Introduction

Mountaintop removal is a form of strip mining that pertains to Central Appalachia. It is quite different than other forms of mining where there are several distinct steps that occur in order to extract coal from the mountain. First, all trees and vegetation are cleared, which can sometimes be sold to timber companies, but usually are dumped into the valley next to the removal site known as the "valley fill". The topsoil is saved after removal to either be replaced once the site has been mined or is spread over an existing site. A dragline, which is a piece of machinery that removes the earth and coal, is used to pre-strip the area. In addition, access roads for the machinery are created in order to make the operation run smoothly. The overburden, which is the soil that is now exposed, is drilled, blasted, and removed from the site. The trucks spend most of the day inching around the site, slowly backing up to the edge of a cliff and dropping the overburden into the valley fill. The result is exactly what it sounds like — the valley gets filled in, burying anything on the surface, including the mountain streams that form the headwaters of many Appalachian rivers (Darrow, 2010, page 7). After the explosion, when hundreds of feet of mountain have been removed and the coal seam has been broken, and the overburden is moved out of the way, the coal is extracted. Overburden that is manageable is used to put back on top of the mountain. Unusable overburden is left in the valley fill. Lastly reclamation is performed by attempted to restore the site to as close to its original state as possible. Graded and compacted topsoil are placed on the mountain and some vegetation is planted to make the site now somewhat of a habitat. However, the mountain never looks the same as it did before the destruction.

In the late 1900s, controversy began to occur in coal mining states such as West Virginia, Kentucky, and Tennessee due to the increase in demand for low sulfur coal, which is obtained in mountaintop removal. Since this style of mining was faster and produced a higher yield of profitable coal, mountaintop removal (MTR) became extremely popular for coal companies to use over other forms of mining. A 2003 environmental impact assessment by the EPA estimated that mountaintop removal had stripped more than 380,000 acres of land in Appalachia between 1985 and 2001, burying or polluting 1,200 miles of streams in the process (Darrow, 2010, page 5). With an increase in demand for MTR site requests, an increase in concern for the environment, the health of the people, and the economic stability of the areas surrounding the mining sites occurred. MTR is still a controversial topic that debates over these 3 topics. Virginia Tech, a well-known institution located in Blacksburg, VA, has a power plant on campus that partially runs off mountaintop coal from Sidney, Kentucky. In addition to this, they buy their electricity from Appalachian Power, which generates power from coal. With efforts from the university through research, there are other alternatives that can be discovered that will reflect better on Virginia Tech since there are extremely negative environmental, health, and economic issues relating to the current energy source used.

Environment: Water Quality and Habitat Destruction

Since mountaintop removal is an extremely invasive procedure, there are a multitude of environmental effects on the surrounding area. For instance, the waters and habitats have been altered dramatically due to the effects of MTR. When the overburden is removed from the mountaintop and pushed into the valley fill, there are several environmental consequences to this

action. Such removal of overburden is not monitored well and has resulted in several violations of the Clean Water Act. A 2003 review by the EPA found 150 valley fill violations in West Virginia wherein coal companies had been illegally dumping into valleys without the proper Clean Water Act permits (Burns, 2005, page 174). Not only do the mineral concentrations increase in the waters due to the overburden, but the erosion rate increases as well. With an increase rate of erosion, sedimentation occurs more frequently, which results in a decrease of water quality and an increase in habitat destruction.

Microorganisms are sensitive to water quality change, thus result in a decrease in their populations when alterations to the waters occur. With a loss of biodiversity, there are detrimental effects on the wildlife of this area. Appalachia is rich with biodiversity, but as the increase in mountaintop sites have been approved and excavation has been completed, the waters have been affected with noticeable changes. A group of aquatic ecologists conducted samples of such streams in these watersheds and found an increase in minerals in the water and the macroinvertabates and fish that remain are not as diverse and are more "pollutant-tolerant" than what had been there (Burns, 2005, page 189). This shows that the waters are being affected by the minerals that are released in the explosion that settle from the air into the waters and the runoff from the overburden, which contains soils and coal particles, pushed in valley fills. With a decrease in macroinvertabrates, there is an ultimate decrease in species in these areas since they are a major food source for fish such as the Brook trout (a sporting fish), which has seen reduction in numbers as the lower organisms it feeds upon have been reduced by MTR..

