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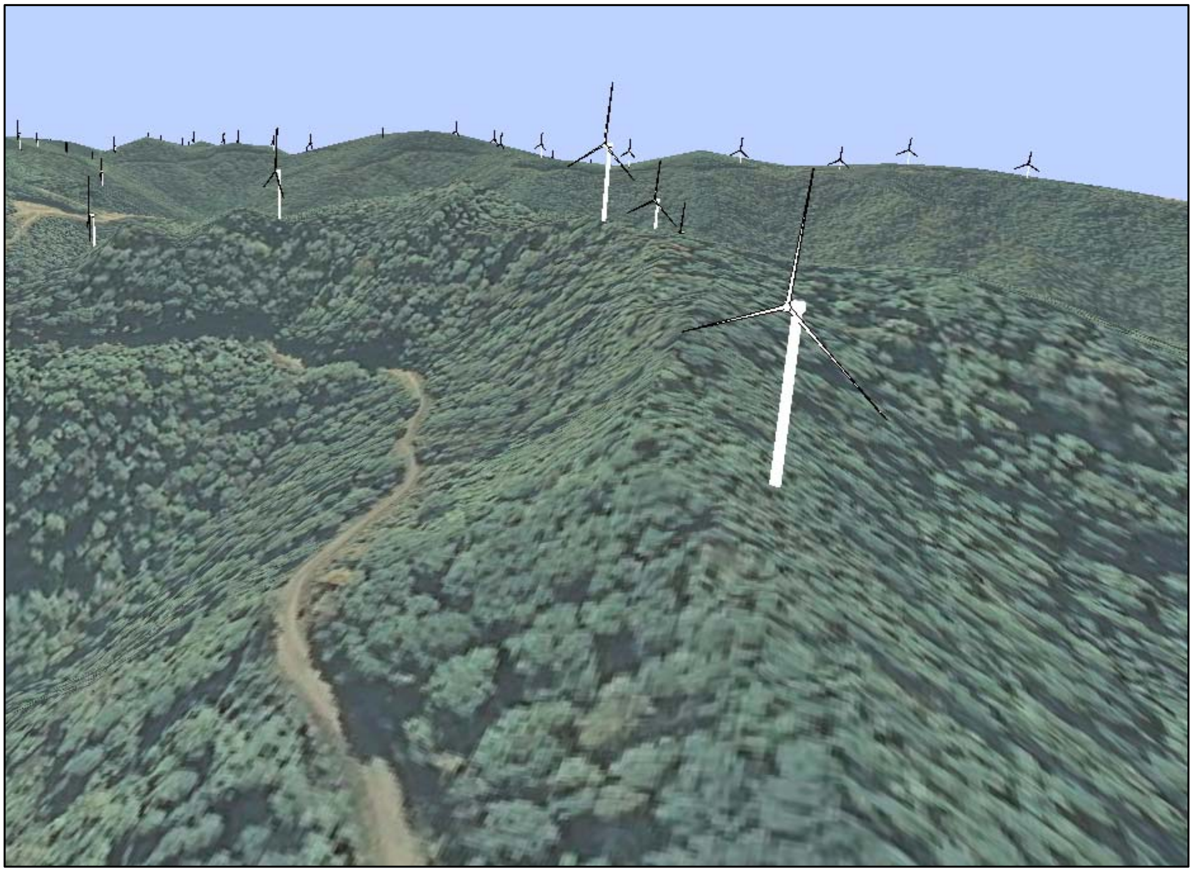

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building capacity for sustainability

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ABOUT DOWNSTREAM STRATEGIES

Downstream Strategies is an environmental consulting firm based in Morgantown, West Virginia. Downstream Strategies provides science, research, and tools to organizations, businesses, and agencies. We combine sound interdisciplinary skills with a core belief in the importance of protecting the environment and linking economic development with natural resource stewardship.

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ABBREVIATIONS

CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
EIS	environmental impact statement
EROI	energy return on investment
JEDI	Jobs and Economic Development Impact
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
MSHA	Mine Safety and Health Administration
MW	megawatt
MWh	megawatt-hour
NA	not applicable
N_2O	nitrous oxide
NO_X	nitrogen oxides
NREL	National Renewable Energy Laboratory
PM	particulate matter
SO_2	sulfur dioxide
USEPA	United States Environmental Protection Agency
VSL	value of statistical life
WVDEP	West Virginia Department of Environmental Protection

EXECUTIVE SUMMARY

Mountaintop removal coal mines are poised to begin operation on Coal River Mountain in Raleigh County, West Virginia. In West Virginia as well as surrounding states, hundreds of mountaintop removal mines have flattened hundreds of thousands of acres of mountain peaks in order to access the coal, while pushing the waste material into adjacent valleys and burying headwaters streams.

Coal River Mountain Watch—an organization that works to stop mountaintop removal mining and to help rebuild sustainable communities—is promoting an alternative: the development of a wind farm on Coal River Mountain. This alternative would protect the surface of the mountain, produce green electricity, and preserve current underground coal mining jobs.

This report presents two starkly different choices for Coal River Mountain: mountaintop removal versus a wind farm. As this report demonstrates (see Chapter 3), after mountaintop removal, Coal River Mountain would be rendered uneconomical for wind farm development.

Three scenarios are examined in this report: mountaintop removal, conservative wind, and local industry wind scenarios. Both wind scenarios envision 164 wind turbines on Coal River Mountain. The third scenario includes development of a local wind industry that, when combined with construction of wind turbines on Coal River Mountain, would further enhance the local economic benefits of wind.

For each scenario, the local economic benefits are quantified based on increased jobs, earnings, and economic output. In addition to these economic benefits, costs due to excess deaths and illnesses from coal production and local environmental problems are quantified and added to earnings to demonstrate how each scenario impacts the citizens of Raleigh County.

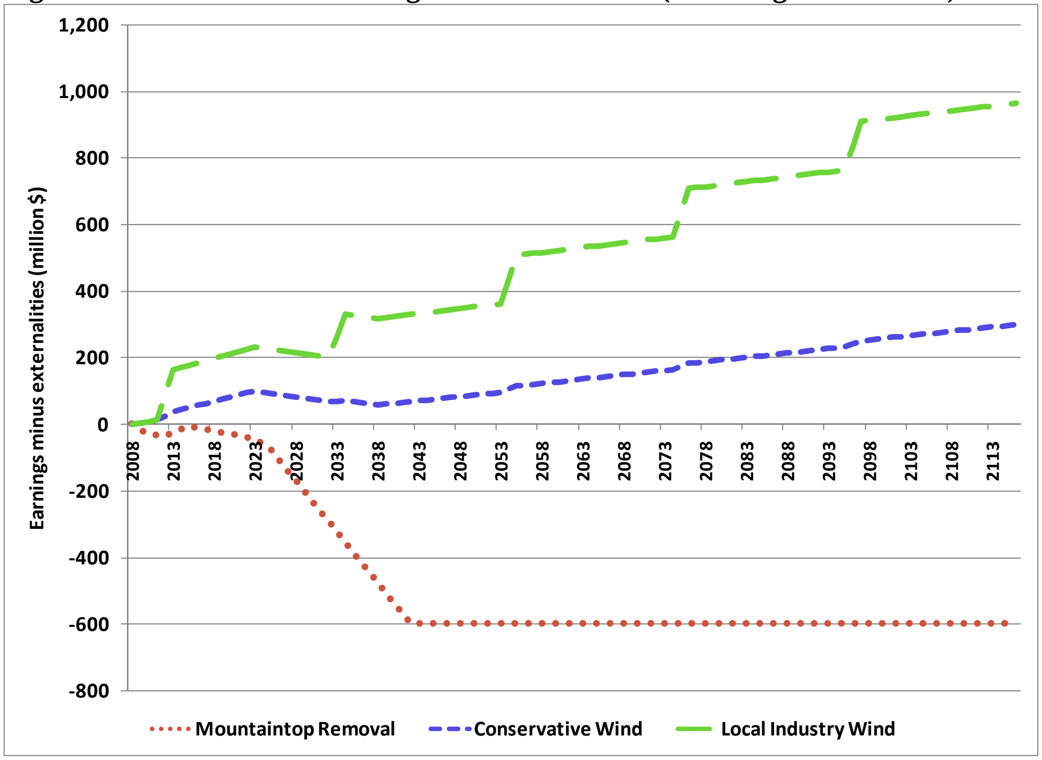
Other externalities—including global environmental costs; forestry; tourism; property values; and gathering, hunting, and heritage—are not quantified in this report. However, quantification of these additional externalities would tend to favor the development of a wind farm over mountaintop removal mines.

The economic results of the mountaintop removal and wind scenarios stand in stark contrast (Figure ES-1). For mountaintop removal, the cumulative external costs from coal production exceed the cumulative earnings in every year. Even without comparing it with the wind scenarios, the mountaintop removal scenario is not defensible from the perspective of Raleigh County citizens when considering just two externalities: excess deaths and illnesses, and environmental damage.

In contrast, both wind scenarios show cumulative earnings that exceed cumulative externalities in every year. Based on our economic analyses, the wind scenarios are preferable to mountain removal coal mining to the citizens of Raleigh County. When combined with a local wind turbine manufacturing industry, even more significant additional local economic benefits are achieved.

The timing of these costs and benefits are important. The benefits of mountaintop removal mining would end after 17 years when the mining ends, but the costs of mountaintop removal mining are projected to continue due to the expected deaths and illnesses caused by the coal mining. In contrast, the benefits from the wind scenarios continue indefinitely.

Figure ES-1: Cumulative earnings for each scenario (including externalities)



Even without considering externalities, the local industry wind scenario would provide more cumulative jobs than the mountaintop removal scenario after 2033—only eight years after the mountaintop removal mines would close.

In addition to higher local earnings, the wind scenario would generate significantly more local taxes for Raleigh County than the mountaintop removal scenario. Only an additional $36,000 per year in coal severance taxes would be paid to Raleigh County by mountaintop removal mining on Coal River Mountain. In comparison, a wind farm would generate an additional $1.74 million in local property taxes each year.

While wind provides greater economic benefits to the citizens of Raleigh County, a final decision about mountaintop removal rests with the landowners and leaseholders on Coal River Mountain, who are concerned with the value of their investments. This report computes the present value of revenues to landowners generated by a wind farm versus mountaintop removal. Wind farm revenues were found to be much lower than those realized through mountaintop removal. In addition, currently held coal leases on Coal River Mountain stay in existence until “all minable coal” is extracted, further inhibiting surface developments like wind farms.

It is therefore no surprise that both landholding companies and leaseholders have pursued coal mining as opposed to wind farm development on Coal River Mountain. Without societal intervention, these companies will pursue mountaintop removal in order to provide the greatest private profits possible from the land and coal resources on Coal River Mountain.

A wind farm on Coal River Mountain has been contentious since this concept was first proposed by Appalachian Voices and others in late 2006. However, the conclusions of this report confirm that a wind farm would produce greater economic benefits to citizens of Raleigh County, particularly when health and environmental externalities are included in the analysis.

There are several actions that could shift the current emphasis on coal production to one that includes coal and wind production. These actions include a change in the regulatory or legal landscape in regard to surface coal mining.

State and local leaders and stakeholders can all play a role to promote the use of wind energy. Based on the findings of this report, state and local leaders should reconsider their singular focus on extraction of coal resources in southern West Virginia and chart a common path forward with local citizens that not only preserves private profits, but also strives—as a central objective—to sustain the local economy over the long term.

1. INTRODUCTION

Mountaintop removal coal mines are poised to begin operation on Coal River Mountain in Raleigh County, West Virginia (Figure 1). In West Virginia, Kentucky, Virginia, and Tennessee, hundreds of mountaintop removal mines have flattened hundreds of thousands of acres of steep mountain peaks to access the coal, while pushing the waste material into adjacent valleys and burying headwaters streams.

Coal River Mountain Watch—an organization that works to stop mountaintop removal mining and to help rebuild sustainable communities—is promoting an alternative: the development of a wind farm on Coal River Mountain. This alternative would protect the surface of the mountain, produce green electricity, and preserve current underground coal mining jobs while facilitating the creation of new ones.

Renewable energy technologies such as wind turbines—which produce electricity without direct greenhouse gas emissions—are becoming more economical, and installed wind capacity is growing significantly in West Virginia. Like coal, wind power is an indigenous energy source and brings jobs and taxes to local communities. As the national debate regarding climate change, energy independence, and economic recovery unfolds with the new Obama administration, national policy goals and outcomes will be affected by decisions made in specific locations like Coal River Mountain.

This report presents two starkly different choices for Coal River Mountain: mountaintop removal versus wind. It also analyzes the development of a local wind industry that, when combined with the development of a wind farm on Coal River Mountain, would further enhance the local economic benefits of wind. More broadly, the local manufacture of wind turbines and equipment would also help promote the development of green jobs and renewable energy across West Virginia.

For each of the three scenarios examined in this report—the mountaintop removal, conservative wind, and local industry wind scenarios—the local economic benefits are quantified based on increased jobs, earnings, and economic output. In addition, costs due to excess deaths and illnesses and local environmental problems are quantified. Other externalities are discussed but not quantified.

As demonstrated by these calculations, a wind farm on Coal River Mountain combined with a new local wind industry would provide the greatest long-term economic benefits to the citizens of Raleigh County. In contrast, mountaintop removal coal mines would provide larger short-term economic output and greater profits to the landholding companies that own the coal and the mining company poised to begin mining. But these profits would come at the cost of generating human health and environmental externalities.

In short, the private interests of the landholding companies and the leaseholders suggest one course of action, while the long-term benefits to local citizens and the county suggest an alternative. While decisions about which path to follow ultimately rest with the private sector, this analysis points to the need for local and state officials to seriously consider how best to promote the public good for citizens of Raleigh County, and more broadly, across southern West Virginia.

Figure 1: The Coal River Mountain study area

2. BACKGROUND

West Virginia sits atop 33 billion tons of coal reserves and produces more than 150 million tons of coal per year (Energy Information Administration, 2007). Both the state of West Virginia and Raleigh County governments obtain substantial financial benefits from the coal industry. Statewide, West Virginia collected over $338 million in severance taxes during the 2007-2008 fiscal year. Over $1.7 million of this tax revenue was returned to county and local governments in Raleigh County during this same period (West Virginia State Treasurer's Office, 2008).

Of all the Appalachian states, West Virginia is the most heavily dependent upon severance and sales tax revenues (Thompson et al., 2001). Both statewide and locally in Raleigh County, about 10% of total earnings are derived from coal mining (Thompson et al., 2001). In terms of jobs, about 3% of both Raleigh County and West Virginia employment comes from coal mining (Minnesota IMPLAN Group Inc., 2008; West Virginia Coal Association, 2007; Bureau of Labor Statistics, 2008).

Despite the importance of coal mining in West Virginia, it is important to evaluate its impacts and to consider whether alternative forms of energy development—such as wind farms—may provide long-term benefits that exceed those provided by mountaintop removal mining.

2.1 Mountaintop removal coal mining

In 2006, mountaintop removal methods were used to mine about 70% of the surface-mined coal in West Virginia, and surface mining accounted for almost 43% of total coal production (Britton et al., 2007). Therefore, in 2006, about 30% of all West Virginia coal was mined using mountaintop removal methods.

The environmental impacts and social costs from coal mining in general—and from mountaintop removal coal mines like those proposed for Coal River Mountain—are described in a recent report (Bjureby et al., 2008), as well as in books by concerned Appalachian authors (Reece, 2006; Burns, 2007).

The federal programmatic environmental impact statement (EIS) for mountaintop removal and valley fills catalogs the scale of this mining practice and presents scientific data and analyses on specific environmental impacts (USEPA, 2003 and 2005).

According to the draft EIS, mountaintop removal mining was already prevalent in West Virginia, Kentucky, Virginia, and Tennessee before 2002. Between 1985 and 2001, 6,697 valley fills were approved by state agencies in these states, and these fills would cover 83,797 acres, or 131 square miles (USEPA, 2003).

USEPA summarizes the environmental impacts from mountaintop removal as follows:

- "an increase of minerals in the water—zinc, sodium, selenium, and sulfate levels may increase and negatively impact fish and macroinvertebrates leading to less diverse and more pollutant-tolerant species
- streams in watersheds below valley fills tend to have greater base flow
- streams are sometimes covered up
- wetlands are, at times inadvertently and other times intentionally, created; these wetlands provide some aquatic functions, but are generally not of high quality
- forests may become fragmented (broken into sections)
- the regrowth of trees and woody plants on regraded land may be slowed due to compacted soils
- grassland birds are more common on reclaimed mine lands as are snakes; amphibians such as salamanders, are less likely
- valley fills are generally stable
- cumulative environmental costs have not been identified
- there may be social, economic and heritage issues" (USEPA, 2005)

USEPA also notes that individuals and agencies outside of the PEIS process conducted studies. These studies estimated that approximately 1,200 miles of headwater streams (or 2% of the streams in the study area) were directly impacted by mountaintop removal and valley fill features including coal removal areas, valley fills, roads, and ponds between 1992 and 2002. An estimated 724 stream miles (1.2% of streams) were covered by valley fills from 1985 to 2001 (USEPA, 2005). Blasting is also prevalent, resulting in noise complaints and alleged damage to residential dwellings and domestic water systems (USEPA, 2003).

In the vicinity of Coal River Mountain, surface mining and valley fills are already prevalent (Figure 2). As shown in Table 1, 11,006 acres of existing valley fills are within the Coal River watershed. Of these, 2,096 acres are within the Clear Fork and Lower Marsh Fork subwatersheds in which Coal River Mountain is located. The valley fills proposed on Coal River Mountain would bury an additional 901 acres, or about 1.4 square miles.

These fills bury streams, as shown in Table 2. Across the Coal River watershed, 571,540 feet of streams, or 108 miles, have already been buried by valley fills. Within the Clear Fork and Lower Marsh Fork subwatersheds, 81,401 feet of streams—more than 15 miles—have been buried. The fills proposed on Coal River Mountain will bury an additional 47,374 feet, or 9 miles, of streams.

