant funding for projects focused on the use of renewable energy resources in Illinois	www.commerce.state.il.us/com/pdf/RENEWABLE%20ENERGY%20RESOURCES%20Grant.pdf

Additional Wind Energy Resources

The American Wind Energy Association (AWEA) is a national trade association that promotes wind power as a renewable energy resource.	www.awea.org
The National Renewable Energy Laboratory (NREL) is DOE's premier laboratory for renewable energy research and development.	www.nrel.gov
The National Wind Technology Center is the subgroup of NREL that focuses on wind energy.	www.nrel.gov/wind
The National Wind Coordinating Committee (NWCC) supports the development of sustainable commercial markets for wind power.	www.nationalwind.org
The Golden Field Office manages many of DOE's renewable energy programs.	www.golden.doe.gov
AWEA policy document that describes wind energy development efforts around the world.	www.awea.org/policy/incentives.html

Attachment B: Contact Information for Wind Energy Companies and Consultants

The list below provides contact information for wind energy developers and consultants that are members of the American Wind Energy Association (AWEA). For a comprehensive listing of wind energy developers, operators, consultants, and turbine manufacturers, please refer to AWEA's online directory at www.awea.org/directory.

- ABB Power: www.abb.com
- AEP Energy Services, Inc.: www.aep.com
- Atlantic Renewable Energy Corp.: www.atlantic-renewable.com
- Black & Veatch Corp.: www2.bv.com/energy/index.htm
- CalWind Resources, Inc.: www.calwind.com
- Catamount Energy Corp.: www.catenergy.com
- CHI Energy, Inc.: www.chienergy.com
- Cielo Wind Power LLC: www.cielowind.com
- Clipper Windpower LLC: www.clipperwind.com
- Distributed Generation Systems, Inc.: www.disgenonline.com
- DP Energy Ltd.: www.dpenergy.com
- EAPC Architects & Engineers: www.eapc.net
- Endless Energy Corp.: www.endlessenergy.com
- Energy Unlimited, Inc.: www.eui-windfarm.com
- enXco: www.enXco.com
- Eurus Energy America Corp.: www.eurusenergy.com
- FPL Energy, Inc.: www.fplenergy.com
- Foresight Energy Company: www.foresightenergy.com
- GE Wind Energy: www.gewindenergy.com
- Generation Resources Holding Co.: www.grhc.biz
- Global EnerCom Management: www.gemengr.com
- Global Winds Harvest, Inc.: www.globalwinds.com
- Green Mountain Energy Company: www.greenmountain.com
- Greenlight Energy, Inc.: www.glnrg.com
- Guascor North America: www.guascor.com
- International Applied Engineering: www.iaeinc.com
- LG&E Power, Inc.: www.lgeenergy.com
- M.A. Mortenson: www.mortenson.com
- Midwest Renewable Energy Corp.: www.midwest-renewable.com
- National Wind Power, Ltd.: www.natwindpower.com
- NedPower US LLC: www.nedpower.com
- Northern Alternative Energy, Inc.: www.windpower.com
- North American Renewables Corp.: www.narenewables.com
- Oak Creek Energy Systems, Inc.: www.oakcreekenergy.com
- Orion Energy, LLC: www.orion-energy.com
- PB Power, Inc.: www.pbworld.com/power
- Pacific Winds, Inc.: www.powerworksinc.com
- Renewable Energy Systems (USA), Inc.: www.res-ltd.com
- SeaWest WindPower, Inc.: www.seawestwindpower.com
- Specialized Power Systems, Inc.: www.spswind.net
- Superior Renewable Energy: www.superiorrenewable.com
- Tenderland Power Company: www.tenderland.com
- Tennessee Valley Infrastructure Group: www.tvigroup.com
- United American Energy Corp.: www.uaecorp.com
- US Wind Force, LLC: uswindforce.com
- Wintec Energy, Ltd.: www.wintecenergy.com
- Zilkha Renewable Energy: www.zilkha.com

Attachment C: Acknowledgments

Information for this report was gathered from various reports, papers and online sources, categorized below:

General Wind Energy Information

- the U.S. Department of Energy's Wind Energy Program website, at www.eren.doe.gov/wind/homeowner.html.
- the 1995 book *Wind Energy Comes of Age* by Paul Gipe.
- the 1995 book *Renewables Are Ready* by Nancy Cole and P.J. Skerret.
- the Appalachian Mountain Club's 1996 *General Policy on Windpower*, at www.nationalwind.org.
- the U.S. Department of Energy's 2000 fact sheet *Wind Powering America: Clean Energy for the 21st Century*.
- the March 2000 *Smithsonian* article "A Second Wind."
- the August 2002 *Time* article "The Winds of Change."
- the August 16, 2002 *USA Today* article "Wind Energy Generates Income."
- the August 20, 2002 *Washington Post* article "Windmills on the Water Create Storm on Cape Cod."
- the American Wind Energy Association's website, at www.awea.org.
- the National Wind Coordinating Committee's wind energy fact sheets, at www.nationalwind.org.

AML-Related Information and the Buffalo Mountain and Somerset Wind Farms

- the December 4, 2001 *Elizabethton Star* article "Windmills on the Mountain? TVA Project Could Boost Tourism," at www.starhq.com/html/localnews/1201/120401Windmills.html.
- the December 28, 2001 *Charleston Gazette* article "Grant Wind Farm will be Largest in East."
- the Oak Ridge Nuclear Laboratory's website, at www.ornl.gov.
- the Tennessee Valley Authority's Green Power Switch and Public Power Institute programs websites, at www.tva.gov/greenpowerswitch/index.htm.
- the Powering the South organization's website, at www.poweringthesouth.org.
- the Community Energy, Inc.'s New Wind Energy program website, at www.newwindenergy.com.
- the August 2002 *Progressive Engineer* article "A New Crop Takes Root," at www.progressiveengineer.com/frm_back.htm.
- October 2002 and January 2003 interviews with Gary Verkleeren, Zilkha Renewable Energy.
- October 2002 interview with Robert Will, Somerset wind farm landowner.
- the Pennsylvania Department of Environmental Protection website, at www.dep.state.pa.us.

- the Fall 1995 *Land and Progress* article "Wind Energy Creates Jobs, Power in East Kern."
- the 1997 European Wind Energy Association report *Wind Energy in Europe - The Facts*, at www.ewea.org/doc/ewea.pdf.
- the U.S. Department of Energy's 2000 fact sheet *Wind Powering America: Clean Energy for the 21st Century*.
- the August 2001 National Wind Coordinating Committee report *Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States,* at www.nationalwind.org.
- the October 2001 *AgJournal* article "Wind Energy Investment Benefits Landowners," at www.agjournal.com.
- the October 2001 *Penn Almanac* article "Wind Energy to Power Penn," at www.upenn.edu/almanac/v48/n10/WindPower.html.
- the November 2001 Renewable Energy Policy Project report *The Work That Goes Into Renewable Energy,* at www.repp.org/repp.
- the December 2002 *Grist* article "Tilting at Windmills: Activists Are Split on Proposed Project Off Cape Cod," at www.gristmagazine.com.
- February 2, 2002 *Patriot News* article, at www.pennlive.com/patriotnews.
- the American Wind Energy Association's website, at www.awea.org.
- the U.S. Department of Energy's Wind Energy Program website, at www.eren.doe.gov/wind/homeowner.html.
- the Pennsylvania Department of Environmental Protection's *Wind Farming* fact sheet, at www.dep.state.pa.us.
- the Office of Surface Mining, Reclamation, and Enforcement website, at www.doi.gov/pfm/ar4osm.html.