Not only do the minerals affect the water quality, the increased sedimentation caused by valley fill dumping creates issues for the aquatic ecosystems. With an increase in filled streams, there results an increase in erosion rates. This excessive sedimentation leads to a drop in the overall productivity of the stream and may result in a decrease in lower order organisms that higher level organisms prey upon (Burns, 2005, page 14). Essentially, the natural order of life in these streams is severely altered or lost. The increased sedimentation eliminates vital spawning habitat for many fish species and invertebrates by filling in gravel spaces in the streambed. This sedimentation results in the reduction of streamside vegetation, which serves vital roles in creating habitat as well as aiding in the prevention of temperature fluctuations (Burns, 2005, page 177). Streamside vegetation is extremely important for the aquatic ecosystems because it moderates dissolved oxygen levels, which is the amount of oxygen in the water. Dissolved Oxygen is needed for survival of aquatic organisms because they cannot live without a sufficient supply of oxygen, just like terrestrial species. Ultimately the water quality is damaged through different steps of the mountaintop removal process.

While the process of excavation has detrimental effects on water quality and habitat destruction, the reclamation process also ruins habitats for existing species and allows for an increase in runoff. Since the topography of the sites are changed dramatically before and after the mountaintop removal process, the species living on the site before the excavation have a hard time continuing life on the new habitat. Before MTR the area was largely hardwood forests, but after reclamation it resembles midwestern grasslands (Burns, 2005, page 14). While there is soil formation on these MTR sites, it is unknown how long it will take the soil to become similar to what it was before the mining took place, or if such a transformation will ever occur with the higher pH levels that are now present in the minesoils. In addition, planted trees must compete

for nutrients with the grasses that were planted for quick covering, and results in slower regrowth of trees and woody plants (Burns, 2005, page 181). Thus, the change in habitat must result in change in species since every animal migrates to areas that will serve their needs. A bird that needs a large tree to live in can no longer live on this mountain since there are no longer mature trees to serve this purpose. Thus that bird species must migrate to find a new home. This has also caused issues with larger animals since they need large amounts of food sources that are no longer found on the mountain, thus they migrate toward civilization scavenging for food (Burns, 2005, page 195). While these larger animals leave the once forested land, small grassland animals replace them on the mountain such as mice due to the newer, flatter land that has now been "reclaimed." Reclamation is a questionable word to use in comparison with the standards that are put into place with the reclamation of a MTR site because to reclaim land is to "bring back to a preferable manner or to recover in a pure or usable form from refuse" (Dictionary). However, the reclamation sites are not necessarily back in a preferred manner to the animals that lived there before because it has been completely transformed from mountainous to grassland.

With that said, habitat destruction from MTR has also attributed to the increase in erosion and temperature fluctuations. Mature trees help as a buffer for temperature control and keep the soil in place with their root system, decreasing erosion. However, when these trees are removed, temperature is more susceptible to change and erosion increases down the mountain, continually affecting the valleys below. This allows for more sedimentation in the streams and water quality changes with extra material continually running off that was originally kept in place before the excavation of coal occurred. Ultimately, strip mining produced massive scars on the land, and reclamation provided only a covering for the nutrient deficient land left behind. However, MTR not only leaves a scar on the environment, but it also causes permanent damage on those living in these areas.

Human Health & Social Impacts

Coal has a profound impact on those living in communities where mountaintop removal is present. It not only has a health impact, but it also affects the community in a negative way. According to the Relations study, in general, as coal production increased, health status decreased. Rates of cardiopulmonary disease, lung disease, cardiovascular disease, diabetes, and kidney disease all increased. COPD (Chronic Obstructive Pulmonary Disease) is a disease that makes it harder to breathe over time. COPD can cause coughing with mucus, shortness of breath, and wheezing among other things. As it worsens, it prevents people from doing even routine activities such as walking or taking care of themselves (NHLBI). Studies done in West Virginia, Pennsylvania, and Kentucky show that chances for COPD increased by 1% for each 1462 tons of coal produced. This same study showed that the chances of having hypertension increased by 1% for each 1873 tons of coal produced. Hypertension is abnormally high blood pressure. This can lead to sever headaches, dizziness, and chest pains in sufferers (Hospitalization).