Figure 2: Surface mining and valley fills in the Coal River watershed

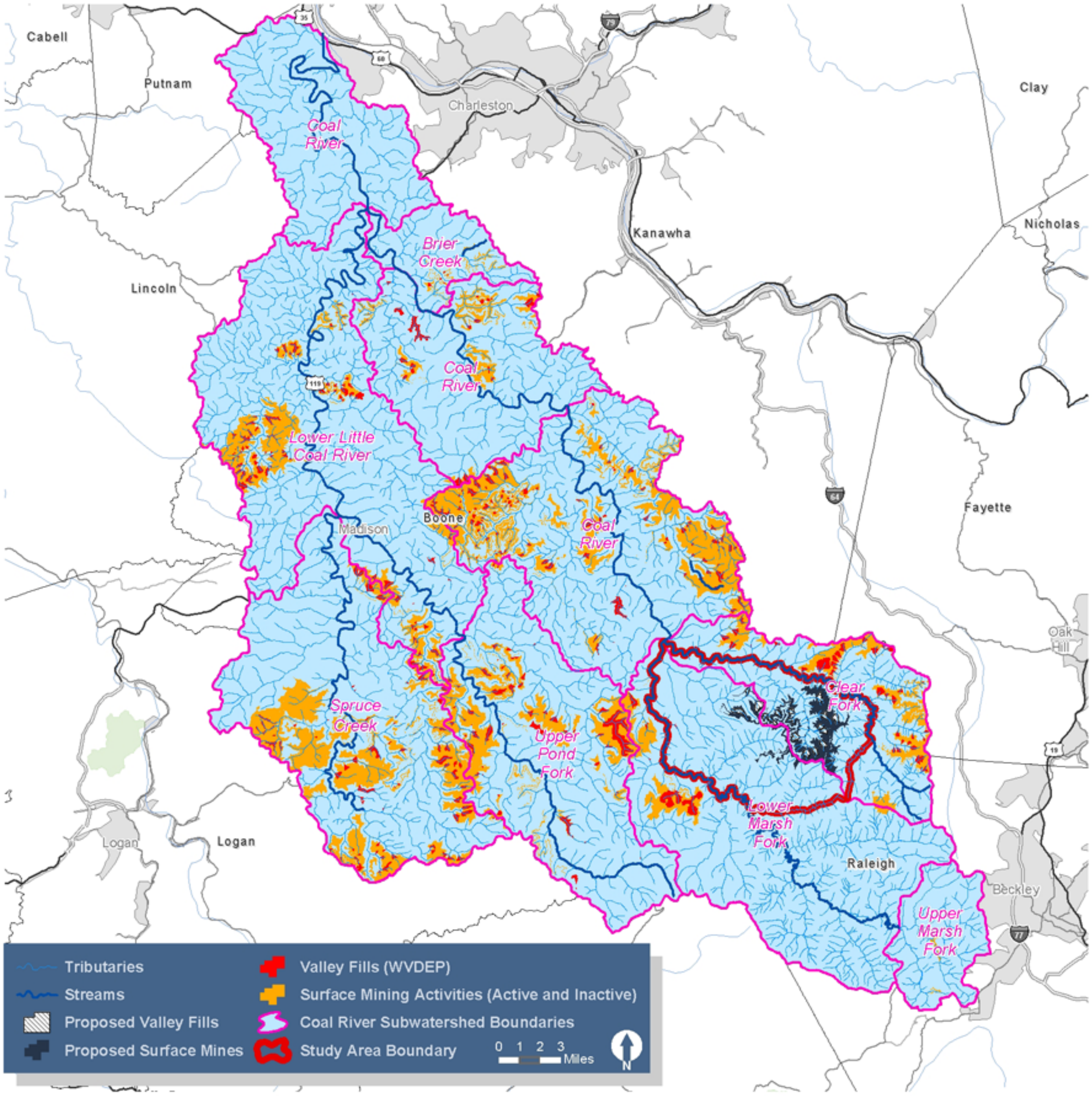


Table 1: Acres of valley fills in the Coal River watershed

Subwatershed	Total area (acres)	Existing fills: Fill area (acres)	Existing fills: Percent of area buried	Proposed fills: Fill area (acres)	Proposed fills: Percent increase in impacts
Brier Creek	14,274	31	<1%		
Clear Fork	41,463	1,316	3%	696	53%
Coal River	165,338	3,146	2%		
Lower Little Coal River	98,689	1,739	2%		
Lower Marsh Fork	88,568	780	1%	205	26%
Spruce Creek	80,719	1,962	2%		
Upper Marsh Fork	16,072	0	0%		
Upper Pond Fork	65,877	2,033	3%		
Total	571,001	11,006	2%	901	8%

Note: Valley fill data from Schaer (2008), except for proposed fills, which are those specified in permit applications for the mountaintop removal mines on Coal River Mountain.

Table 2: Streams impacted by valley fills in the Coal River watershed

Subwatershed	Stream length (feet)	Existing fills: Stream impacts (feet)	Existing fills: Percent of streams buried	Proposed fills: Stream impacts (feet)	Proposed fills: Percent increase in impacts
Brier Creek	274,988	0	0%		
Clear Fork	970,809	57,214	6%	37,671	66%
Coal River	3,299,673	176,538	5%		
Lower Little Coal River	2,172,412	105,336	5%		
Lower Marsh Fork	2,060,632	24,187	1%	9,703	40%
Spruce Creek	1,507,025	114,071	8%		
Upper Marsh Fork	333,533	0	0%		
Upper Pond Fork	1,162,626	94,194	8%		
Total	11,781,698	571,540	5%	47,374	8%

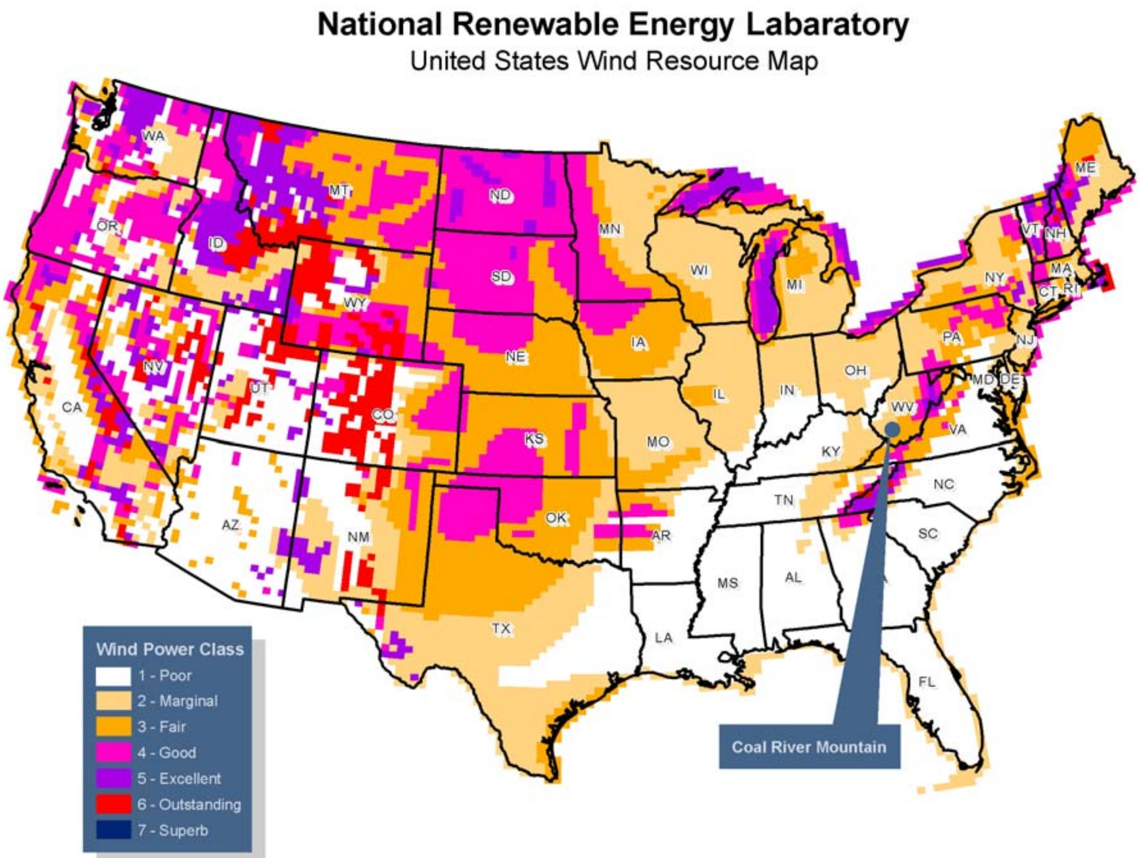
Note: Valley fill data from Schaer (2008), except for proposed fills, which are those specified in permit applications for the mountaintop removal mines on Coal River Mountain.

2.2 Wind

The United States wind industry is growing quickly and experienced unprecedented growth in 2007 (Wiser and Bollinger, 2008). Wind farms are generally located on the windiest sites, because stronger winds usually produce more electricity at lower cost. To characterize sites, the wind industry divides wind resources into seven classes, ranging from poor (Class 1) to superb (Class 7). Wind farms are typically sited where the resource is Class 3 through 7 (US Department of Energy, 2008).

While the broadest areas of high wind potential are generally located in western states, portions of West Virginia show fair to excellent wind resource potential, even at this level of resolution. The national map in Figure 3 is helpful in identifying broad wind patterns across the country, but more fine-grained analyses are needed to calculate the potential for specific sites.

Figure 3: Wind potential across the United States



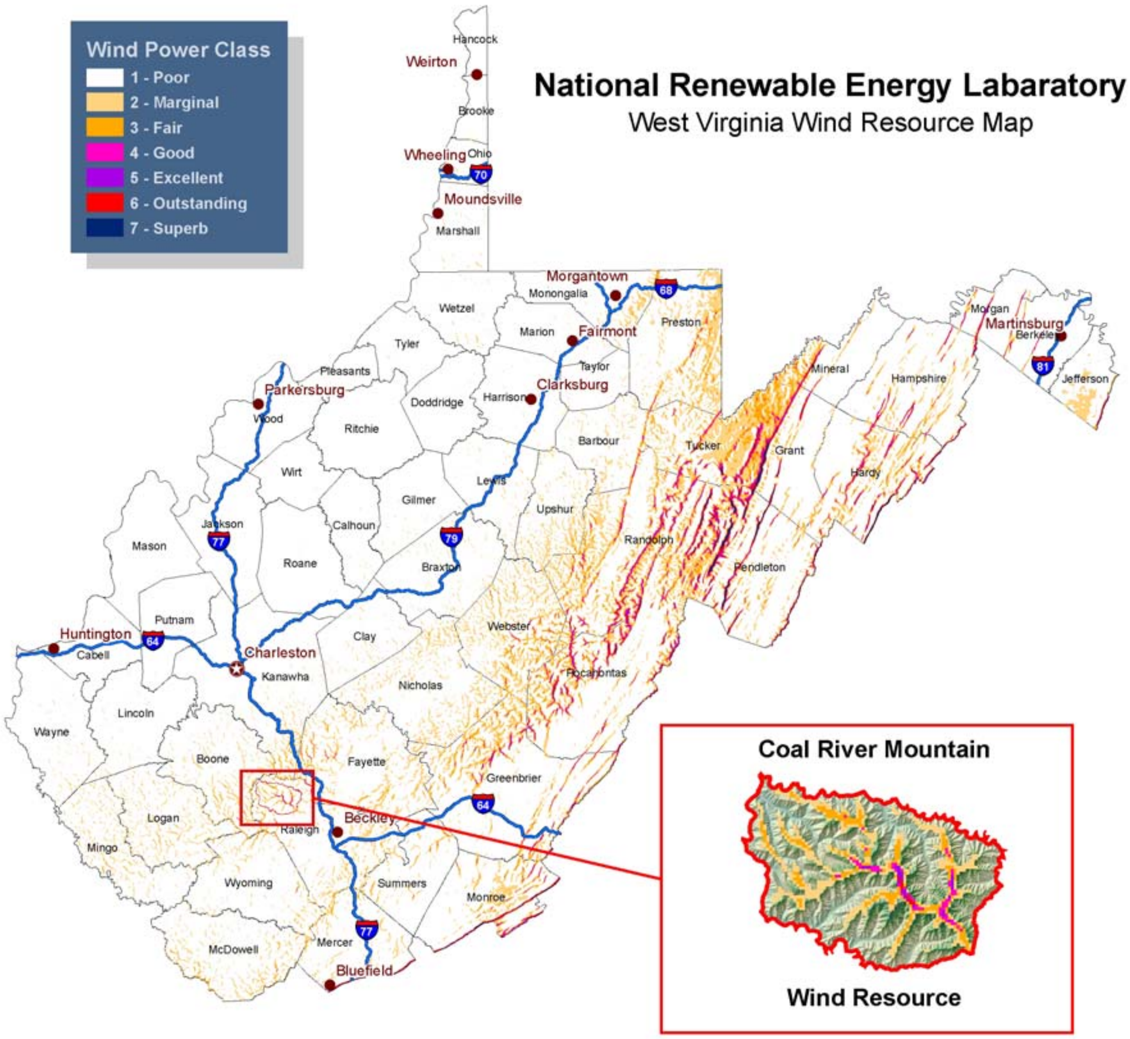
Source: Elliott et al. (1986). Wind classes are at 50 meters above ground level.

A more detailed analysis of wind potential across West Virginia confirms that most of the best sites are located in eastern West Virginia (Figure 4). However, in the western portion of Raleigh County, northwest of Beckley, Coal River Mountain shows a significant presence of good, excellent, and outstanding wind power classes.

Two additional nearby mountains also show the potential for development of wind resources: Kayford Mountain to the north-northeast of Coal River Mountain and Cherry Pond Mountain to the southwest. Both of these mountains, however, have already been extensively impacted by mountaintop removal operations, and their wind potential has been diminished.

According to a study conducted for the West Virginia Development Office, private land in the state of West Virginia can potentially support 3,830 megawatts (MW) of wind power in areas with Class 4 through 7 winds (TrueWind Solutions, 2007). The recent energy plan from the West Virginia Division of Energy considers wind to be the most significant renewable energy opportunity in the state at the current time (West Virginia Division of Energy, 2007).

Figure 4: Wind potential across West Virginia

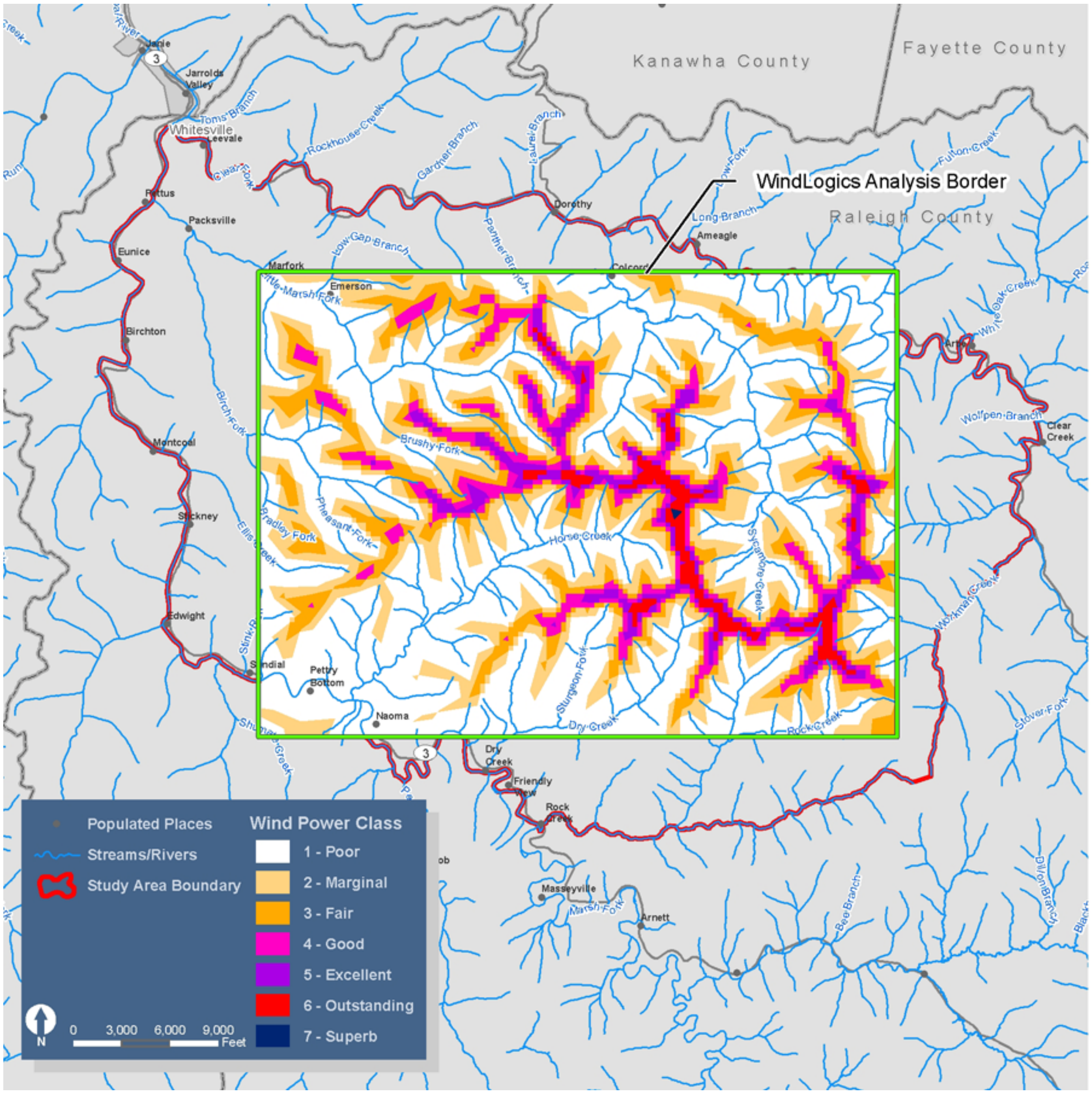


Source: US Department of Energy and NREL (2003). Wind classes are at 50 meters above ground level.

WindLogics (2006) studied the Coal River Mountain area in more detail, and found wind speeds as high as Class 4 through 7 (Figure 5). Notably, these good, excellent, outstanding, and superb wind classes are located atop the mountain peaks—the very areas that will be impacted the most by mountaintop removal coal mining.

Several wind farms have been built or are in various stages of construction or approval in West Virginia. The Mountaineer Wind Energy Center in Tucker County was the state's first wind farm; 44 1.5-MW turbines are installed at this site (American Wind Energy Association, 2008). Dominion and Shell WindEnergy recently finished installing 82 2-MW turbines in Grant County, and a second phase of 50 turbines is under construction (American Wind Energy Association, 2008). Other wind farms are in process, and new ones are under consideration. For example, Gamesa is currently evaluating four potential sites for wind farms in Grant and Tucker, McDowell, Nicholas, and Randolph Counties. These four sites are projected to total 280 MW of capacity (Framel, 2008).

Figure 5: Wind potential on Coal River Mountain



Source: WindLogics (2006). Wind classes are at 80 meters above ground level.

Although wind power is becoming more common, it is not without environmental impacts (National Research Council, 2007). As discussed in Chapter 4, potential impacts on Coal River Mountain include harm to birds and bats and impacts from construction.

3. FUTURE SCENARIOS FOR COAL RIVER MOUNTAIN

As discussed in the previous chapter, WindLogics (2006) has modeled wind speeds of Class 4 through 7 on top of Coal River Mountain. While this analysis suggests that wind speeds exist that are sufficient to generate electricity, a wind farm will not be built unless the landowners agree. One impediment is the existing lease agreements between landholding companies and mining companies.

Over the decades, the major surface and mineral owners of Coal River Mountain have leased the coal development rights to mining companies. These leases stay in existence until "all minable coal" is extracted, and landholders are currently profiting as active underground mines pay royalties. The three proposed mountaintop removal mines on Coal River Mountain—described in more detail below—will produce even more royalties as they mine thin coal seams not accessible to the underground mines.