The impacts of coal are not just felt by the surrounding community. The miners are also exposing themselves to significant levels of danger just by going to work each day. According to the Bureau of Labor and statistics, coal mining is still the second most dangerous job in America with 27 deaths per 10,000 workers. Also, accidents in coal mining plants since 1900 have killed over 100,000 U.S. coal miners (BLS). A recent example of the inadequacy of safety measures in

mines would be the Upper Big Branch mine explosion in 2010, which killed 29 workers. The mine had even been cited for dangerous buildup of combustible gases like methane, which likely caused the explosion. In 1966, the National Safety Council put the frequency of disabling injuries in coal mining at 3.42 per million-labor hour worked. In comparison, the national average at the time was 7.2. On top of operational dangers to coal miners, there is also an additional health danger. Since 1900, 200,000 U.S. mineworkers have been killed from black lung disease. Black lung disease is a disease that is caused by an accumulation of dust in the lungs. It can cause shortness of breath and coughing. In time it progresses to cause an enlargement of the heart, fluid retention, and a swollen abdomen. Eventually, it can lead to heart failure.

Mountaintop removal mining also poses a significant threat to the community's drinking water. This type of mining specifically causes a high level of sulfate to be in the drinking water. Drinking high levels of water contaminated with sulfur can lead to extreme dehydration through diarrhea. The sulfur comes from abandoned mines where the coal slurry injections have flowed through the rock layers at the mine and into the aquifers, which supply drinking water to inhabitants (Sludge Safety). Residents have complained that their drinking water smells of sulfur, rotten eggs, kerosene, and sewer gas (Sludge Safety). Most of the water from the well contains black flakes and has a slimy feel. The water also causes red & black stains on appliances, walls, clothing, and dishes. Toxins in the water may also effect the brain development of children and infants.

The blasting of the mountain also causes a substantial impact on people's health through the decrease in air quality. The blast releases coal waste material that spreads into the atmosphere negatively affecting air quality. The elements emitted from coal powerplants include carbon dioxide, water vapor, sulfur dioxide, nitrogen oxides, carbon monoxide, and hydrocarbons (Burns, 2005, page 175). This can lead to many health problems for those who have to breathe in the toxic air. It is believe that high concentrations of sulfur dioxide can cause physiological damage in the long run. Powerplant pollution is responsible for 38,200 nonfatal heart attacks per year as well as 554,000 asthma attacks per year. The same study also says that people dying prematurely from exposure to air pollution lost an average of 14 years of their life because of the pollution. The study was done by the Pew Trust and was cited by the Busch administration in 2003.

Another potential danger of coal energy comes from the possibility of a dam bursting. Dams are created to separate the wastes from coal from the surrounding communities. These dams can contain millions (and sometimes billions) of tons of solid waste from the coal burning process. Coal companies choose to dispose of their wastes in the dams because they find that it is cheaper to do so then to properly dispose of their waste. When a dam bursts, all of the toxic materials, including heavy metals that are byproducts of coal incineration, being held back by the dam flood the surrounding area. The sludge held back by the dams can contain carcinogenic chemicals as well as arsenic, mercury, chromium, and boron among other chemicals (Sludge Safety). The Buffalo Creek incident on February 25, 1972 resulted in the death of 125 people, more than 1100 injuries and left 4000 people homeless. Since the Buffalo Creek Disaster, thirty-two other spills have occurred in West Virginia with twenty (or 62.5 percent) of those occurring from 2000 to 2004 (Burns, 2005, page 198).

This type of mining can physically damage the structure of the surrounding homes. Families living close to the removal sites report cracks in the walls of their homes as well as the foundation of the home. Mountaintop Removal Mining has furthermore been known to cause damage to roads and property devaluation. People in some communities have even been killed after being struck by the flying debris. Mountaintop Removal blasts can go on for 24 hours a day and be as close as 300 feet to a home. Some residents have found it difficult to do even routine tasks at home while the blasts go on.

Mountaintop Removal Mining not only physically devastates the surrounding communities but it also mentally and socially destroys them as well. The Gallup-Healthways Well Being Index ranked West Virginia, a state where Mountaintop Removal Mining is prevalent, last in the well being of their citizens. This index takes into account life evaluation, work quality, emotional health, and basic access among other things (App Voices). In addition, West Virginia has the fourth highest rate of citizens in poverty of any state in the United States. As the effects of Mountaintop removal mining continue to worsen, residents of the communities most affected are starting to speak out. In her book, *Bringing Down the Mountains: The Impact of Mountaintop Removal on Southern West Virginia Communities*, Shirley Stewart Burns discusses the social impacts of Mountaintop Removal Mining. She speaks of residents losing their jobs, losing their homes, and divided communities. In many towns it has become the opponents of Mountaintop Removal against those who support it. Burns, a longtime resident of Southwest Virginia, sees the devastation of Mountaintop Removal Mining everyday. She feels that if this destructive type of mining isn't stopped, the communities surrounding it will disappear once all of the coal is gone. According to Burns, "Those economically benefiting from the jobs are directly pitted against those who believe the cultural and environmental cost of extracting coal by MTR is a much too expensive price to pay."

Economic Evidence

The common argument for the coal industry, in general, is that coal is a plentiful resource and that the benefits primarily lie in the relatively low cost to other sources of energy. As a result, over fifty percent of electricity generated in the U.S. is from coal-fired power plants. The counterarguments presented by the coal industry are motivated by profiteering and convenience with complete disregard for the adverse externalities that accompany its use. When considering job hazards, environmental damages, and other externalities, the economic argument for the pro-coal faction does not hold. Let us consider the "true cost" of coal. To do so, we must address the valuation of the environmental and health effects. We concede that quantification in monetary terms of many of these factors is, at the very least, difficult if not impossible but, in an attempt to address arguments stating the economic benefits of coal, we will make an effort to do so.

In beginning with some statistics on deaths and health problems directly related to the mining process, a Harvard medical study that investigated the "full cost of coal" states that "[…] accidents since 1900 have killed over 100,000 U.S. miners and more than 200,000 have died from black lung disease, with long-term support of them dependent on state and federal funds" (Daley, 2011). Within this argument, here is where we first encounter the problem of valuation.

Although not directly related to coal, the following case discussion provides a useful example of an attempted quantification of a human life in monetary terms. In Corrosion Proof Fittings v. U.S. Environmental Protection Agency, the "value" of a human life was considered during the proceedings which centered on the validity of the cost-benefit analysis used by the EPA to promulgate a ban on asbestos. Within these discussions, the EPA stated that such a ban, at a cost of $128-227 million, would save three lives which would equate to $43-76 million per life. For the sake of argument, conservatively translating this "valuation" (at $43 million per life) to the aforementioned statistics would result in an amount of approximately $13 trillion. For the one-hundred year timeframe to which the statistics apply, this figure would average to $13 billion per year. These are just the deaths directly related coal mining. Of course, the value of a human life is incalculable but this case provides a theoretical monetary figure for the price of the lives lost due to mining activities. Without considering the intrinsic value of life, just in monetary terms, that does not constitute "cheap fuel."

Another frequently used argument by the advocates of coal is that it provides jobs and benefits the local economies. This is simply not true. In the book Environmental Sociology, Julia Fox observes that "although the coal companies have made massive profits from the extraction of coal, the prosperity has not trickled down to the workers of the residents of West Virginia. Despite the vast natural resources, West Virginia is the second poorest in the United States. As the most recent census data indicate, the coal-producing states are the poorest. In West Virginia, the poverty rate was 23%, the per capita income $9,326, and the unemployment rate was 14.5%" (King, 2009, page 45). These statistics are indicative of the fact that the coal companies have little concern for the status of the local communities. They are primarily concerned with cheap labor and low overheads without any reinvestment into the local communities that suffer from side-effects of mining.