Therefore, the current landownership pattern and the existing coal leases effectively prevent the development of a wind farm on Coal River Mountain. These landowners are not in a legal position to allow surface developments, like wind turbines, which may impede the surface mining of coal. Thus, a shift in the legal landscape, a government intervention, or a shift in economic development priorities is needed to make the development of the wind resources possible.

While it is not clear at this time how the legal, economic, and political forces can be marshaled to incentivize the development of the wind resources, a wind farm deserves a serious assessment by local and state government officials. As is shown in this report, the economic benefits to Raleigh County citizens from wind farm development are substantial and in the long-term exceed the benefits derived from surface mining of coal. Given the strong financial incentives by coal leaseholders and landholding companies to surface mine on Coal River Mountain, private and societal best interests diverge and must be reconciled by government action.

To quantify the economic and financial benefits and costs, we create scenarios. Our scenarios describe the amount of coal that would be mined and the number of turbines that would be installed. As such, these scenarios capture the major characteristics of the coal mines and wind farm to allow fair economic and financial comparisons.

These scenarios are not precise forecasts of what will actually happen. For example, the amount of coal actually mined over the next two decades and the number of turbines actually built would be based on multiple decision criteria that are beyond the scope of this analysis.

Coal River Mountain can support wind turbines, underground mines, surface mines, or some combination of these operations. We consider three scenarios.

The first, which we call the mountaintop removal scenario, assumes that the coal targeted by the three mountaintop removal mines are mined as specified in the permit applications.[1] We consider only the coal targeted by these surface mining operations, and do not include adjacent underground mining in this scenario.

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[1] An application for the third permit, Eagle III, has not been submitted yet. The acreage for this mine is very similar to the adjacent Eagle II mine, and therefore for the purpose of this analysis it is assumed that the tonnage will be the same as for Eagle II.

The second scenario, which we call the conservative wind scenario, includes wind turbines and underground mining, but no mountaintop removal operations. This scenario assumes that underground mining on Coal River Mountain can be accomplished in such a way as to be compatible with the development of wind turbines by either leaving necessary supports in the mines or by avoiding mining in areas under turbine locations. Underground mining would be far beneath the eight-foot deep tower foundations that are generally used by the wind farm developer Gamesa (Lutz, 2008). Like in the mountaintop removal scenario, we do not include underground mining that occurs beyond the mountaintop removal permit areas.

The third scenario, which we call the local industry wind scenario, is similar to the conservative wind scenario but assumes that a local wind industry is developed such that the wind turbines, towers, and blades are built locally. This scenario provides a more equal comparison between wind and coal because supporting businesses for the coal industry already exist in Raleigh County. These businesses provide a range of services from environmental science to engineering and equipment repair. The local industry wind scenario is also instructive because it helps clarify the vital importance of investing in green jobs in West Virginia to support a new renewable energy economy.

We do not consider scenarios that include both wind turbines and mountaintop removal mines because obliteration of the windy mountaintops would reduce wind capacity substantially, rendering it uneconomical for development. One indication that mountaintop removal coal mining would effectively eliminate the economic viability of a wind farm is demonstrated in Figure 6. The blue line shows the elevation of the existing land surface for the turbines proposed above the mountaintop removal permit areas. The red line shows the elevation of the top of the Little Eagle coal seam for each of these turbines. This is the lowest seam targeted by the mountaintop removal mines. While the final post-mining contour of the mountaintop removal permit area is not known at this time, elevations will be reduced by hundreds of feet should the final contour be close to the Little Eagle seam.

The horizontal dashed lines in Figure 6 show the average elevations for Class 1 through 7 winds. For example, the Class 7 locations on Coal River Mountain average 3,077 feet and the Class 6 locations average 2,964 feet. Should mountaintop mining lower the final contours on Coal River Mountain to the top of the Little Eagle seam, hundreds of feet of elevation will be lost. Lower wind classes would then be expected, making wind farm development less economical.[2]

A second reason we do not consider building turbines after mountaintop removal is because of the challenges to building turbines on strip mines noted by Gamesa (2008a). These challenges include unstable soil that would require digging to 30 or 40 feet, rather than the standard 8-foot depth for tower foundations. In addition, there is a concern about the potential to inherit environmental liabilities.

Additionally, a combination of surface mining and wind farm development is outside this project's scope because the project sponsors are interested in a scenario that will protect the surface of Coal River Mountain and preserve its forests, recreational opportunities, and resources (such as ginseng and firewood, which are currently harvested by local residents) while utilizing the mountain's energy resources: underground coal and wind.

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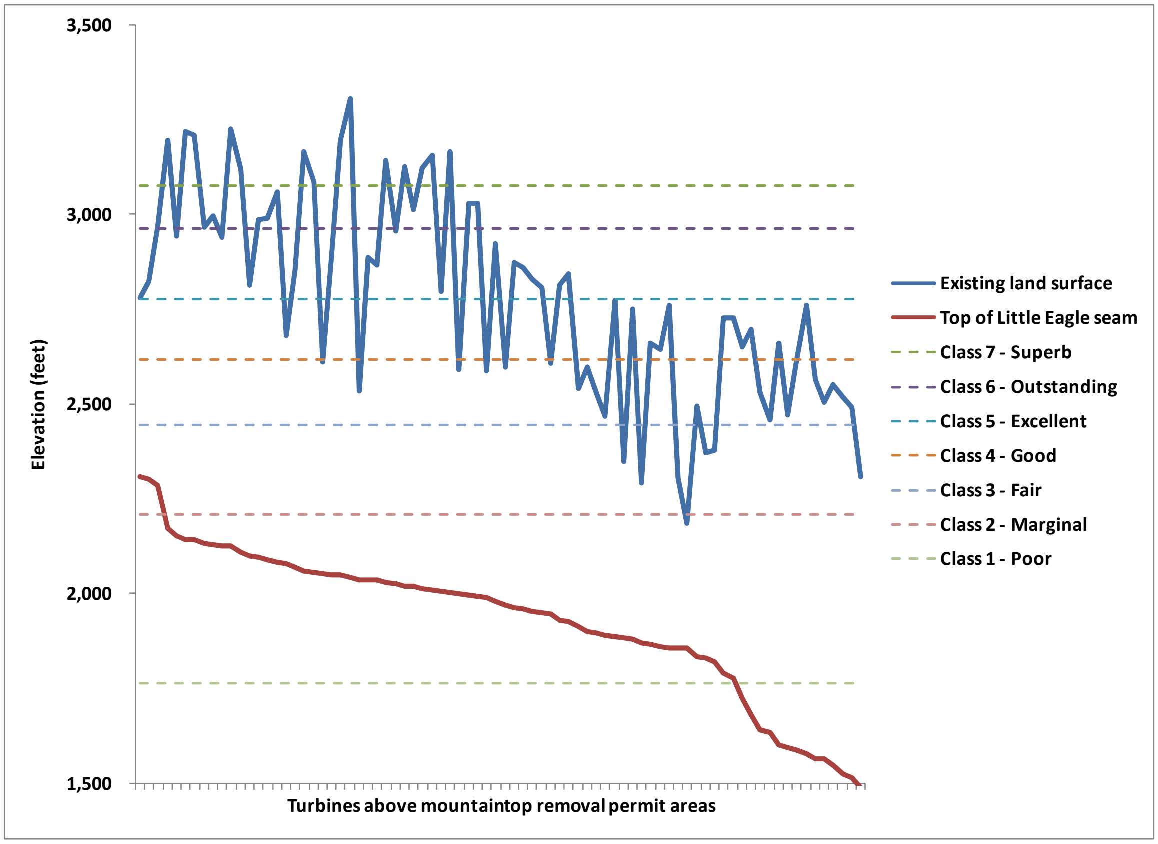
[2] While this figure shows a general pattern, more detailed wind modeling would be needed to confirm the precise expected decrease in wind class for each turbine location, given the post-mining contour of the permit area.

Figure 6: Potential loss of elevation in relation to wind classes on Coal River Mountain



Note: Elevations for wind classes in this chart are the mean elevations for each wind class within the area studied by WindLogics (2006). The projected wind class for a particular turbine location would need to be taken from the WindLogics report, and not from this chart.

3.1 Mountaintop removal scenario

The mountaintop removal scenario describes the coal production from the three Marfork Coal Company[3] mines proposed for Coal River Mountain: Bee Tree, Eagle II, and Eagle III (Table 3 and Figure 7). While the West Virginia Department of Environmental Protection (WVDEP) issued the Bee Tree permit in 2006 and the Eagle II permit in 2008, mining has not started.[4] The application for the third mountaintop removal mine, Eagle III, has not yet been submitted; however, its boundaries are shown in the previous applications.

[3] Marfork Coal Company is a subsidiary of Massey Energy Company.
[4] While Marfork recently revised its Bee Tree permit application with the goal of starting to mine soon, we consider the entire original Bee Tree permit application as representing the intentions of Marfork Coal Company.

Table 3: Surface coal mining in the mountaintop removal scenario

Mine	Permit	Issue date	Total production (tons)	Annual production (tons)	Years of production	Assumed start year
Bee Tree	S-3010-04	7/11/2006	10,917,636	1,559,662	7	2009
Eagle II	S-3028-05	6/6/2008	18,088,151	1,391,396	13	2011
Eagle III	NA	Not submitted	18,088,151	1,391,396	13	2013
Total			47,093,938			

Source: Issue dates from WVDEP (2008). Total and annual production for Bee Tree and Eagle II mines from permit applications. Total and annual production for Eagle III is estimated to be the same as for Eagle II. Assumed start years for Bee Tree and Eagle II are staggered by two years as per the permit applications. Start year for Eagle III is estimated to also be staggered by two years from Eagle II.

In the mountaintop removal scenario, more than 47 million tons of coal are projected to be mined via these three operations from 2009 through 2025. As shown above in Table 1 and Table 2, valley fills for these operations would cover 901 acres and fill in 47,374 feet, or 9 miles, of streams.

While underground mines are now active on Coal River Mountain and will continue into the future, the coal produced by these underground mines is not included in the mountaintop removal scenario. The same underground mines would continue producing coal in the wind scenarios as well; therefore, these mines provide the same economic and financial benefits and costs in all three scenarios.

3.2 Wind scenarios

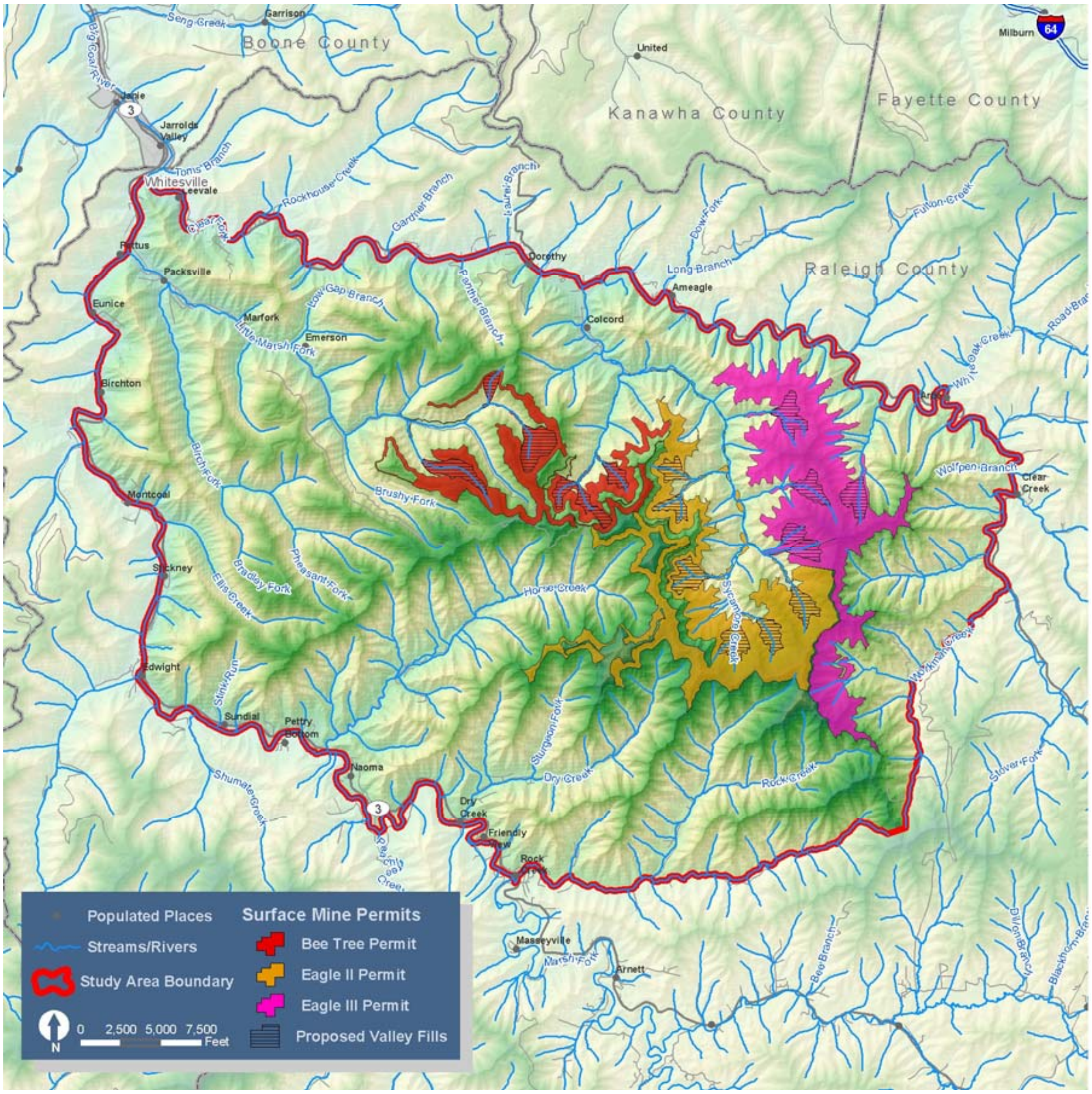
Two wind scenarios were analyzed that place turbines along the ridgelines that make up the Coal River Mountain area (Table 4). The two wind scenarios make the same assumptions about the number of turbines and the extent of underground mining; they differ in whether a manufacturing facility will produce the towers, turbines, and blades locally.

While we have created a reasonable first approximation of the wind farm parameters atop Coal River Mountain, wind development companies would require additional analyses before deciding on final turbine placements and before investing in the project.

Table 4: Characteristics of the wind scenarios

Wind scenario	Number of turbines	Local wind industry builds turbines?	Underground coal mining continues?
Conservative	164	No	Yes
Local industry	164	Yes	Yes

Figure 7: Mountaintop removal mine permit boundaries



3.2.1 Wind turbines

Both wind scenarios include 164 turbines, as shown in Figure 8.[5] This figure also shows the permitted area for the three mountaintop removal coal mines in gray. Almost one-half of the 164 turbines are located on areas slated for mining by the Bee Tree, Eagle II, or Eagle III operations. The other turbines were placed beyond this area because the sites met the criteria presented below and they are near the turbines sited on the land slated for mountaintop removal. These turbines would likely be developed with the others as part of a unified project. Because the WindLogics (2006) study

[5] A more optimistic scenario of 220 2-MW turbines was developed by Coal River Mountain Watch by placing turbines on all ridges exhibiting Class 4 or higher wind speeds with turbines spaced a minimum of three rotor diameters apart. The chosen turbines had a rotor diameter of 80 meters; therefore, they were placed 240 meters apart. This scenario included a total installed capacity of 440 MW. It is not considered further in this report.

provided data for a rectangular area that does not exactly coincide with the mountain peaks on Coal River Mountain (See Figure 5), an additional few turbines that likely meet the siting criteria on the east side of the mountain were not included in this scenario.

Turbine placement is based on identification of areas on the mountain with gross energy production of at least 4.5 million kilowatt-hours (kWh) and a gross capacity factor of at least 30% (i.e., produces at least 30% of potential electricity given a turbine's rated capacity), using data from WindLogics (2006). These criteria were derived from Tiffany (2007), who computed economic feasibility of wind turbine construction in Minnesota.

We considered three different 2-MW turbines offered by Gamesa, and chose the turbine most suitable for low-wind sites: the G90 (Figure 9). While this turbine has a rotor diameter of 90 meters and therefore must be spaced farther apart than smaller turbines, it generates more electricity at slower wind speeds compared with Gamesa's smaller turbines. According to WindLogics' model, average annual wind speeds of about 7-9 meters per second would be found at the proposed turbine locations (WindLogics, 2006). According to the power curves in Figure 9, the G90 produces more power than the other two turbines at wind speeds below about 15 meters per second.

Spacing between turbines was assumed to be 3.5 times the rotor diameter. This spacing is consistent with—and even slightly more conservative than—the spacing at Florida Power and Light's Mountaineer Wind Energy Center in Tucker County, West Virginia. Turbines in this wind farm are located primarily along the ridgetop of Backbone Mountain and are spaced, on average, about 3.1 rotor diameters apart.

For comparison, the National Renewable Energy Laboratory (NREL) suggests that turbines be spaced five-to-ten rotor diameters apart (NREL, 2008). However, proper spacing depends on whether turbines are placed in rows or along ridge tops. When turbines are placed in rows, upwind turbines can produce interference on downwind turbines and cause energy losses. But when most energy-producing winds come from a single direction, turbines can be placed as close as three or four turbine diameters apart (Global Energy Concepts and AWS Truewind, 2005).

In summary, the wind scenarios include 164 turbines, each rated at 2 MW, for a total installed capacity of 328 MW. At an assumed capacity factor of 30%, the wind farm would produce 861,984 megawatt-hour (MWh) of electricity each year. It is assumed that construction of the wind farms would occur in 2012 and 2013, allowing a period of time for further evaluation of the resource, engineering design, and permitting.

It is worth noting that the typical ridgeline wind development project in the Mid-Atlantic region is between 50 and 80 MW (Framel, 2008). Thus, a 328 MW wind farm would seem to be large compared with existing facilities. However, Dominion and Shell WindEnergy recently completed a 164 MW project in Grant County, West Virginia and are installing an additional 100 MW of capacity at this site (American Wind Energy Association, 2008). This project alone is therefore approaching the size of the wind farm proposed for Coal River Mountain. With so few landowners on Coal River Mountain, a larger wind facility may be possible.