The pro-coal camp asserts that the "restored" sites create new open, greenspaces for parks and other development which generate economic opportunities. Such is not the case, particularly for development. The loose material that is used to restore the contours is widely considered by engineers as unsuitable for building on. This is because the composition of restoration sites is inadequate for structural integrity due to problems with settling and lack of surface integrity. Therefore, the economic gains to reclamation sites are negated. In addition, the costs of MTR reclamation sites are compounded by the loss of ecosystem resources as well as the compensation for damages to communities as direct results of mining such as flooding and the disastrous cases of slurries failing. Entire communities have been lost because of this. Case and point, the failure of a retention wall used to contain mining waste in central Tennessee in 2008 eradicated local communities. More specifically, CNN.com reported that "a wall holding back 80 acres of sludge from a coal plant in central Tennessee broke this week, spilling more than 500 million gallons of waste into the surrounding area." In this report, environmentalists have provided estimates that the size of the spill is over 30 times the size of the Exxon Valdez spill. Although this was not at a mining site, it is in need of mentioning because the types of incidents are due to the use of coal and must be factored into the "cost" of coal as a fuel. Valley fills have similar effects in that the hydrology of the affected area is destroyed which exacerbate risks of major flooding in communities near MTR sites. The hundreds of millions of dollars spent on disaster relief at the cost of taxpayers are not considered in the bottom line.

Again, the so called "low cost" cost of coal does not include other negative externalities associated with its mining and use, such as long-term social and environmental costs. In terms of lost ecosystem resources, we must again address the valuation issue. In Environmental Science: toward a sustainable future, Wright and Boorse explain that MTR "totally destroys the ecology of the region, as forests are removed and streams are buried by the coal wastes" (Wright, 2011, page 365). What is the value of the lost ecosystem resources? For example, clean water previously provided by natural sources is no longer available. This means that the alternative would be install additional treatment plants to restore the water quality in affected areas to usable levels. The discharges from mining sites, due to the presence of heavy metals, result in the most difficult of treatment challenges. That being said, coal companies are not required to install such facilities; which effectively absolve them of the associated costs.

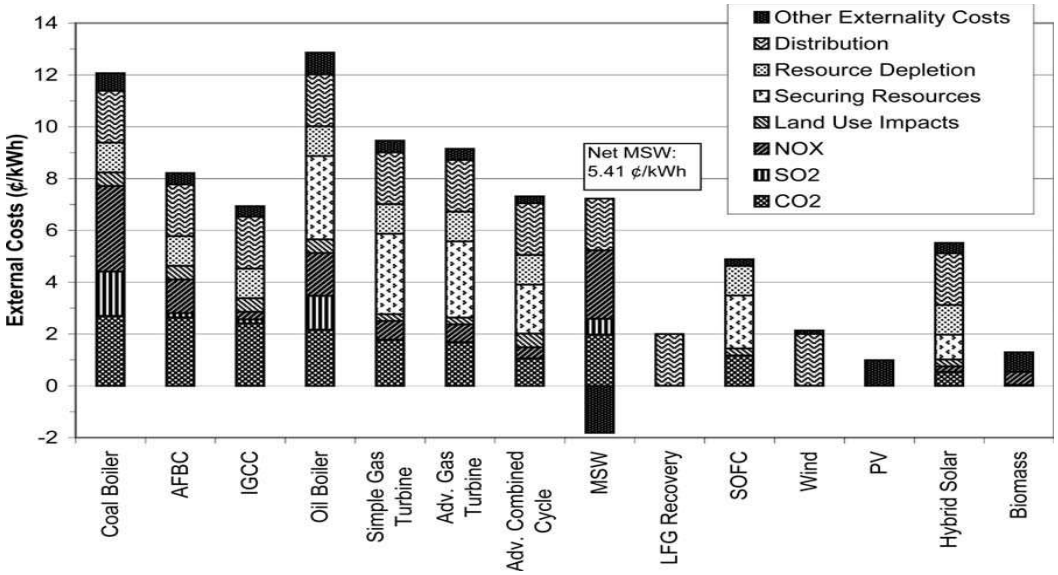
A study conducted by scientists Roth and Ambs investigates the cost of coal when externalities are considered. They report that although the study was confined to "[…] one region in the country, Appalachia, […] its conclusions were national. […] Mountaintop removal was examined -- some 500 Appalachian summits have been removed, transforming 1.4 million acres -- to extrapolate costs of polluted and buried streams, drinking water contamination, and methane and carbon releases due to disturbed lands." The costs of cleanup (even if possible) would be enormous. These sites will take years to recover from side-effects, if they ever do. Advocates argue that reclamation of mining sites undo the environmental damage that has occurred. They do not restore sites voluntarily. In an attempt to alleviate the effects of coal extraction, the Surface Mining Control and Reclamation Act vainly requires coal companies to "…restore the land to the pre-mining use or a reasonably likely higher use; restore the topsoil or the best available subsoil to support vegetation; ensure that reclamation efforts proceed in an environmentally sound manner and as contemporaneously as practical with the mining operations; to the extent possible using the best technology available, minimize disturbances and adverse impacts on fish, wildlife, and related environmental values, and achieve enhancement of these resources where practical." This is an impossible task. Wright and Boorse ascertain that, after grading and replanting, "it takes many decades before an ecosystem remotely resembling the original one can develop, and the topography is in shambles" (Environmental Science, 2011, page 365). The Act is simply trying to achieve some sort of damage control and mitigate the after-effects of the mining process but, as we have already discussed, the environmental and health impacts during mining alone constitute significant economic costs. Valuating the long-term effects would raise societal and environmental costs exponentially.

King and Leslie bring attention to the predatory nature of the coal industry by explaining that "coal companies […] control vast natural and economic resources and have the capacity to apply any technology that will intensify the rate of production, regardless of the social and environmental costs to society as a whole" (Environmental Sociology, 2009, page 44). They recognize that "the price of a cheap energy source such as coal does not include the 'negative externalities' of mountain-top strip-mining. Indeed, the reduction of all such costs to externalities that do not enter into the balance sheets of corporations makes both human beings and natural externalities of the market valueless to the bottom line"(45). The energy industry is partly to blame for these types of misrepresentations, both at the state and federal levels. They succumb to the financial and political pressure from the coal industry, partly because of an

unwillingness to devote resources and monies to fully investigate the effects of the coal industry. They also hesitate due to the amorphous nature of the negative externalities.

Dr. Paul Epstein, who conducted the Harvard medical study mentioned above, in a similar light, suggests that "accounting for these 'hidden costs' doubles to triples the price of electricity from coal per kWh, making wind, solar, and other renewable very economically competitive. Policymakers need to evaluate current energy options with these types of impacts in mind. Our reliance on fossil fuels is proving costly for society, negatively impacting our wallets and our quality of life." This persistent reliance on coal for generating electricity undermines the development of other alternative fuels and energy sources that present far less environmental and social costs. This situation presents a two-fold problem in that the impacts of coal continue and the potential environmental recovery is delayed.

The following graph shows the estimated cost of coal to other sources of energy, when externalities are included in the cost function. An "honest" pricing of coal would place it second to only oil and only slightly less expensive than natural gas. It is also important to recognize that the costs other forms of electricity generation such as solar, wind, and biomass (last four bars) presently considered "expensive" pale in comparison when these externalities are considered.



Source: Roth, I, & Lawrence, A. (2004). Incorporating externalities into a full cost approach to electric power generation life-cycle costing. Energy, 29(12-15), 2125-2144.