Figure 8: Turbine locations

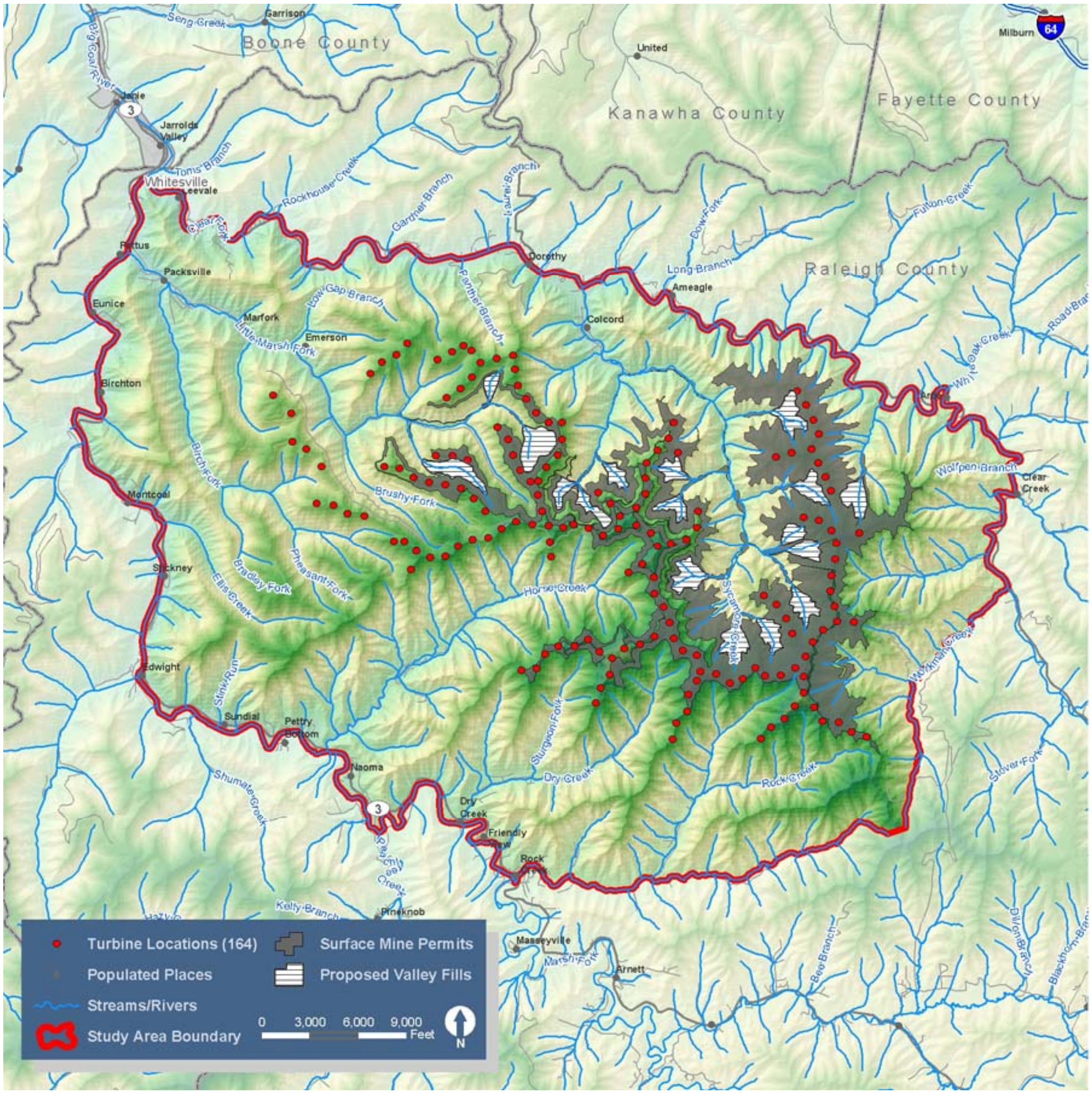
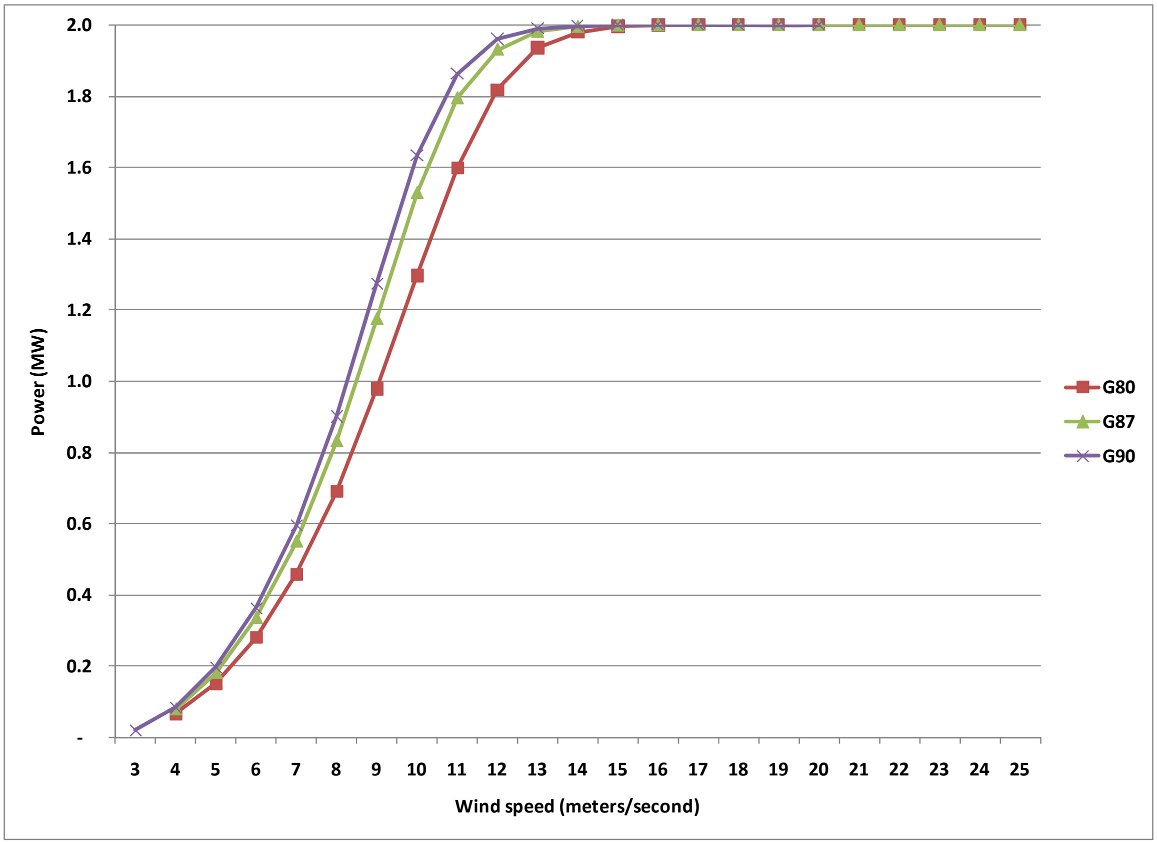


Figure 9: Power curves for Gamesa wind turbines



Source: Gamesa (2008b, c, and d).

3.2.2 Local production of wind turbines

The local industry wind scenario is distinguished from the conservative wind scenario because it examines the increased jobs, earnings, and output should a local wind turbine manufacturer locate in Raleigh County. Currently, Gamesa manufactures turbines in Fairless Hills, Pennsylvania. This would be the most likely source of turbines for the Coal River Mountain wind farm. A local wind industry scenario was included to evaluate what wind resource development might do for the local economy if, similar to the coal industry, there was a supporting industrial base in the local area for the wind resource.

The local industry wind scenario is important because it helps quantify the dramatic impacts of promoting the development of green jobs in southern West Virginia. As shown below, should a local turbine manufacturer be available, the number of jobs and the associated earnings and economic output would be much more significant for the Coal River Mountain wind farm. The economic output for other West Virginia wind farms that purchased equipment locally would also be significantly higher.

3.2.3 Underground coal mining

Both wind scenarios assume that underground mining will continue in the area now slated for mountaintop removal. The coal that is underground-mined in the wind scenarios would be surface-mined in the mountaintop removal scenario.

To determine which seams would be underground-mined in the wind scenarios, we reviewed permits for several existing underground mines on Coal River Mountain. These mines access the Eagle, Powellton, Lower No. 2 Gas, Middle Cedar Grove, Upper Chilton A, and Upper Winifrede seams. In the wind scenarios, mountaintop removal does not occur; therefore, it is assumed that these seams are mined within the proposed mountaintop removal permit area using underground room-and-pillar methods.

Using information in the permit applications, the total production at the mountaintop removal mines was divided among the coal seams based on seam thickness, mining method, and area. For the six seams mentioned above, it was estimated that one-half of the coal that would have been mined using contour and area methods could be recovered by underground mines. It was also estimated that the same amount of coal that would have been recovered using auger mining could also be recovered through underground mines.

These calculations produce a total underground mining potential for the proposed mountaintop removal permit area of about 8.7 million tons (Table 5). This represents only 18% of the 47 million tons that would be expected to be surface-mined should the mountaintop removal permits be implemented. This estimate is so much lower because the mountaintop removal mines access additional coal seams that would not be underground-mined, and because the contour and area mining methods recover a larger percentage of the coal, as compared with room and pillar underground mines.

Table 5: Underground coal mining in the wind scenarios

Mine	Total production (tons)	Annual production (tons)	Years of production	Assumed start year
Unspecified	8,650,264	576,684	15	2009

The timing of the underground production was based on existing underground permits on Coal River Mountain that state that 575,000 tons will be produced each year.[6] The total production was split into 15 years of production to result in an annual production rate that is very close to this 575,000 figure.

While underground mining will likely continue outside of the proposed permit area for the three mountaintop removal mines, the wind scenarios only estimate the amount of coal that would be underground-mined within the boundaries of these three mines. Any underground mining that occurs outside the boundaries of these three mines would affect the mountaintop removal and wind scenarios equally; therefore, this mining would not affect the relative difference between the scenarios. However, by omitting this underground mining from our scenarios, we underestimate the jobs, earnings, and output that would result from all three scenarios when considered on their own.

[6] For example, permits U-3001-04 and U-3021-00 both anticipate annual production of 575,000 tons per year.

4. LOCAL ECONOMIC BENEFITS AND COSTS

To compare the effects of the mountaintop removal, conservative wind, and local industry wind scenarios on Raleigh County, a range of local economic benefits and costs are considered. Some—such as jobs, earnings, and output—are relatively easy to quantify and are included in the analysis. Others—such as global environmental costs, forestry, and tourism—may be equally important but are more difficult to quantify given the scope of this project.

Table 6 summarizes the types of benefits and costs that are discussed in this report. All of the unquantified local economic benefits and costs would tend to favor the development of a wind farm, were these benefits and costs quantified. As such, the results in this report would tend to underestimate the local economic benefits of developing a wind farm.

Table 6: Types of local economic benefits and costs

Type	Quantified for mountaintop removal scenario?	Quantified for wind scenarios?
Jobs, earnings, and output	Yes	Yes
Deaths and illnesses	Yes	Yes (underground mining only)
Local environmental costs	Yes	No
Global environmental costs	No	No
Forestry	No	No
Tourism	No	No
Property values	No	No
Gathering, hunting, and heritage	No	No

4.1 Jobs, earnings, and output

The main economic benefits quantified in this report include the jobs, earnings, and economic output that result from the three scenarios.

The local economic impact analyses were conducted using two input-output models: (1) IMPLAN (Minnesota IMPLAN Group Inc., 2008) for the coal mining, and (2) the Jobs and Economic Development Impact (JEDI) model (Goldberg and Tegen, 2008) for wind turbine development. Input-output models trace supply linkages throughout economies to show how expanded economic activity in one sector (like increased coal sales from an expansion of coal mining) impacts all other sectors of the economy. See Shaffer, Deller, and Marcouiller (2004) for a more detailed explanation of input-output analysis.

All analyses were conducted at the county level with 2007 data (coal and electricity prices, costs, economic structure, and population) for Raleigh County, West Virginia. Economic impact computations were made on an annual basis for the increased economic output generated from resource development. This increased output is quantified by the following three terms: the number of jobs created (full-time equivalents) by the increased economic output, employee compensation from the additional jobs created (earnings), and the dollar value of goods and services produced in the county (output).

The increased jobs, earnings, and output from resource development were computed by summing impacts from three sources: direct, indirect, and induced. Direct refers to increased jobs, earnings, and output resulting from the resource development activity itself, i.e., the construction of a wind turbine or the mining of coal. Indirect refers to the jobs, earnings, and output that are created when goods and services are purchased locally to support resource development. For example, concrete is purchased locally for wind turbine construction, which provides increased jobs, earnings, and output in that sector of the economy. Finally, induced jobs, earnings, and output stem from the additional purchases made within the community with the earnings created from the direct and indirect impacts. For example, coal miners buy food at the local grocery store and fill their vehicles at the local gas station.

No discount factors were applied to the projections of jobs, earnings, or output. These analyses were not conducted as a project analysis where an alternative investment opportunity has been identified. Instead, these local economic analyses are presented to show what flows of economic activity are projected to occur over time and to compare these flows between coal-only development versus wind and coal development.

4.1.1 Mountaintop removal scenario

Surface mining is included under the mountaintop removal scenario and underground mining is included in both wind scenarios. Annual production projections are shown above in Table 3 and Table 5. Coal resource assumptions are provided in Table 7. The increased jobs, earnings, and output generated by surface coal mining were projected to take place over a 17 year period. Underground mining was assumed to span 15 years.

Annual projections of these local economic impacts were made using IMPLAN and were based on expanded employment in the coal mining sector created by additional coal mining on Coal River Mountain. Since the current coal mining sector in Raleigh County consists of a mixture of underground (57%) and surface (43%) mining, the IMPLAN model was adjusted to account for different employment and output productivity per worker that would occur with increased underground mining versus surface mining.

Employment was estimated based on full-time jobs per million tons of coal mined annually. Production and employment data for 2007 for existing underground mines on Coal River Mountain were used to estimate an average of 135 employees per million tons mined (MSHA, 2008). The estimate of 57 employees per million tons mined for surface mining employment came from the Eagle II community impact statement on projected employment and mine production. Both of these estimates are substantially below U.S. Department of Energy estimates for southern West Virginia of 195 and 95 employees per million tons for underground and surface mining, respectively (Energy Information Administration, 2007).

Separate IMPLAN analyses were used to project the economic impacts of increased coal mining from underground mining versus surface mining. Once this coal is extracted, the local economic benefits from coal mining on Coal River Mountain were assumed to end. No economic benefits were projected for the reclaimed land. This is consistent with the Bee Tree and Eagle II permit applications, which do not present plans for economic development on the mined land after mining has ended.

The state government's distribution of coal severance taxes to Raleigh County is not insignificant. In the 2005-2006 fiscal year, about 7% of total Raleigh County revenue was derived from the coal severance tax fund (West Virginia State Auditor's Office, 2007). During the 2007-08 fiscal year, Raleigh County government received $1.655 million. Including local governments of Beckley, Mabscott, Lester, Rhodell, and Sophia, a total of over $1.7 million in coal severance taxes was distributed to governments in Raleigh County.

However, increased coal production from expanded coal mining on Coal River Mountain would, by itself, return very little to Raleigh County governments. This low return rate reflects the fact that the state government keeps 93% of severance tax revenue and shares the remaining revenue among local governments throughout the entire state in both coal and non-coal producing areas.

On average, only about $0.50 for every additional hundred dollars of severance tax collected from expanded coal mining would return to Raleigh County. For the coal mined in the mountaintop removal scenario, the severance tax returned to Raleigh County would total $618,000, or, on average, $36,000 per year over 17 years. Thus, additional severance tax revenues are small and were ignored in the coal resource development analyses.

Increased coal production from expanded coal mining on Coal River Mountain would also return very little to Raleigh County in property taxes. Property taxes are already paid on the reserve coal, and the property taxes paid on active coal will not be particularly significant. The mountaintop removal EIS uses a case study of an actual West Virginia mine to quantify ten types of taxes for a typical large mountaintop removal mine. Of the total taxes of $3.54 per ton, only $0.19 per ton is attributable to property taxes (USEPA, 2003).

Table 7: Assumptions and calculations utilized in coal resource development analyses

Category	Numbers	Description	Sources
Coal extraction rates	See Table 3 and Table 5	Annual extraction rates were developed by the research team using coal mining permits	Coal mining permits
Coal types	20% Metallurgical 80% Steam	Rounded percentage for Massey coal mines in 2006 and 2007	Massey Energy Company (2008)
Coal prices	Metallurgical: $68.15 per ton Steam: $46.98 per ton	Three year averages (2005-2007)	West Virginia Department of Revenue (2008)
Employment	Underground: 135 Surface: 57	Annual full-time equivalent employees per million tons	Underground: Data for 2007 for underground mines on Coal River Mountain (MSHA, 2008) Surface: Eagle II community impact statement

The Bee Tree, Eagle II, and Eagle III mines would create hundreds of direct, indirect, and induced jobs annually, which in turn would pump hundreds of millions of dollars into Raleigh County. As shown in Table 8, these economic benefits would last for the 17 years for which the mines are in operation and would end in 2025.

Table 8: Annual jobs, earnings, and output from the mountaintop removal scenario

Year	Jobs				Earnings (Million $)	Output (Million $)
	Direct	Indirect	Induced	Total		
2008	0	0	0	0	0	0
2009	89	138	84	311	16	113
2010	89	138	84	311	16	113
2011	168	260	159	587	30	214
2012	168	260	159	587	30	214
2013	248	383	235	866	44	315
2014	248	383	235	866	44	315
2015	248	383	235	866	44	315
2016	159	245	151	555	28	202
2017	159	245	151	555	28	202
2018	159	245	151	555	28	202
2019	159	245	151	555	28	202
2020	159	245	151	555	28	202
2021	159	245	151	555	28	202
2022	159	245	151	555	28	202
2023	159	245	151	555	28	202
2024	79	122	75	276	14	100
2025	79	122	75	276	14	100

4.1.2 Wind scenarios

Several unknown factors resulted in making two important assumptions in regard to the development of a wind farm. The first assumption is that there is adequate capacity on local transmission lines to accept the electricity generated by 328 MW of installed capacity from 164 turbines. Connection to transmission lines from wind power is complicated by its temporal variability of electricity generation (Logan and Kaplan, 2008; Hau, 2006). A 765-kilovolt (kV) transmission line runs parallel to I-64 and comes approximately 10 miles from the center of Coal River Mountain. Wind development scenarios included the cost of building a 115-kV transmission line to connect with this 765-kV line.

The second assumption is that underground coal mining can be conducted without impeding wind turbine placement. Room and pillar mining was assumed for underground mining to minimize surface subsidence. Construction of additional support may be required for turbines located above underground mining activity (USEPA, Undated). Alternatively, coal mining might be conducted in such a manner as to provide sufficient support for the turbines.

The key assumptions related to the wind scenarios are shown in Table 9. One important assumption is the cost to develop the wind farm. An estimate of $1.6 million per MW of capacity developed was used to estimate the cost of tower, turbine, blades, interconnection, professional services, and site plus road construction costs. Financing costs were not included due to their non-local nature. Four estimates of development costs were derived from the literature (Tiffany, 2007; Kildegaard et al., 2006; Hau, 2006; Wiser and Bollinger, 2008). These estimates gave an average of about $1.5 million per MW in 2007 for 2 MW turbines. The selected value of $1.6 million is a close approximation of these estimates and is approximately the reported average cost for eastern wind developments between 2004 and 2007 (Wiser and Bollinger, 2008).