Conclusion and Solution

In conclusion, the environmental, social, and economic costs (when externalities are considered) of our reliance on coal by far outweigh the benefits. Of the mining practices, mountaintop removal is the most aggressive, environmentally damaging method for extracting coal. In addition, coal combustion has extreme nationwide environmental and health-related implications. The Virginia Tech community is directly subject to many of the adverse conditions

related to coal generated electricity due to its on-site coal-fired power plant. Although these factors require attention and bear relevance to our argument, confining the discussion to the impacts of mountaintop removal is enough to generate salient reasons as to why the use of coal must be phased out and eventually ceased. Coal, when considered "cradle-to-the-grave", literally affects every element of our surroundings. It is the cause and source of innumerable detrimental effects to the quality of air, water, and land. With damages being so comprehensive, the arguments presented by coal advocates wane significantly. We are not in a situation where coal presents the only option for the generation of electricity and are forced to resort to it. It is, essentially, strictly business without any outside considerations. There are numerous, more environmentally and health-friendly alternatives coming online such as renewable energy applications that have minimal such affects. The actual social, environmental, and monetary costs of coal, as described above, are far greater than what the industry indicates or incorporates into its cost figures. When an honest comparison is made to alternative and renewable energy sources, the scales tip in favor of cleaner fuels with little to no environmental impacts. Already, markets and technologies are developing to where these new energy sources are becoming increasingly more affordable. When the factors presented in this study are considered, they may, in fact, be cheaper in the long-term. With Virginia Tech being a research institution, it is in an advantageous position to develop such technologies. It is afforded the resources of highly dedicated and progressive energy researchers as well as an exceptionally equipped engineering program which facilitate progress toward these ends. Renewables and alternative fuels must become the primary source of energy. The transition away from coal must begin on the demand-side through efficiency and conservation measures. This alone will yield dramatic reductions in the use of coal, which will translate beneficially to public health and environmental wellbeing as well as serve as a bridge to renewable energy applications. Let's go Hokies!

Work Cited

"Coal Mining: Injuries, Illnesses, and Fatalities Fact Sheet." ***U.S. Bureau of Labor Statistics*****. Web. <http://www.bls.gov/iif/oshwc/osh/os/osar0012.htm>.**

This website highlights the dangers of being a coal miner. This site is to be trusted because the U.S. government, specifically the Bureau of Labor & Statistics, runs it. The information directly from this site should be deemed credible

"Community Impacts of Mountaintop Removal « Appalachian Voices." ***Appalachian Voices*****. Web. <http://appvoices.org/end-mountaintop-removal/community/>.**

This website goes into detail about how residents of MTR communities feel. It shows the effects that MTR has on the surrounding areas from the viewpoints from someone on the inside. This website is valuable because it gives the perspective of the people actually living in these communities.

Corrosion Proof Fittings v. U.S. Environmental Protection Agency, 947 F.2d 1201 (U.S. Ct. App., 5th Cir., 1991)

In conjunction with the Harvard study covered in this study, this provides a theoretical value to the human life variable that is derived from an EPA argument in a case dedicated to resolving the costs and benefits of toxic substance regulations. Although not directly involving mountaintop removal mining, there are correlations in the negotiation public health issues against the value of industrial practices that have relevance to the public. The credibility of this reference is absolute.

Daley, B. New Harvard study examines the full cost of coal. ***The Boston Globe*****.**

Retrieved from

http://www.boston.com/lifestyle/green/greenblog/2011/02/new_harvard_stud

y_looks_at_ful.html

This article provides reference to the wide ranging health effects of the coal industry and, more specifically, the deaths related to coal mining. It serves as a basis for our extrapolation of valuating the cost of human lives lost to the industry when coupled with other interpretations that are presented in this study.

Darrow, Robert R. (2010). ***Searching West Virginia for a democratic response to***

mountaintop removal**. Blacksburg, VA: Virginia Tech.**

This source is relevant because it discusses the impacts mountaintop removal has on the coal communities. It also explores the social, economic, political, and environmental consequences of MTR. The paper is credible because it is a peer reviewed thesis paper.

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Dictionary.com | Free Online Dictionary for English Definitions**. Web. 10 Apr. 2011.**

<http://dictionary.reference.com/>.

This website was necessary to make a point on the word "reclamation." It helped talk about how reclamation isn't the right word to use when comparing MTR sites before and after excavation of coal. This site is reliable because it is an online dictionary used widely and is respected for giving accurate definitions.