Table 9: Assumptions and calculations used in wind resource development analyses

Category	Numbers	Description	Sources
Turbine type and size	2 MW	Gamesa G90	Gamesa (2008b)
Number of turbines sited	164	Sites with at least 4.5 million kWh and 30% capacity factor	WindLogics (2006) Tiffany (2007)
Development cycles	5 cycles each with a 20 year operating life	Projections were made over approximately 100 years for developments of wind turbines using the industry standard of a 20-year operating life	
Development cost	$3.2 million per turbine	Four examples gave an average of about $1.5 million per MW in 2007 for 2 MW turbines. $1.6 million is a close approximation and is approximately the reported average for eastern projects between 2004 and 2007.	Tiffany (2007) Kildegaard et al. (2006) Hau (2006) Wiser and Bollinger (2008)
Transmission line	$8 million for 10 miles of 115 kV line	Average of cost for transmission line construction in Vermillion, South Dakota and Texas	City of Vermillion (2008) Texas Comptroller of Public Accounts (2008)
Annual operations and maintenance costs	$44,000 per turbine	Service, maintenance, insurance, and utilities	Tiffany (2007)
Wind electricity price	$61/MWh	Capacity-weighted average for eastern U.S. wind projects brought on-line during 2006 and 2007	Wiser and Bollinger (2008)
Landowner revenue	$10,997 per turbine	Assumes 3.5% of gross revenue from electricity generation with 30% capacity and 98% operation time	Tegen (2006)
Property tax revenue to Raleigh County	$10,627 per turbine	Annual average over 20 years based on Senate Bill 441 taxation rules	Amburgey (2008)
Local shares	See Appendix A	JEDI default values for a small county of 100,000 population except (1) landowner revenue set to 25% and (2) construction, electrical, foundation, and interconnection costs set to 50% because these local industries are available in Raleigh County	Goldberg and Tegen (2008)

Tax revenue from wind turbines was computed using the provisions of Senate Bill 441 passed in 2007. Over twenty years, property taxes collected by Raleigh County per wind turbine were calculated to be $212,554, for an average of $10,627 annually. All 164 turbines would then generate, on average, $1.74 million in property taxes per year.

Landowner revenue was estimated to be $10,997 per turbine. This estimate was based on a 3.5% gross revenue share from electricity generated by the wind turbines. The electricity price of $61/MWh represents a capacity-weighted average of wind power prices based on east coast projects brought on-line during 2006 and 2007. This revenue estimate is higher than an average of $5,840 from high range estimates presented in the literature (Costanti and Beltrone, 2006; Tegen, 2006; Ritsema et al., 2003; Grover et al., 2002). This higher estimate was used because only 25% of landowner revenue was assumed to stay in the local economy due to a high prevalence of out-of-area property owners for Coal River Mountain.

Compared with the mountaintop removal scenario, where the benefits last for only 17 years, the benefits in the wind scenarios continue essentially indefinitely. The projected economic impacts from construction of wind turbines are shown in Table 10. These results were computed using JEDI for the wind turbines and IMPLAN for the transmission line construction.

During each construction period, increased economic output of $59 million would occur for the 164 turbines. Annually during the operating period, increased economic output was $8 million. Including indirect and induced impacts, 3 jobs per turbine are created during the construction period and 0.4 jobs per turbine are created on an annual operating basis. These results are comparable to the local jobs created in other areas. In North Dakota, wind farm development created 6.5 and 0.5 jobs per turbine of during construction and operation (Leistritz and Coon, 2008). In Washington State, Grover et al. (2002) estimated 0.7 and 0.2 jobs per turbine during construction and operation phases of wind turbine development.

The economic impacts results from Table 10 demonstrate the value of a local wind industry to economic development. With a local manufacturing facility, local economic output during construction periods is almost 12 times larger than if the towers, turbines, and blades were imported from outside of Raleigh County. More than seven times more jobs and earnings would be created with a local wind manufacturer.

In addition to wind farms, the wind scenarios include underground mining. For purposes of this analysis, the underground mining is averaged over 15 years starting in 2009. From 2009 through 2023, this mining will produce 177 jobs per year, of which 78 are direct jobs at the mines, 44 are indirect, and 55 are induced. Annual earnings will equal $10 million, and annual output will equal $42 million during these years.

Similar to the mountaintop removal scenario, the increased local taxes due to underground mining would be small. Severance taxes returned to Raleigh County would total $113,000, or, on average, $8,000 per year over 15 years. Increased property taxes on active coal would also be small.

Table 10: Annual jobs, earnings, and output from wind farms in the wind scenarios

	Jobs	Earnings (Million $)	Output (Million $)
Conservative scenario			
Each construction period			
Direct	277	$13	$39
Indirect	85	$3	$8
Induced	140	$4	$12
Total	502	$19	$59
Per turbine	3	$0.12	$0.36
Annual operating years			
Direct	39	$2	$5
Indirect	9	<$1	$1
Induced	24	$1	$2
Total	72	$3	$8
Per turbine	0.4	$0.02	$0.05
Local industry scenario			
Each construction period			
Direct	1,750	$81	$483
Indirect	1,026	$36	$116
Induced	1,055	$28	$92
Total	3,831	$146	$691
Per turbine	23	$0.89	$4.21
Annual operating years			
Direct	43	$2	$6
Indirect	10	<$1	$1
Induced	27	$1	$2
Total	80	$3	$9
Per turbine	0.5	$0.02	$0.06

4.2 Deaths and illnesses

Coal mining produces pollution, which affects the health of the general population in the vicinity of mining activities by causing premature deaths and extra medical problems (Hendryx and Ahern, 2008). The occupational risks of coal mining also include premature death and medical problems for coal miners (Attfield et al., 2008). In this section, we quantify these costs in dollar terms so that they can be accounted for when considering the local economic benefits of the mountaintop removal and wind scenarios.

An analysis was conducted based on value of statistical life (VSL) calculations supplemented with estimates of other non-fatal illness costs. VSL estimates have been established by many federal agencies to guide policymaking decisions regarding the costs and benefits of risk-reduction policies that impact premature mortality. The most recent official VSL employed by the United States Environmental Protection Agency (USEPA) is $6.9 million per life. This figure was reduced this year from the previous value of $7.8 million (OMB Watch, 2008). The $6.9 million figure will be used for this analysis. This is an estimate of the value of every life lost from premature mortality from environmental hazards.

In addition to VSL costs of premature mortality, there are additional costs related to excess medical care, including direct treatment costs and lost productivity. The basis for our estimate comes from an analysis conducted by the government of Ontario in a study of the health costs of coal-fired electricity generation (DSS Management Consultants, 2005). They estimated that costs associated with hospital admissions, emergency room visits, and minor illnesses equated to 0.53% of the VSL costs, or $36,570. These costs constitute only a small fraction of the total cost, which is dominated by VSL; nevertheless, we added this estimate to the VSL costs.

4.2.1 General population

To calculate excess deaths and illnesses, we start with the tons of coal that will be mined in the mountaintop removal and wind scenario. We statistically adjust for the effects of age, sex, race/ethnicity, education, poverty, health insurance, supply of primary care doctors, education, smoking, and rural-urban setting to estimate the impact of every additional ton of coal on increasing the probability of death among the population at large. These data are based on previous research on excess mortality in coal mining portions of Appalachia (Hendryx and Ahern, 2008).

Under this analysis, every 1,000 tons of coal predicts an extra 0.021 annual deaths per 100,000 population among the general public. For comparison, the average annual death rate in the United States is 826 per 100,000 people (National Center for Health Statistics, 2008). Thus, for every million tons of coal, mining increases the death rate by 21 out of 100,000 people. This is about a 2.5% increase.

A total of 15,109 people live within the census blocks in the immediate vicinity of the three mountaintop removal permits, shown as the dark and light orange areas in Figure 10. When we multiply the total tons of coal by these factors, the results indicate 149 additional deaths in the mountaintop removal scenario[7] and 27 in the wind scenarios.[8]

Pollution from mining is expected to impact population health both on an immediate and a lagged basis; that is, some health impacts are felt immediately upon exposure to additional air pollution from mining activities (Wellenius et al., 2006), whereas others may develop over the course of 20 years or more due to the long-term effects of reduced air and water quality (Ferreccio et al., 2001). Furthermore, the environmental impacts of these activities may not end when the expected 17-year life of the mountaintop removal mines or the 15-year life of the underground mines end, but may continue to impact environmental health for 40 years or more (Ferreccio et al., 2001). Therefore, for the purpose of deriving a long-term cost analysis, we estimate that one-half of these impacts occur during mining, and the other half occur after mining has ceased. In other words, deaths and illnesses from mountaintop removal mining are spread across 34 years, and deaths and illnesses from underground mining are spread across 30 years.

When the estimate of excess deaths is multiplied by the cost figure of $6,936,570 per life, the resulting annual cost is $30.5 million per year for the mountaintop removal scenario and $6.3 million per year for the wind scenarios. These costs may be subtracted from the earnings calculated for each scenario to estimate the net benefit of the scenario after accounting for increased risk of premature death and illness from environmental hazards of coal mining. This estimate of premature mortality is for the population at large who live near mining activities, not for coal miners specifically. A separate estimate of costs for coal miners is presented below.

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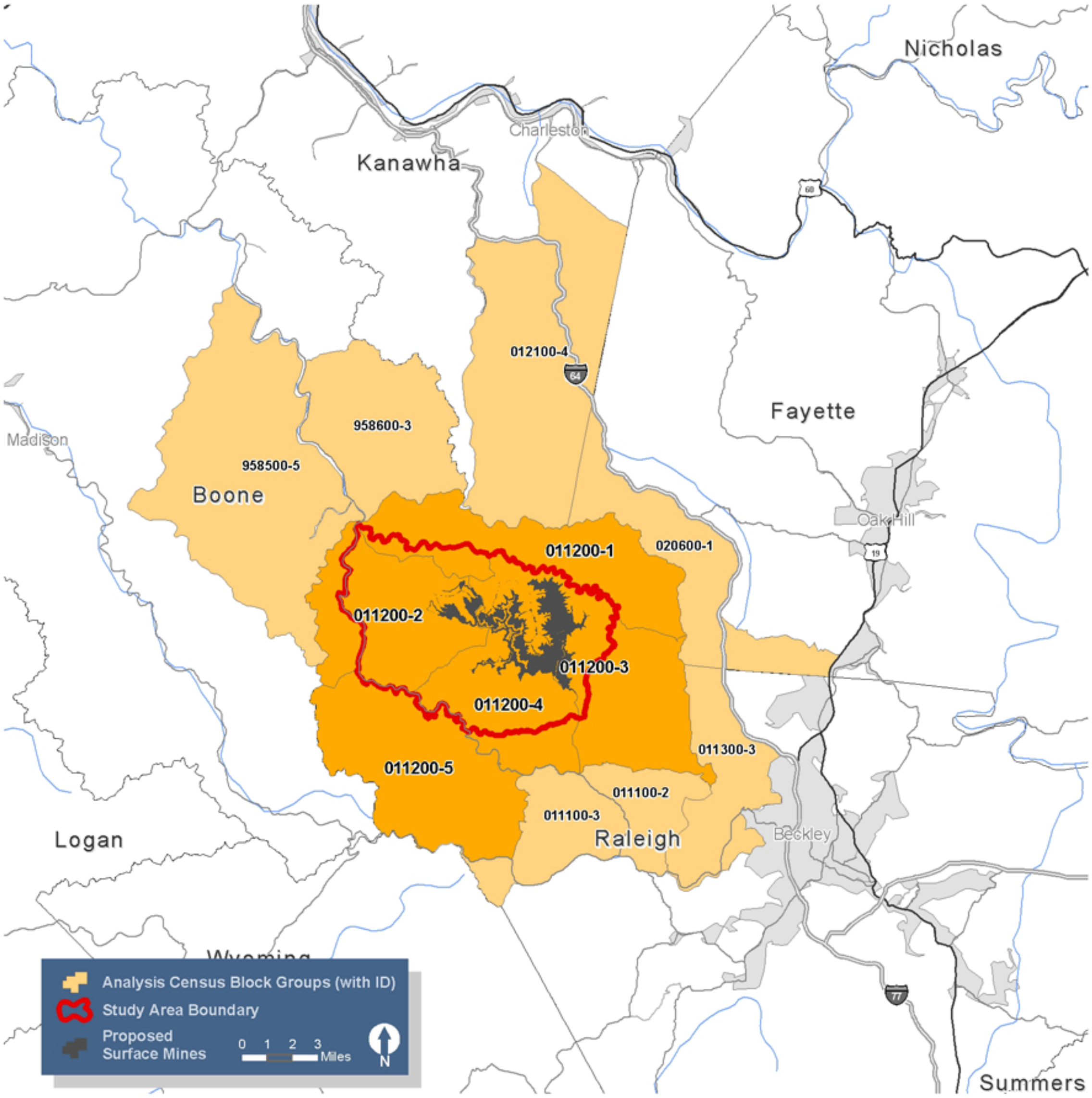
[7]0.021 deaths per year per 100,000 people per 1,000 tons coal * 15,109 people * 47,093,938 tons coal.
[8]0.021 deaths per year per 100,000 people per 1,000 tons coal * 15,109 people * 8,650,264 tons coal.

Figure 10: Area of analysis for general population risk



4.2.2 Coal miners

In addition to health risks for community residents, there are also risks to the coal miners themselves. Rice and Janocha (2008) report that there were on average 38.2 fatal accidents per 100,000 coal miners in 2005-2006 across the United States. The fatality risk for an underground miner is about three times as high as for a surface miner, or about 57.3 per 100,000 for an underground miner, and 19.1 per 100,000 for a surface miner.

There are 78 direct underground mining jobs estimated in the wind scenario each year, and an average of 158 direct surface mining jobs in the mountaintop removal scenario. The annual risk of death for an underground miner is thus 0.045 deaths per year, or one death every 22 years.[9] The

[9] For underground miners, deaths per year is calculated as 0.000573 deaths per worker per year * 78 workers.

annual risk for a surface miner is 0.030 deaths per year, or one death every 33 years.[10] The corresponding annual VSL cost of this risk is $308,389 per year in the wind scenario and $208,228 in the mountaintop removal scenario.

Rice and Janocha (2008) also report that underground bituminous coal miners experience 7.1 illnesses or injuries per 100 full-time workers, and that the rate for surface miners is 2.3 per 100 full-time workers. Using the 0.53% estimate of non-fatal to fatal costs introduced in Section 4.2, we can estimate the total fatal and non-fatal costs for coal miners at $310,023 per year for underground mining in the wind scenario and $209,332 per year for surface mining in the mountaintop removal scenario.

These costs may be subtracted from the earnings calculated for each scenario to estimate the net earnings of the scenario after accounting for increased occupational hazards of coal mining.

4.3 Local environmental costs

There can be little doubt that surface mining of coal on Coal River Mountain will have much larger external impacts to the surrounding environment (land, water, and air) than will construction of wind turbines and underground mining of coal. The impacts of mountaintop removal surface mining have been studied and documented in an EIS, as discussed in Section 2.1.

Externalities are the costs resulting from damages associated with the production of a good or service, and which are not accounted for in the market price of the good or service. For example, surface coal mining produces dust and air pollutants that impact the health of nearby residents. Environmental regulations of coal mining have reduced, but not eliminated, external damages.

Few studies of surface mining externalities have been conducted; the externalities study most applicable to surface mining on Coal River Mountain is Randall et al. (1978). This study provides a comprehensive assessment of the externality costs associated with coal mining, including impacts on drinking water, fish and wildlife, recreation, flooding, land and buildings, and aesthetic qualities. This study estimates the externality costs that exist even under full compliance with federal coal mining reclamation regulations. Their estimates for these external damages ranged from $0.21 to $5.48 per ton of coal depending upon whether damages were measured only within the immediate vicinity of the mine, or within the entire region where coal was used. Indexed from 1976 to 2007 with the consumer price index, these external cost estimates become $0.77 to $19.97 per ton. For this analysis, we use the lower number, $0.77 per ton, because this number estimates the externalities to the local region.

Over the course of the 17 years of surface mining in the mountaintop removal scenario, these externalities total $36 million. Table 11 illustrates how these externalities are split among the categories used by Randall et al.

[10] For surface miners, deaths per year is calculated as 0.000191 deaths per worker per year * 158 workers.

Table 11: Environmental externalities from mountaintop removal on Coal River Mountain

Category of costs	External cost (Million $)
Water treatment	1
Fish, wildlife, and recreational	3
Flooding	3
Land and buildings	19
Aesthetic	11
Total	36

Note: Total does not match due to rounding.

Most of the recent literature on externalities from coal has focused on air pollution from coal's use in electricity production. In this case, electricity from coal has been found to generate much higher external costs than wind. Sundqvist (2004) examined 132 studies of external costs from electricity generated by eight different fuel sources. The median external cost for electricity generated from coal was 8.3 cents per kWh (29 studies) compared with 0.32 cents per kWh from wind generated electricity (14 studies). In a statistical analysis examining various factors that potentially influence external costs of electricity, wind as a fuel source was found to lower external costs while the use of coal was found to increase external costs (Sundqvist, 2004).

As with any energy development, wind turbines also have external environmental impacts. For example, avian and bat mortality are of concern when turbines are located along east coast ridgelines. Of all wind energy sites examined, the highest bat mortalities have been found at wind energy sites located in the Mid-Atlantic region (National Research Council, 2007). Additionally, the clearing of trees associated with turbine and transmission line construction alters the ecosystem, at least on a local scale. However, when compared with all other electricity sources, wind energy has been rated as having the lowest potential risk to wildlife (Newman et al., 2008). Newman's analysis examined potential impacts on wildlife across the entire life cycle of power production from fuel extraction to generating plant construction, operation, and shutdown.

While electricity from wind clearly produces fewer environmental externalities than coal, recent literature has demonstrated that wind is not a particularly cost-effective emission abatement strategy. Cullen (2008) concludes that subsidizing wind power as a form of pollution abatement is more costly than other types of abatement. He computed that the value of emissions offset by wind power in Texas ranged from $3 to $31 per MWh. However, wind power receives a total of $30 per MWh in subsidies (federal production tax credit of $20 per MWh along with renewable energy credits in Texas worth $10 per MWh). Thus, subsidies are greater than the value of emissions offset except for the highest pollution prices. Benitez et al. (2008) also conclude that the costs of reducing carbon dioxide (CO_2) emissions using wind power with hydropower storage was higher than both current emission trading market prices and Canada's penalty for excess CO_2 emissions.

Other local environmental externalities include air emissions from surface mining operations. According to Chan (2008), coal cleaning generates particulate matter (PM), sulfur dioxide (SO_2), nitrogen oxides (NO_X), methane (CH_4), and CO_2; surface mine explosives detonation generates carbon monoxide (CO), SO_2, and NO_X; truck, shovel, and vehicle use to move and break overburden and coal releases total suspended particulates; surface mine vehicle diesel consumption generates CO, NO_X, PM, CO_2, CH_4, and nitrous oxide (N_2O); and underground mine equipment electricity consumption releases CO_2, CH_4, N_2O, NO_X, and SO_2. Some of these air pollutants add to local and regional environmental problems, while others are greenhouse gases. Costs are not assigned to these air emissions and these externalities are not accounted for in our analysis.

4.4 Global environmental costs

Coal mining generates greenhouse gas emissions, which cause global climate change. In particular, mining releases coalbed methane. Compared with CO_2, CH_4 is 21-times more potent as a greenhouse gas. Mining is the fourth largest source of methane in this country, contributing 11% of the total CH_4 emissions in 2006 (USEPA, 2008). Chan (2008) has estimated external costs for CH_4 at $9-46 per ton of surface-mined coal, depending on the coal seam.[11] While these external costs are very large, they are not included in this analysis.

In addition to coalbed methane, mining and combustion of coal also produce other greenhouse gases. In particular, the combustion of the coal mined in these scenarios would produce a large amount of carbon dioxide. When burned, the coal mined in the mountaintop removal scenario would produce 135 million tons of CO_2. For comparison, the coal mined in the wind scenario would only produce 25 million tons.[12]

4.5 Forestry

In its current state, the land slated for mountaintop removal on Coal River Mountain can be used for logging, generating periodic income for the landowners. Assuming that sustainable harvesting techniques are used, this income can continue forever with minimal environmental effects.

According to the Bee Tree and Eagle II permit applications, the existing land use is unmanaged forest land and wildlife habitat. With high levels of management, the Bee Tree application states that the land can produce 90-175 board feet per acre per year, and the Eagle II application states that the land can produce much more: 150-690 board feet per acre per year.

Both permits plan to encourage wildlife habitat first, and to let natural reforestation of indigenous hardwood species occur later at a natural pace, which would likely take a significant amount of time. The mountaintop removal EIS notes that regrowth of trees may be slowed on such sites (USEPA, 2005).

While not assigned costs and not integrated into the current analysis, the long-term economic benefits from forestry operations would be significantly larger should the areas slated for mountaintop removal operations remain as forest land.

4.6 Tourism

USEPA's mountaintop removal EIS notes a positive correlation between environmental quality and tourism growth (USEPA, 2003). Several communities around the world are already benefiting from wind farm-based tourism. Surveys around the world, including those conducted in Australia, Scotland, and Vermont, indicate that the vast majority of tourists would be more or equally likely to

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[11] One outlier, $217 per ton of surface-mined coal, is not included in this range.
[12] These estimates are based on a 78.25% average carbon content for Raleigh County coal from the US Geological Survey (2008).

visit an area if wind farms were constructed (Countryside Energy Co-operative, 2006; AusWind, 2004; East Haven Wind Farm, 2003).

A 2006 Atlantic City Weekly article cites established tourism successes in southern California and Denmark and discusses the plans of the Atlantic County Utility Authority to build a boardwalk and scenic overlook area for visitors to the small wind farm at their wastewater treatment facility (Golubcow, 2006). There are also local indications that wind farms can attract visitors. It is not uncommon for visitors to pull to the side of the road and take photos at the Mountaineer Wind Energy Center in Tucker County, West Virginia, even though only a few of the turbines are visible from the road and this facility is not advertised as a tourist destination.

Contrary to these studies and anecdotal evidence, opponents of wind farm developments argue that wind farms in wild places detract from the characteristics that make those places tourist attractions in the first place. This debate over the effects of wind farms on tourism is far from settled. What is clear, however, is that while wind farms at least have the potential to draw visitors and attention, mountaintop removal operations are not tourist attractions.

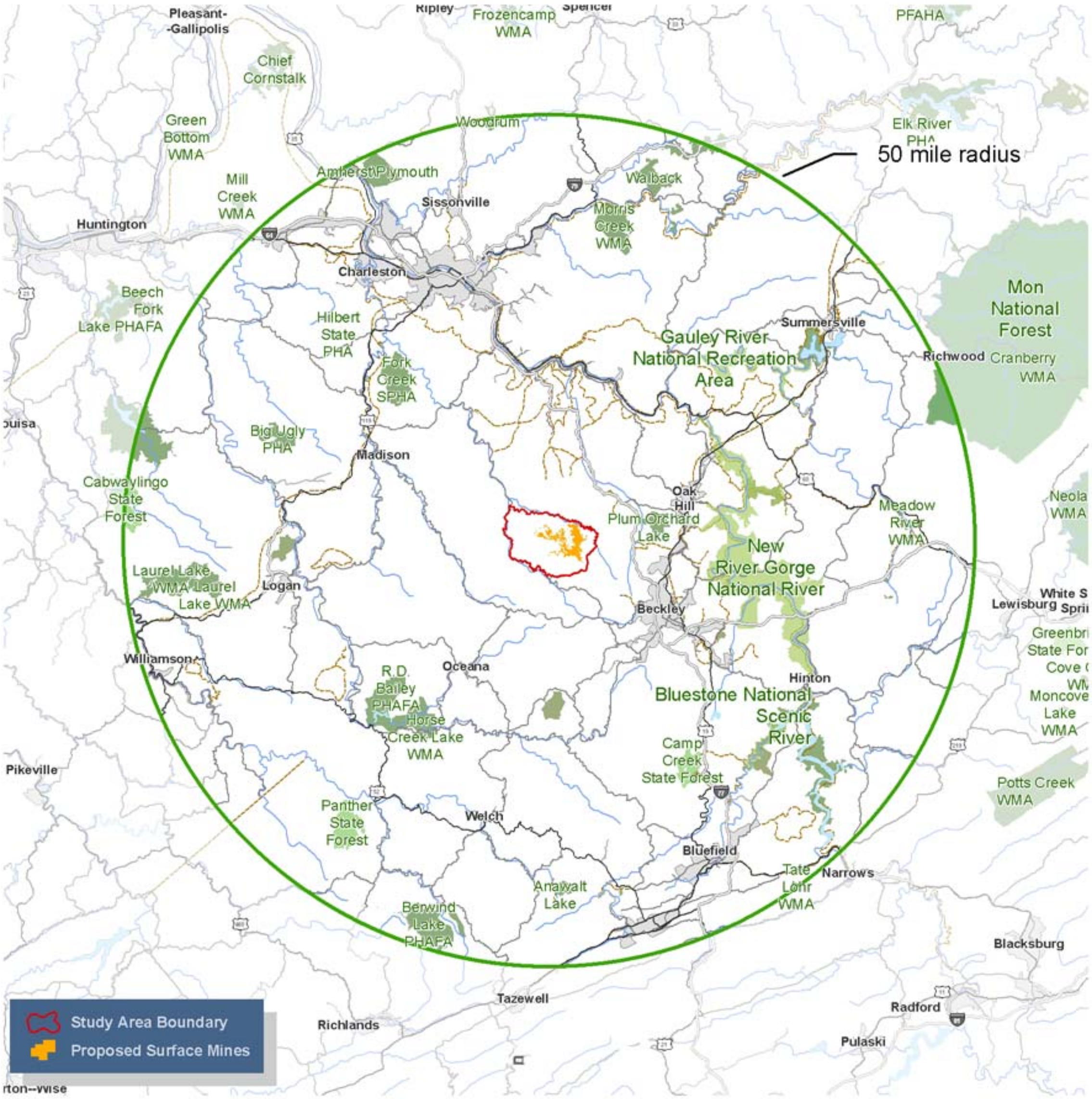
Scenic Coal River Mountain is just a few miles from interstates 64 and 77. While the mountain is not currently known as a tourist destination, it is in close proximity to several large West Virginia attractions and could potentially be developed as an attraction to take advantage of the large numbers of visitors already in the general area.

Tamarack—which boasts a statewide collection of hand-made arts and crafts, a theater, a fine art gallery, a food court, and a conference center—draws about 500,000 visitors each year (Tamarack, 2008). Tamarack is located in close proximity to Coal River Mountain.

The nearby New River Gorge National River and the Gauley River National Recreation Area are popular whitewater rafting destinations (Figure 11). Numerous state recreational resources, the Monongahela National Forest, and cities and towns are located within a 50-mile radius, including Charleston, the state capital. Bridge Day, which takes place each October, draws 200,000 visitors to neighboring Fayette County. Festival attendees include BASE jumpers parachuting off New River Gorge Bridge, rapellers, and vendors selling food and souvenirs.

While the local economic benefits from increased tourism are not quantified in this study, the potential for developing the Coal River Mountain wind farm as a tourist destination should be investigated, especially considering the mountain’s location and proximity to many other southern West Virginia tourist destinations.

Figure 11: Recreational resources near Coal River Mountain



4.7 Property values

While definitive studies are not available, anecdotal evidence suggests that mountaintop removal coal mining decreases the value of nearby properties. There exists little evidence, however, that wind turbines reduce surrounding property values. Based on property sales data from ten study areas in the vicinity of wind projects, there was no evidence of negative effects on property values within the projects' viewsheds (Sterzinger et al., 2003). This study also compared how property value changes before and after projects came on-line. In the vast majority of cases, values increased faster after a wind project came on line. Changes in property values are not quantified in this analysis.

4.8 Gathering, hunting, and heritage

According to the USEPA draft EIS for mountaintop removal mining:

> "There is a cultural tradition in the region of reliance upon the harvesting of non-traditional forest products and subsistence gardens rather than welfare or other public assistance. This reliance upon the natural environment becomes part of a work ethic of sorts which centers around frequently isolated and tightly knit communities… A recent study from the West Virginia University found that environmental concern was highest in the most rural, low educated, nonprofessional population in the state… This type of result reflects not only reaction to the mining industries, but also concern for their livelihood." (USEPA, 2003, p. III.T-6)

USEPA also reports:

> "In recent years, the evolution of mining practices from underground to surface mining has affected the public's relationship to 'the commons.' Historically, underground mining operations allowed for surface land uses such as gardening or wild gathering to take place. Surface mining operations, by nature, do not allow for concurrent alternate land uses. Therefore, private landowners have increasingly begun to close off these lands to the public. This has a deep cultural as well as economic impact upon the communities in the region." (USEPA, 2003, p. III.T-7)

To understand these issues as they specifically relate to Coal River Mountain, a community meeting was held on September 4, 2008 at the Home School Village Community Center located in Colcord, West Virginia. Twenty-one residents who live in the vicinity of Coal River Mountain were present for this discussion. Those in attendance live mainly in Dorothy and Colcord, West Virginia, no more than two or three miles downstream from the permitted mine areas. Many live in the Sycamore Hollow area. Their ages ranged from mid-thirties to seventies, with the majority being senior citizens.

During the hour-long discussion, it became clear that the mountain is inextricably connected to the local community's past, present, and future. Residents shared childhood memories of time spent on the mountain, old homesteads located on the mountain, and remembrances of how current features, such as trails, were forged by preceding generations. One resident even mentioned how, in the past, garden plots could be leased from the landowner for $3 per year.

Presently, the mountain provides residents with the peace, serenity, and scenic views that have kept them in the West Virginia countryside, or called them to return here. The long-established mountain ecosystem provides those that live along creeks with protection from destructive floods. The mountain provides clean water in the creeks and wells, and allows for gathering of indigenous plants.

Residents mentioned that foods and herbs harvested from the forests of Coal River Mountain include raspberries, blackberries, wild grapes, ramps, walnuts, butternuts, yellow root (golden seal), May apple, red root, ginseng, and morel mushrooms. Harvesting of these foods and herbs saves families money on their grocery bills and sometimes brings in extra income. For example, harvesting of ginseng brings in thousands of dollars of extra income each year for local residents.[13] September

[13] According to the West Virginia Division of Forestry (2008), 349 pounds of wild ginseng were harvested in Raleigh County in 2006 (the most recent year of data). This was the third largest county harvest in the state.

through November is ginseng harvesting season. The income from ginseng is used by some harvesters to buy major items like appliances, and by others to buy Christmas presents.

Alongside the plants, the mountain provides habitat for a multitude of animals. Animals that are hunted for food on Coal River Mountain include squirrels, deer, and turkey. In addition to providing food and income, harvesting and hunting are activities that families can do together on the mountain.

Finally, the mountain connects local residents with the future. The residents mentioned how they educate their children on the mountain by teaching them how to live off the land, while preserving its resources.

It must be remembered that Coal River Mountain is not owned by the local community. It is only because the current landowners allow access that the residents are able to maintain their generations-long relationship with the mountain and its resources. Development of mountaintop removal mines on Coal River Mountain would forever change residents' connection to the mountain, limiting access, shifting habitat, and burying headwaters streams. As an alternative, a wind farm would preserve many of the mountain's resources as well as the ability of local residents to continue their traditional use and enjoyment of the mountain.

While the effects of mountaintop removal were the major concern expressed by members of the discussion group, they also expressed concern about the access restrictions that might accompany a wind farm. In addition, depending on the scale of the wind farm, clearings required for access roads and for the placement of the turbines themselves may impact the uses mentioned by residents. Gamesa, for example, initially clears access roads to a width of 60 feet and maintains 15-foot permanent gravel roads after construction (Lutz, 2008).

Currently, wild ginseng is valued at between $500 and $1,200 per pound of dried root. One of the residents reported that harvesting averaged three pounds per person on Coal River Mountain.

5. COMPARING THE MOUNTAINTOP REMOVAL AND WIND SCENARIOS

While Chapter 4 describes the methods, assumptions, and calculations of the local economic benefits and costs, this chapter compiles these results to compare the mountaintop removal and wind scenarios. Comparisons of jobs, earnings, and economic output are provided. Quantified externalities—deaths and injuries and local environmental effects—are then incorporated into these comparisons to provide a more fair comparison between the development of mountaintop removal coal mines versus wind farms. Next, a comparison of the scenarios is presented from the perspective of a landowner. Finally, the scenarios are compared according to their energy production.

5.1 Local economic benefits without considering externalities

As shown in Figure 12, total annual jobs—including direct, indirect and induced—in the mountaintop removal scenario peak at 866 per year, before declining to zero as the mining ends. For the wind farm, large numbers of workers are needed during the initial construction period and at each 20-year interval as the turbines are replaced. If the turbines themselves are constructed locally, as captured by the local industry wind scenario, then considerably more local jobs are created.

The cumulative jobs chart in Figure 13 demonstrates that over the long term, a wind farm will create more jobs than the mountaintop removal operations, even without the development of a local turbine manufacturing industry. However, as modeled by the local industry wind scenario, wind-related green jobs will exceed mountaintop removal jobs in the initial years as the wind farm is being built. After this construction phase, mountaintop removal jobs will surpass local industry wind scenario jobs for a short time. Then, only eight years after the mountaintop removal mines close and in all successive years, the cumulative number of wind-related jobs will exceed mountaintop removal jobs.

In the long term (five investment cycles for wind turbines), the conservative wind scenario will result in 28% more jobs than the mountaintop removal scenario. Jobs in the local industry wind scenario are 314% greater than the jobs created by mountaintop removal over five investment cycles.

A common pattern emerges when comparing the earnings and output among the scenarios (See Figure 14 through Figure 17). Over the short term, mountaintop removal provides greater local economic benefits. Except for gross output in the conservative wind scenario, earnings and output derived from wind resource development and underground mining eventually exceed those from mountaintop removal mining.

If other wind farms are built in southern West Virginia, a new plant in Raleigh County could provide even more jobs as the plant would manufacture turbines for these other wind sites as well. These extra jobs, earnings, and output can be significant, but are not included in this analysis.

In addition to jobs, earning, and output, these scenarios would provide different amounts of local taxes to Raleigh County. As described above, coal severance taxes would bring in $36,000 per year over 17 years for the mountaintop removal scenario and $8,000 per year over 15 years for the underground mining in the wind scenario. These coal severance taxes are very small compared with the $1.74 million in property taxes expected to be generated by the wind farm each year.

Figure 12: Annual jobs for each scenario

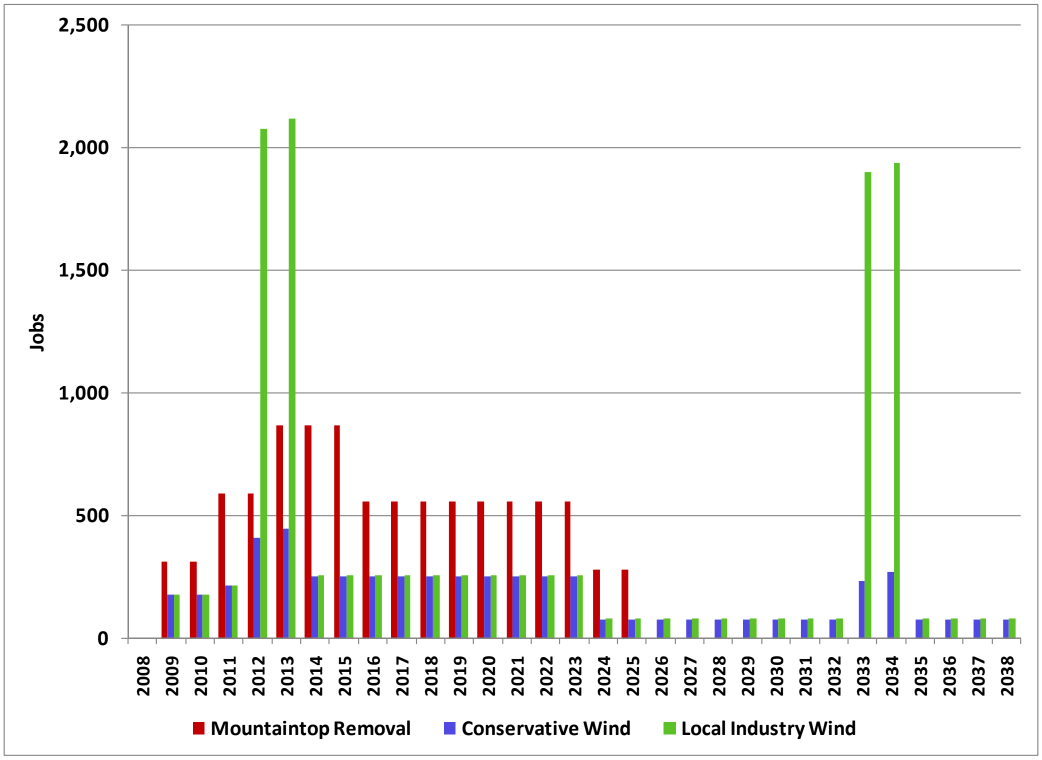


Figure 13: Cumulative jobs for each scenario

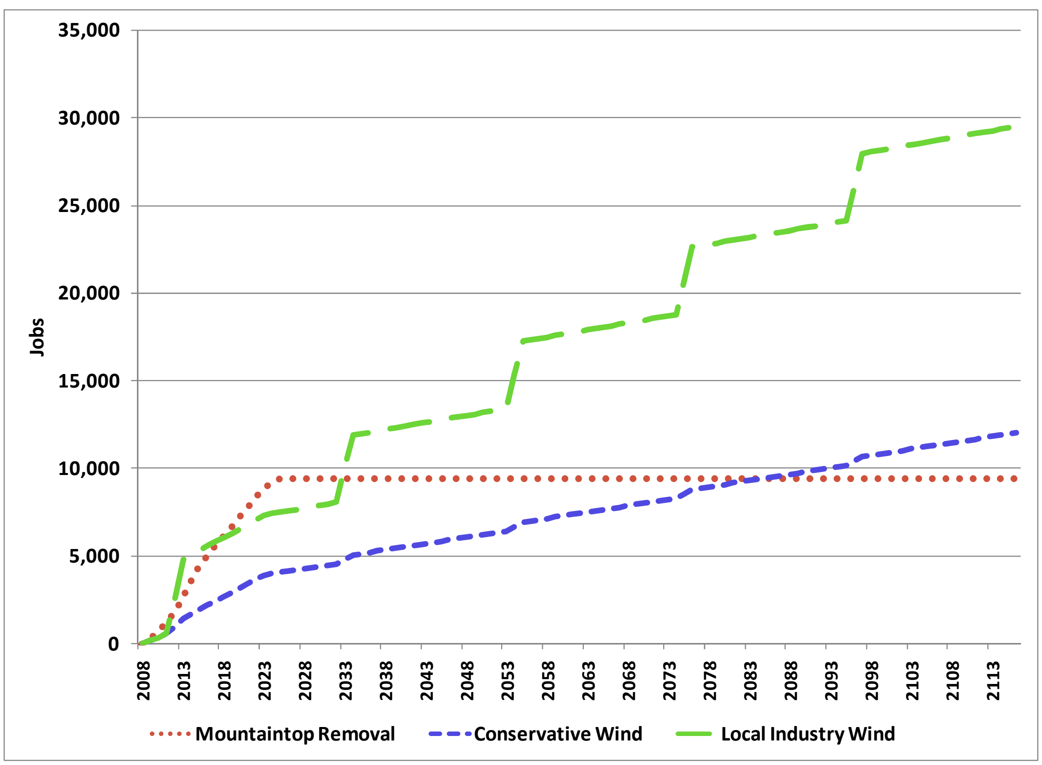


Figure 14: Annual earnings for each scenario (not including externalities)