Hendryx, Michael, and Melissa M. Ahern. "Relations Between Health Indicators

and Residential Proximity to Coal Mining in West Virginia." ***American***

Journal of Public Health **98.4 (2008): 669-671.** ***Academic Search Complete*****.**

EBSCO. Web. 28 Mar. 2011.

This study illustrates the rates between certain health indicators like COPD and Black lung to how close residents live to coal mining. This study is credible because it was completed by two researches at West Virginia University and then published in the American Journal of Public health, a respectable source.

Hendryx, Michael, Melissa M. Ahern, and Timothy R. Nurkiewicz. "Hospitalization Patterns Associated with Appalachian Coal Mining." ***Journal of Toxicology & Environmental Health: Part A*** **70.24 (2007): 2064-2070.** ***Academic Search Complete*****. EBSCO. Web. 28 Mar. 2011**.

This study shows the effects that MTR has on the health of the surrounding communities. It was conducted in West Virginia, Kentucky, and Pennsylvania because these states all have large coal industries. The study was conducted by researchers at West Virginia University as well as Washington State University, two schools which are well recognized in the scientific community.

Roth, I, & Ambs, L. (2004). Incorporating externalities into a full cost approach to electric power generation life-cycle costing. ***Energy*****,** ***29*****(12-15), 2125-2144.**

This is a peer reviewed article that mathematically quantifies the specific externalities identified in the study. It addresses the difficult concept of valuating externalities and derives cost-of-energy comparisons of coal to other sources of energy.

Shirley, Stewart Burns L. (2005). ***Bringing Down the Mountains: The Impact of Mountaintop Removal Surface Coal Mining on Southern West Virginia Communities, 1970-2004*****. Morgantown, WVA: West Virginia University.**

This book discussed much of the impacts the MTR has on the environment and the health of the communities. It is very comprehensive and gave a great scope of the many issues that pertain to mountaintop removal. This source is credible because it is a peer reviewed thesis paper.

Simone, Samira. (2008, December 24). ***Tennessee spill runs over homes, water*****. Retrieved from http://www.cnn.com/2008/US/12/23/tennessee.sludge.spill/?iref=mpstoryview**

This is an online article that presents a real world case of the extent of potential societal repercussions of the failure of control systems used to contain waste elements of the use of coal for the generation of electricity.

Sludge Safety Project for Coal Sludge Impoundments**. Web. 13 Mar. 2011. <http://www.sludgesafety.org/>.**

Sludge safety is a website whose purpose is to educate the public about the hazards of coal waste. It provides a thorough overview of how coal waste is treated. This website is helpful because it provides facts in an easy to understand way. They also provide links to the sites that they get their information from. The sites used include government websites such as NASA, as well as links directly to the energy company themselves.

Wright, R, & Boorse, D. (2011). ***Environmental science: toward a sustainable future.***

San Francisco, CA: Pearson Benjamin Cummings.

This is an educational publication that addresses the many elements of environmentally relevant practices and offers information on the impacts of and potential alternatives to such practices. It provides a comprehensive overview of environmental issues, causes, and approaches to address them. It holds value in offering factual information for the purposes of our analysis.

30 U.S.C. §§ 1201-1328, August 3, 1977, as amended 1978-1982, 1984, 1986, 1987,

1990 and 1992 (SURFACE MINING CONTROL AND RECLAMATION

ACT OF 1977).

This is a reference to a legislative statute that has direct relevance to the issue of discussion. It serves to provide a legal frame of reference. The credibility of this reference is absolute.

"What Is Chronic Obstructive Pulmonary Disease (COPD)?" ***National Heart, Lung***

and Blood Institute**. Web.**

<http://www.nhlbi.nih.gov/health/dci/Diseases/Copd/Copd_WhatIs.html>

This site explains what COPD is as well as the short-term and long-term consequences. The explanations should be taken seriously because this site is run by the U.S. Department of Human and Health Services, specifically the National Institute of Health, who's sole purpose is to provide accurate information to citizens.