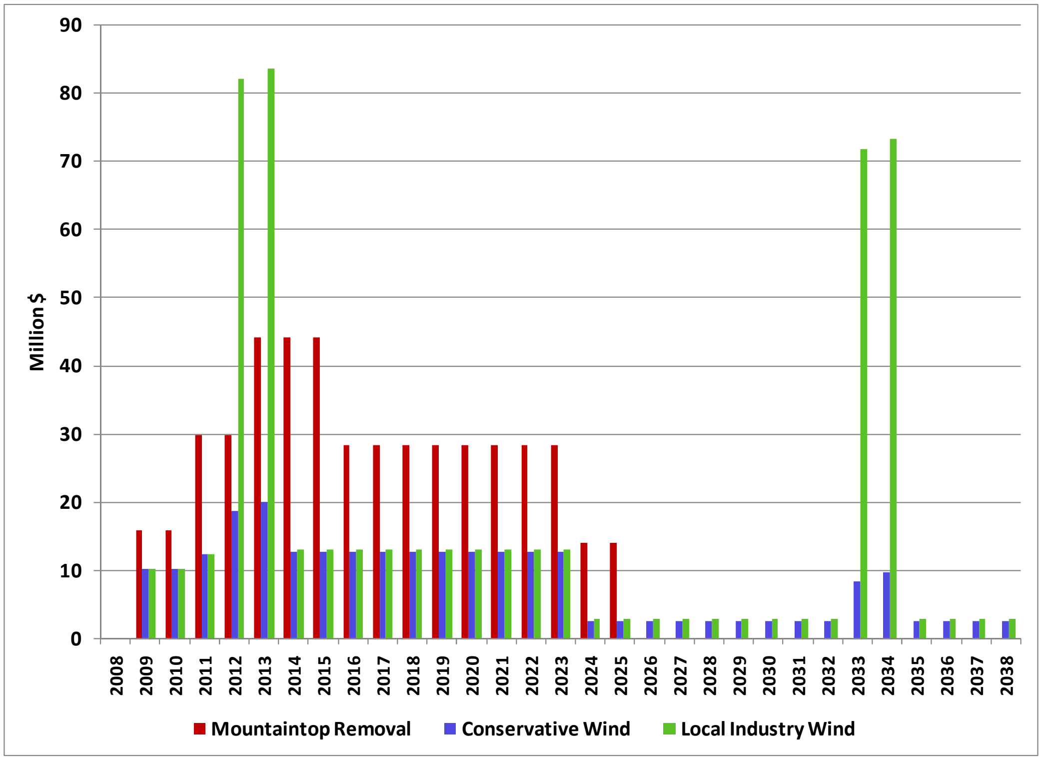


Figure 15: Cumulative earnings for each scenario (not including externalities)

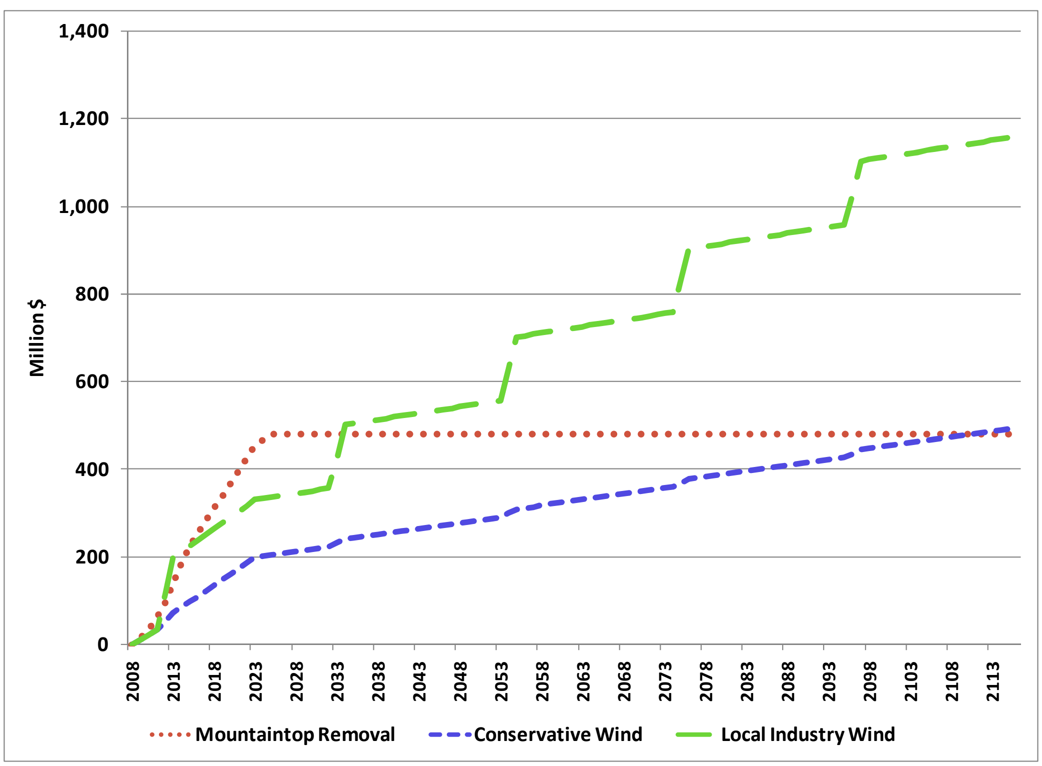


Figure 16: Annual output for each scenario

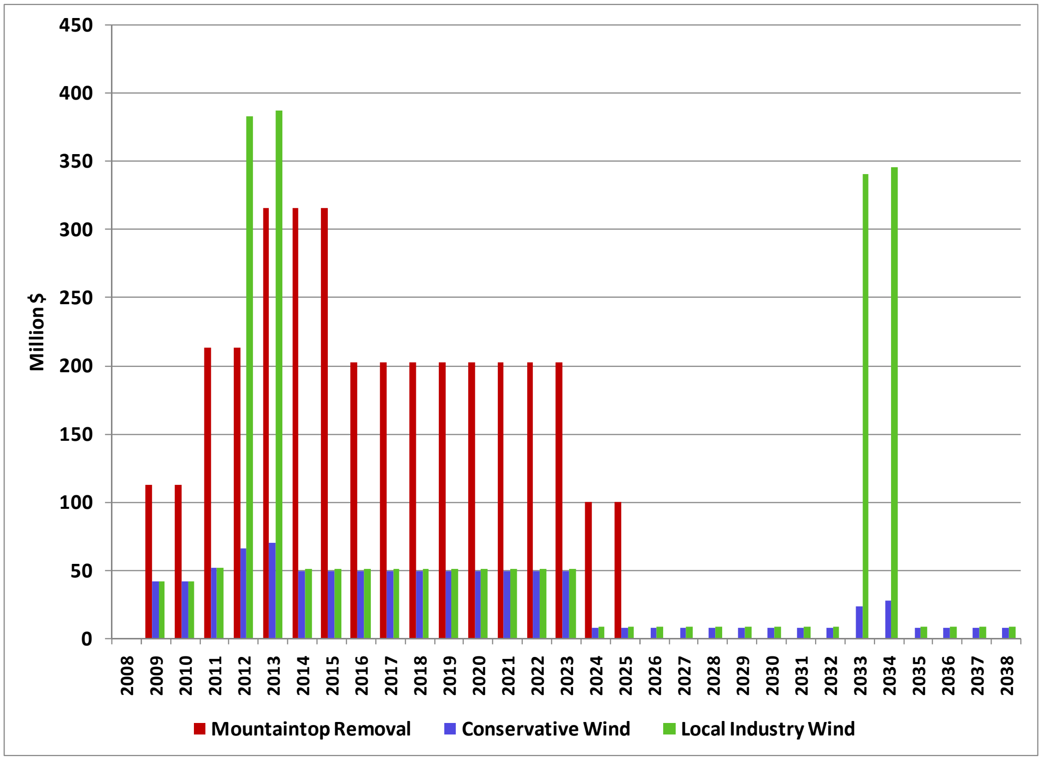
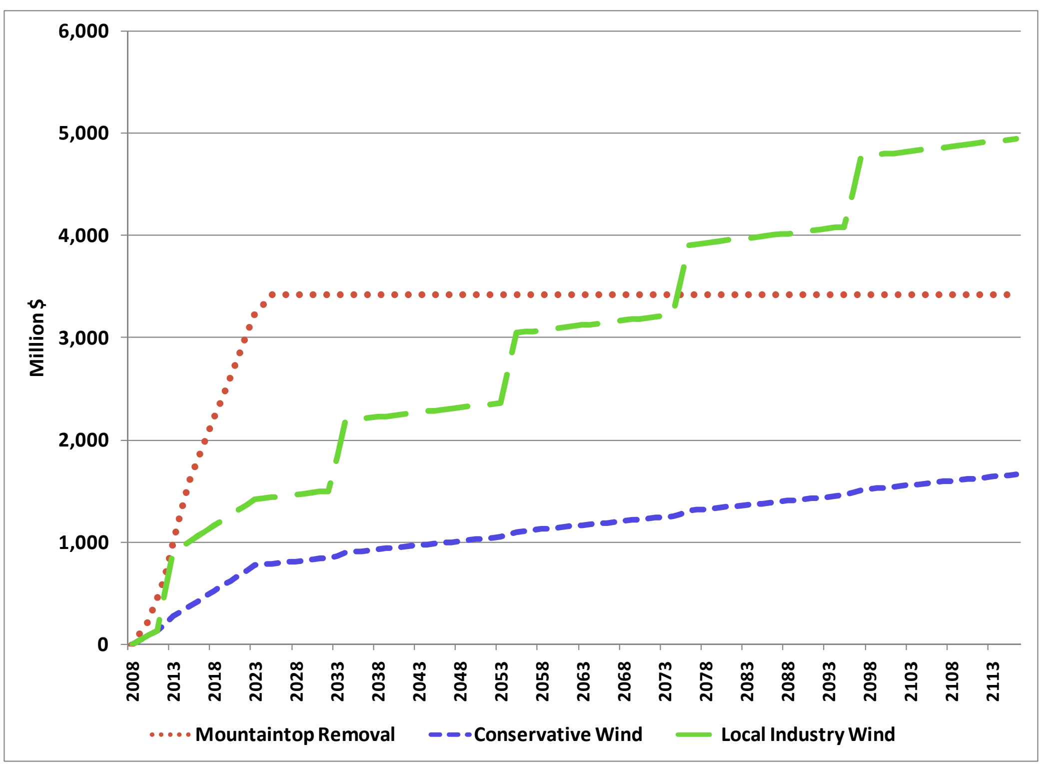


Figure 17: Cumulative output for each scenario



5.2 Earnings considering externalities

The results presented in this previous section do not include externalities, or costs borne by the public. In this section, we revise the earnings estimates for each scenario by subtracting out the local externalities that were calculated above. Externality costs are subtracted from earnings because for the most part, these costs were estimated in monetary terms using a willingness-to-pay approach—what people would be willing to pay to avoid the damages created by external costs. Since willingness-to-pay comes from a person's income, these external costs are most appropriately compared with the earnings generated as a result of the coal mines and the wind farm.

These externalities include deaths and illnesses of the general population and coal miners (Section 4.2) and local environmental externalities (Section 4.3).

As shown in Figure 18, the annual net earnings, after subtracting externalities, shows a drastically different pattern for the mountaintop removal scenario. In fact, in 2009 and 2010, as well as in 2024 through 2042, externalities exceed earnings, causing net earnings to be negative. These results are primarily due to the value of the excess deaths and illnesses attributable to the additional coal mined at the mountaintop removal mines.

This figure also demonstrates that the excess coal mined in the underground mines—which is included in both wind scenarios—also impacts earnings. For 13 of the first 31 years, externalities exceed earnings even in the wind scenarios. These results are caused primarily by the excess deaths and injuries attributable to underground-mined coal.

However, the cumulative results shown in Figure 19 show a stark contrast between mountaintop removal and wind. This chart demonstrates that the cumulative external costs from mountaintop removal coal production exceed the cumulative earnings in every year. Even without comparing it with the wind scenarios, the mountaintop removal scenario is not defensible from the perspective of Raleigh County citizens when considering just two externalities: excess deaths and illnesses, and environmental damage.

The two wind scenarios show a very different result. Both show cumulative earnings that exceed cumulative externalities in every year. When considering externalities, the wind scenarios are the preferred alternatives.

Figure 18: Annual earnings for each scenario (including externalities)

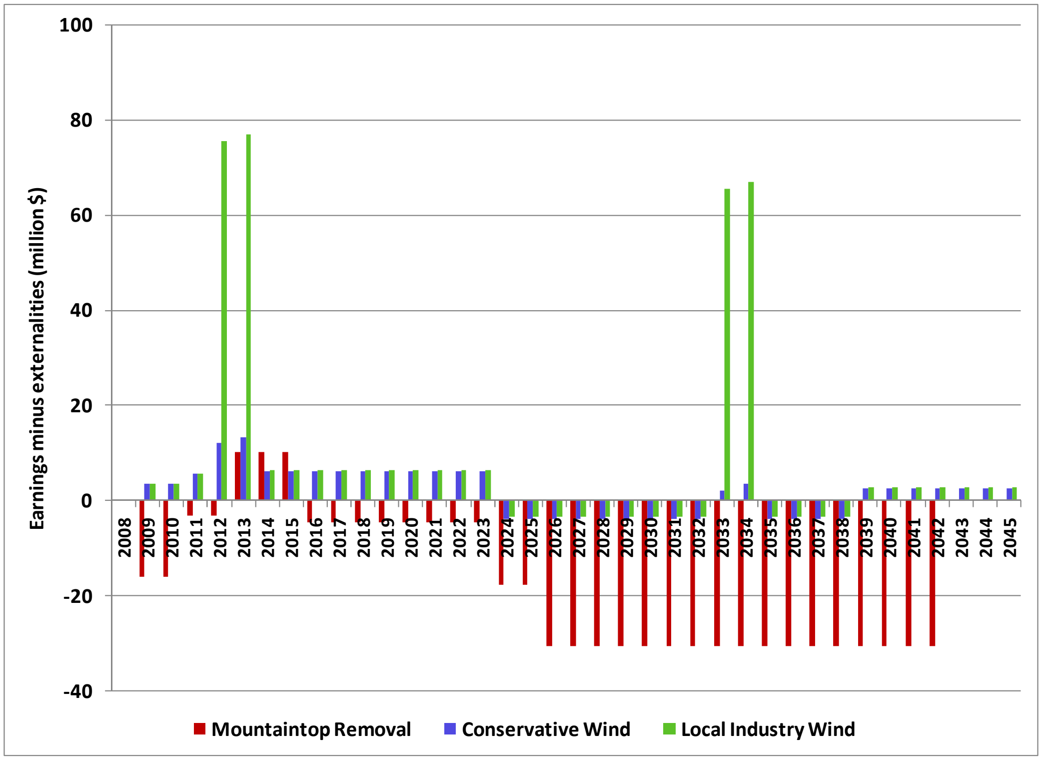
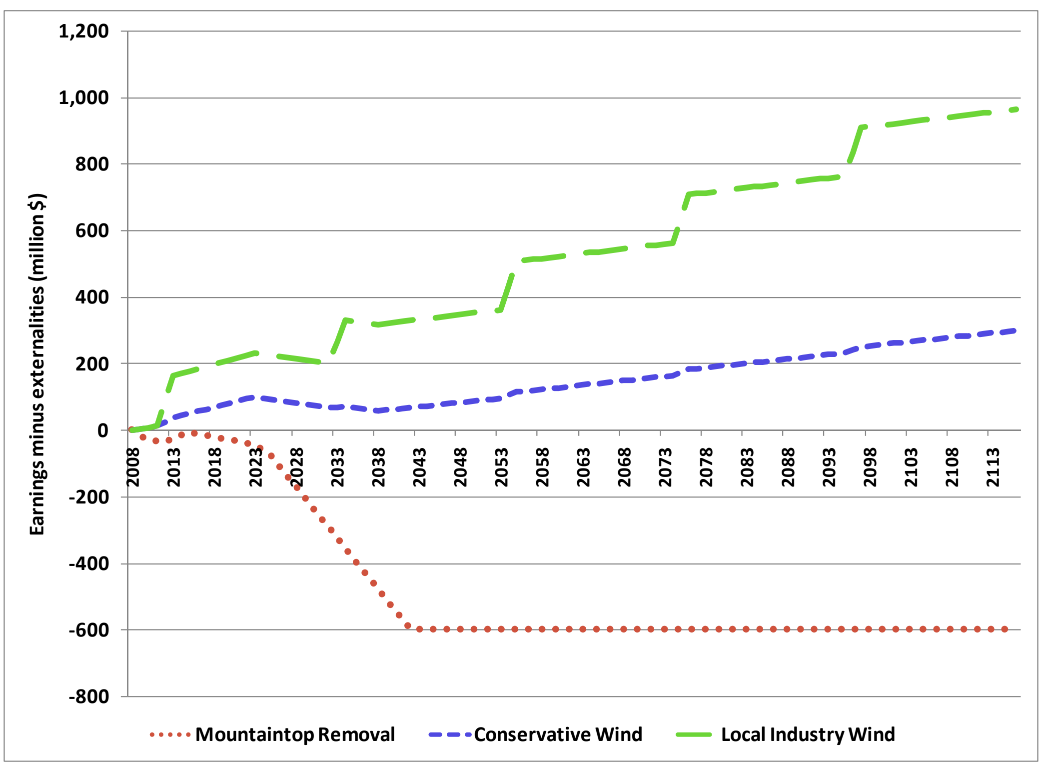


Figure 19: Cumulative earnings for each scenario (including externalities)



5.3 Financial benefits to landowners

While the previous section demonstrates that, over the long term, wind provides greater economic benefits than mountaintop removal coal mines to the citizens of Raleigh County, the final decision rests with the landowners and leaseholders. Landowners and leaseholders are concerned with the value of their investments.

Large landholding companies own the bulk of the land and minerals on Coal River Mountain that would be mined and impacted by the Bee Tree, Eagle II, and Eagle III mines. For coal mining, landowner payments are typically based on royalties: a percentage of the revenues from coal sold. While royalty rates are negotiated mine-by-mine, we use average royalty rates compiled by the West Virginia Department of Revenue (2008): 5.84% for underground coal and 7.01% for surface-mined coal. The price of coal is also important for this calculation. Coal prices vary widely year-to-year and may be influenced in the future based on possible climate change legislation. However, to calculate the financial benefit to landowners we use the same three-year average of recent coal prices that was used for the local economic benefits analysis. Revenues to landowners are summarized in Table 12 for the mountaintop removal scenario.

Revenues to the landowners in the two wind scenarios would be the same, whether or not a local wind industry manufactures the turbines. Based on revenue of $10,997 per turbine per year, as described above in Table 9, the expected income stream to the landowner is also shown in Table 12. These annual revenues are clearly much lower than those that would be realized through mountaintop removal coal mining.

Table 12: Landowner revenue in the mountaintop removal and wind scenarios

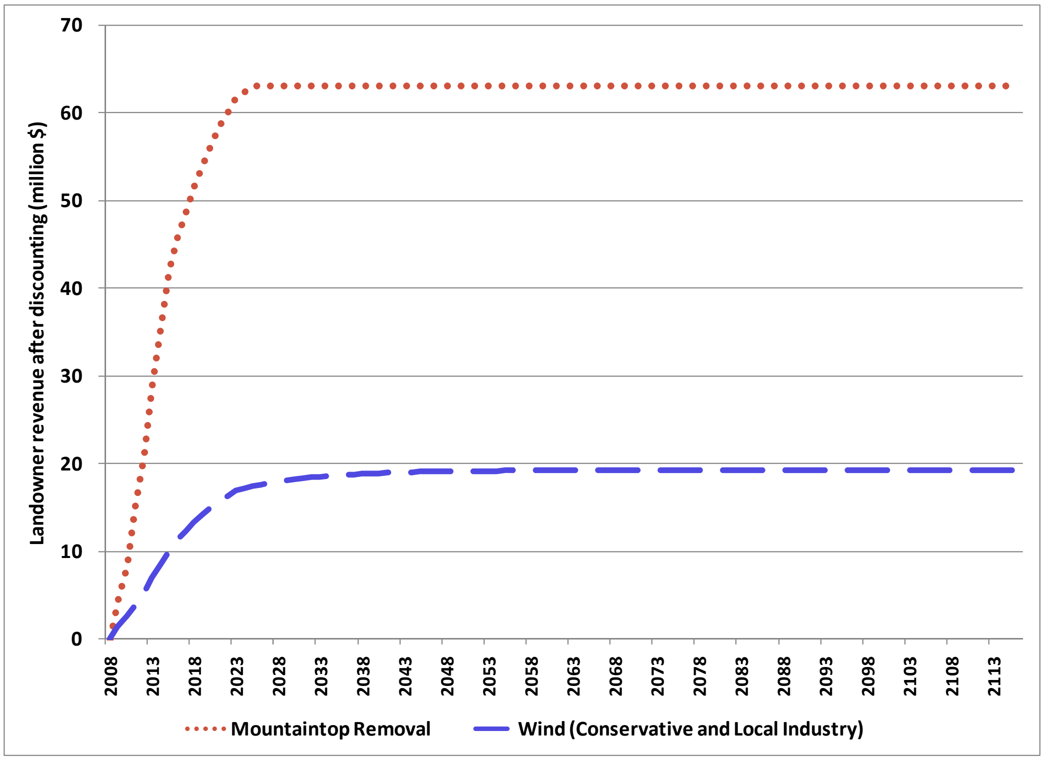
Year	Mountaintop removal scenario (Million $)	Wind scenarios (Million $)
2008	0	0
2009	5.6	1.7
2010	5.6	1.7
2011	10.6	1.7
2012	10.6	2.6
2013	15.6	3.5
2014	15.6	3.5
2015	15.6	3.5
2016	10.0	3.5
2017	10.0	3.5
2018	10.0	3.5
2019	10.0	3.5
2020	10.0	3.5
2021	10.0	3.5
2022	10.0	3.5
2023	10.0	3.5
2024	5.0	1.8
2025	5.0	1.8
2026 and successive years	0	1.8

Note: Future revenues are not discounted in this table.

This difference is highlighted in Figure 20, which illustrates the cumulative landowner revenue after applying a 12.2% discount rate. This discount rate is a standard rate set by the State Tax Department for calculating property taxes on active and reserve coal properties (West Virginia Department of Revenue, 2008), and is based on evaluating the profitability of investments in mineral properties. As shown in this figure, the mountaintop removal scenario would generate a net present value of $63 million in landholder revenues for mountaintop removal versus $19 million for wind. Even over five wind investment cycles, the use of a discount rate means that profits far in the future do not significantly affect net present value.

Based on these results, it is no surprise that landholding companies have pursued coal mining as opposed to wind farm development on Coal River Mountain. Put simply, landholding companies stand to profit much more from developing the coal resources than from developing the wind.

Figure 20: Cumulative landowner revenue



Note: Future revenues are discounted at 12.2%.

5.4 Energy

A body of research examines the energy return on investment (EROI) ratio, where the energy output is compared with the energy input. Across all sources of energy used to produce electricity, wind energy has the highest average ratio (Kubiszewskiet al., 2008). On average, wind energy has a ratio of 18 compared with eight for coal. EROI variability is much higher for wind, with ratios ranging from 5 to over 30 compared with coal's range of 5 to 11. EROI is important because it measures the efficiency of producing energy from different sources.

The mountaintop removal and wind scenarios can also be compared according to the energy they will produce, because the ultimate goal of coal mines and wind farms is to generate electricity.[14] We therefore compare the amount of electricity produced by the coal mined on Coal River Mountain with the electricity produced directly by the wind turbines.

The year-by-year pattern of electricity generation is similar to the patterns for jobs, earnings, and output. Electricity generated with coal from the Bee Tree, Eagle II, and Eagle III mines will exceed that generated by the wind turbines and underground mines for the first 17 years (Figure 21). Over five investment cycles, however, wind energy production approaches but does not exceed coal-based electricity production (Figure 22).

It is also important to note that the wind-based electricity is green power, and is likely more valuable than coal-based electricity. Even today, before national climate change legislation has been passed, renewable electricity can be sold at a premium. In the future, renewable electricity is likely to continue to be more valuable because a carbon cap and trade program or a carbon tax would increase the cost of generating electricity from carbon-intensive fuels such as coal.

[14] Although some coal will likely be sold as metallurgical coal and will not be used to generate electricity, the calculations presented in this section assume that all mined coal will be used to generate electricity. This assumption makes the mountaintop removal scenario seem more favorable when compared with the wind scenarios on an energy production basis.

Figure 21: Annual energy production

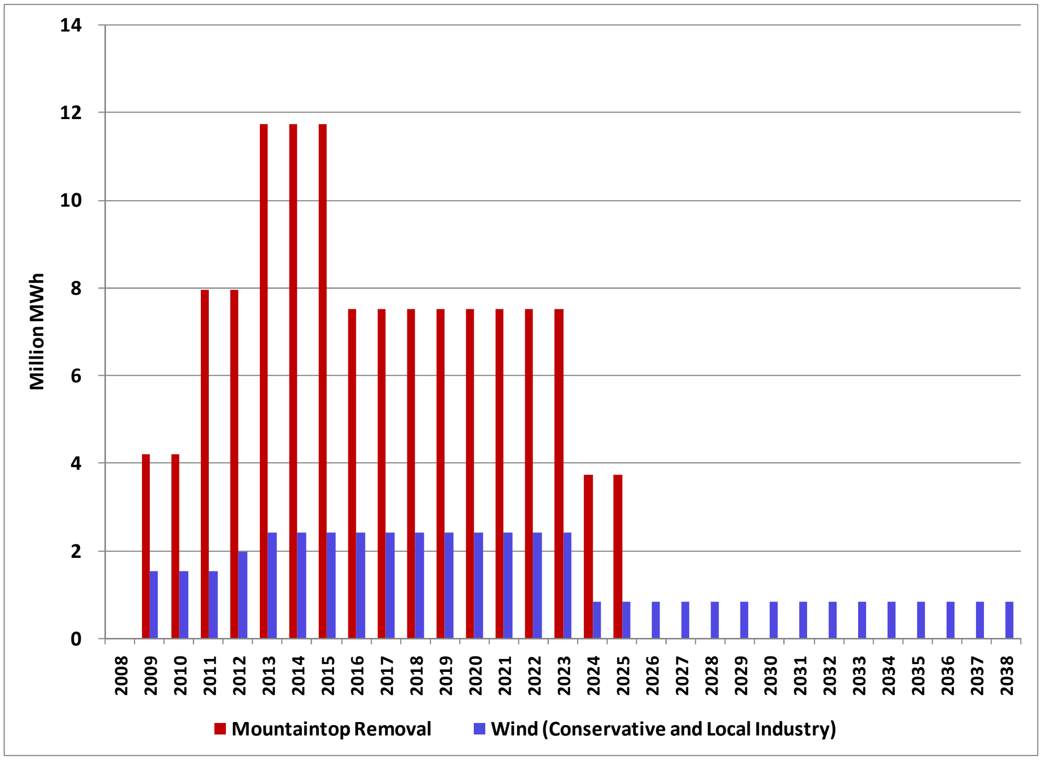
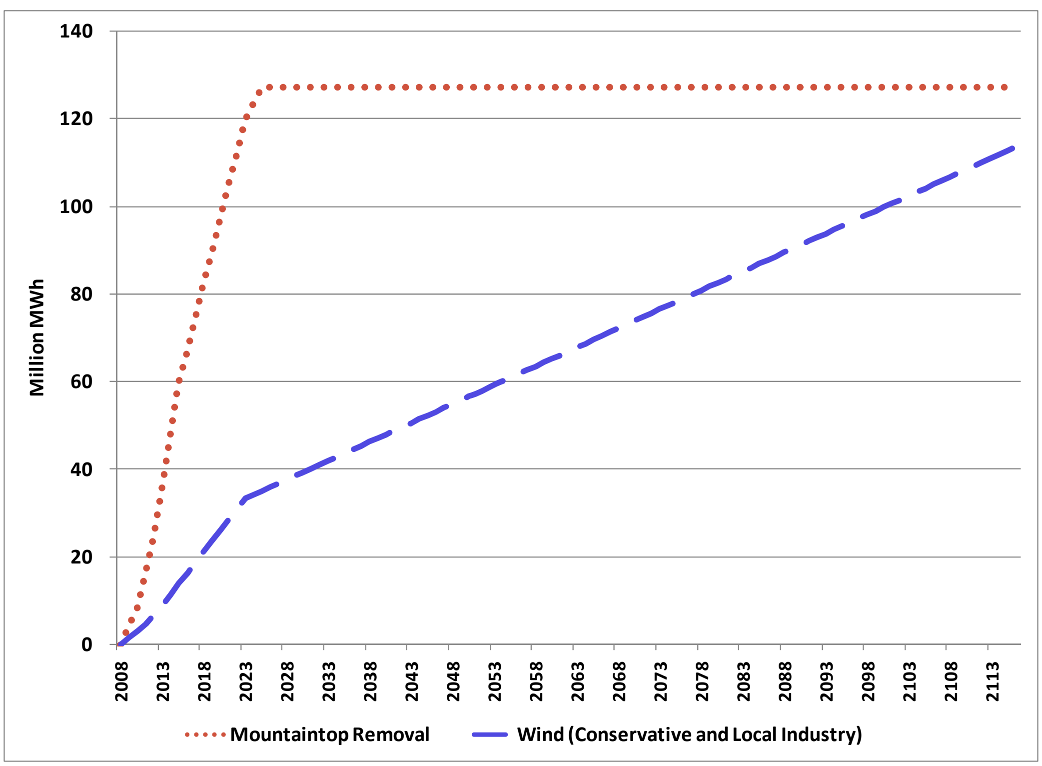


Figure 22: Cumulative energy production



6. CONCLUSIONS AND RECOMMENDATIONS

This analysis considers three possible pathways to develop the energy resources on Coal River Mountain: mountaintop removal coal mines, a wind farm with underground mining, and the same wind scenario with a new, local wind turbine manufacturing facility.

For each scenario, we calculate the local economic benefits to citizens of Raleigh County, West Virginia; these calculations help conclude which scenarios provide a net benefit or a net cost. However, we also compare the scenarios from the landholders' perspectives because it is ultimately up to the private sector to decide what to do with privately held land and minerals.

The results from these two perspectives stand in stark contrast. When combining local externality costs with local earnings, the mountaintop removal mines actually cost the citizens of Raleigh County more than the income they provide. In other words, the increased deaths and illnesses due to increased coal mining—combined with the environmental impacts— are costlier than the earnings provided by the mining.

In comparison, when combining local externalities with local benefits, the wind scenarios are considerably more attractive. Developing the wind resources on Coal River Mountain provides net positive local economic benefits to the region. When combined with a local wind turbine manufacturing industry, even more significant additional local economic benefits are achieved.

The timing of these costs and benefits are important. The benefits of mountaintop removal mining would end after 17 years when the mining ends, but the costs of mountaintop removal mining are projected to continue due to the expected deaths and illnesses caused by the coal mining. In contrast, the benefits from the wind scenarios continue indefinitely.

Even without considering externalities, the local industry wind scenario would provide more cumulative jobs than the mountaintop removal scenario after 2033—only eight years after the mountaintop removal mines would close.

The wind scenario would generate significantly more local taxes for Raleigh County than the mountaintop removal scenario. Only about $36,000 per year in coal severance taxes would be paid to Raleigh County by mountaintop removal mining on Coal River Mountain. In comparison, a wind farm would generate about $1.74 million in local property taxes each year. While the severance taxes end when mining ends, the property taxes from the wind farm will continue into the future.

Despite the clear local economic benefits of pursuing the development of wind, a final decision rests with the landowners and the mining companies that are leasing the land. Without an intervention, these companies are free to pursue mountaintop removal coal mining to provide the greatest profits possible.

There are several actions that could shift the current emphasis on coal production to one that includes coal and wind production. These actions include a change in the regulatory or legal landscape in regard to surface coal mining. For example, a final decision is expected soon from the United States Court of Appeals for the Fourth Circuit; this ruling has implications for the use of valley fills and could impact the profitability of coal mining using mountaintop removal techniques.

One possible government intervention would be based on the recognition that the local economy can benefit more in the long run with the development of a wind farm. Public funds could potentially be used to compensate the holders of private property rights on Coal River Mountain.[15]

The state government could also intervene if the Governor uses his executive powers to rescind the Bee Tree and Eagle II mining permits and prevent the Eagle III permit from being approved.

State and local leaders and stakeholders can all play a role to promote the use of wind energy. For example:

- State government can facilitate the creation of green jobs in West Virginia by attracting a wind turbine manufacturer to the state, so that the development of wind farms will benefit the local economy even more. State leaders can also promote renewable energy, not just alternative energy, by providing greater incentives.
- Local governments can seriously consider the job and tax implications of diversifying the energy economy to include not just coal, but renewable energy such as wind. They can explore how to protect the county's best wind resources and promote wind farm development in these areas.
- Convention and Visitors Bureaus can promote wind farms as tourist destinations, especially sites like Coal River Mountain that are close to targeted tourist destinations like Tamarack and the whitewater area of the New and Gauley Rivers.
- Wind farm developers and landowners can install wind monitors on Coal River Mountain and investigate the profitability of building a wind farm on the mountain.
- More grassroots community and environmental organizations can focus on promoting sustainable alternatives to existing forms of energy.

The Coal River Mountain wind farm has been contentious since this concept was first proposed by Appalachian Voices and others in late 2006. However, the conclusions of this report confirm that a wind farm would produce greater local economic benefits to citizens of Raleigh County, particularly when health and environmental externalities are considered.

It is recommended that state and local leaders and stakeholders chart a common path forward with local citizens that not only preserves private profits, but that also strives—as a central objective—to sustain the local economy over the long term.

[15] A similar arrangement was recently made between the state of Florida and U.S. Sugar Corporation in its efforts to restore the Everglades. In this case, the state of Florida intends to spend $1.75 billion to turn sugar cane fields back to marshes and waterways (Loney, 2008).

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APPENDIX A: JEDI MODEL ASSUMPTIONS

Table 13: Assumptions utilized in the JEDI model for Raleigh County, West Virginia

Category	Assumption
Project cost data	
Construction Costs	**Local share**
Materials	
Construction (concrete, rebar, equip, roads and site prep)	50%
Transformer	0%
Electrical (drop cable, wire,)	50%
HV line extension	50%
Labor	
Foundation	50%
Erection	2%
Electrical	50%
Management/supervision	0%
Equipment Costs **	
Turbines (excluding blades and towers)	0%
Blades	0%
Towers	0%
Other Costs	
HV Sub/Interconnection	50%
Engineering	0%
Legal Services	0%
Land Easements	0%
Site Certificate/Permitting	0%
Wind Plant Annual Operating and Maintenance Costs	**Local share**
Personnel	
Field Salaries	0%
Administrative	0%
Management	0%
Materials and Services	
Vehicles	0%
Misc. Services	5%
Fees, Permits, Licenses	0%
Utilities	0%
Insurance	0%
Fuel (motor vehicle gasoline)	0%
Tools and Misc. Supplies	10%
Spare Parts Inventory	0%
Other Parameters	**Local share**
Tax Parameters	
Local Taxes	100%
Land Lease Parameters	
Lease Payment recipient (F = farmer/household, O = Other)	25%
Payroll Parameters	**Rate per hour**
Field Salaries (technicians, other)	$17
Administrative	$13
Management	$29

Note: ** For the wind local industry scenarios, equipment costs were assumed to be 100% local share.