

Effects of Clean Energy on Appalachia

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Abstract

The aim of this research paper is to analyze and abstract the situation of the Appalachian coal mining communities. The effects of clean energy are not always positive for every group with a stake in the situation. Some groups will be marginalized and be negatively impacted by a positive overall technological innovation.

The situation will be analyzed through the usage of the Social Construction of Technologies framework (SCOT). SCOT holds that technology is driven by social factors and is not an absolute system. The winner of the technological race needs to win hearts and minds and is not inherently the best. States dominated by Appalachian coal mining, such as West Virginia, are excellent sources of information and easily extrapolated to the wider Appalachian community. Also the US Department of Energy contains many useful statistics on energy production in the United States and how they have trended in the past.

Technology has been constructed through society's changing desires. Now that the majority of Americans have access to electricity, the focus has shifted to how it is produced. Capital and time have been allocated from coal to newer sources of energy. Wind, solar, hydro, tidal wave, geothermal and even the transitional fuel natural gas. People's desire for clean air has allowed research, capital, and government mandates into wind, solar, wave, and hydro increasing their market share by massive amounts over the last thirty years even though they can be more expensive to produce than coal is.

While natural gas is not a true clean energy source it has the benefit, through capital investments, of being cheaper than coal is with lower emissions. In the past forty years natural gas has replaced coal in many places leading to lower demand for coal nationwide.

In conclusion: the stakeholders desire for cleaner energy has diverted market share from coal to natural gas and renewable energy sources. This change is a direct result of social forces as their opinions of the best technology has changed. This change has left the Appalachian communities holding the bag from the old technology. The miners, through this transition, have to experience unemployment, displacement and loss of culture, and uncertainty as their technology and livelihood is left behind by the rest of the stakeholders.

Effects of Clean Energy on Appalachia

Introduction:

Since the start of the second industrial revolution, the Appalachian Mountains have been a major source of coal for the rest of the nation. The residents of the mountains, an ethnocultural minority of the United States, have built their society from an agricultural system into a resource extraction society to serve the main source for wealth creation in the region: the coal mines (Lasson, 1972). Public perception has shifted in the past few years, and greener energy sources are on the rise, supplanting coal power. The changing of technology has a direct impact on the Appalachians, their culture, and their livelihoods.

The main framework that will be used to analyse the situation of the Appalachians and their relation to clean energy is SCOT: Social Construction of Technology. SCOT holds that a wide range of social factors ultimately decides whether a technology is embraced or discarded (encyclopedia.com, 2020). A technology is not merely created as inherently the best solution but must win the hearts and minds of the stakeholders to be the best technological innovation. The stakeholders will, in turn, drive the technology forward. The stakeholders are the groups who have a vested interest, or are affected, by an action, policy, or technological innovation. The citizens of the United States, the energy companies, the government, tradesmen that will be replaced by the new technology; these groups are the stakeholders with vested interests, ideas, and the ability to influence a technology's development and usage. Besides the stakeholders, there are marginalized groups who are negatively affected or excluded by the technology.

Examples of marginalized groups include blind people and touchscreen technology. While touch-interface technology has revolutionized cell phones, becoming the best option to the stakeholders, blind people are excluded from its direct benefits and therefore marginalized as compared to push button input devices.

Background:

While usage of coal dates to before the founding of the United States, the widespread need for coal occurred in the nineteenth century spurred by the industrial revolution. Coal dug from mines in Pennsylvania all the way to Alabama provided the power to turn iron into steel, power steam engines, and heat homes (Lasson, 1972). With electricity's allure in the eyes of the stakeholders, who were the people of the nation, the need for coal exploded, turning the difficult to reach hollows of the Appalachians into a source of wealth.

The Appalachians themselves are an ethno-cultural group who are descendants from farmers and backwoodsmen hidden away from the outside world by their impassable mountains. The difficulty in easy access for new peoples, technologies, and capital to penetrate the mountains allowed for a semi-unified cultural identity to form separate from their respective states. With the coming of the industrial revolution, railroads and dynamite allowed the construction of roads into the mountains. Railroads to ship the coal out to the cities also allowed new technologies and organizational structures to flow into the mountains. Unification of the mines under large corporations like US Steel turned the miners into an almost slave labor force; unable to own property, unable to quit, and forced to use company money at company stores. Labor unions gave a voice to the miners and better representation allowed for a better standard of living. Coal mining jobs allowed the Appalachian communities to build schools, roads, hospitals, and attend universities. However, coal production peaked in 2007 in the US and has been on a

steady decline ever since. Evidence for the decline in coal is shown in Table 1 with selected years of energy production data from the U.S. Energy Information Administration displayed.

Table 1: USA energy production for select years by type in million kilowatt-hours

Year	Coal	Oil	Natural Gas	Solar, Wind, Biomass, Waste
1985	1,402,128	100,202	291,946	10,725
2007	2,016,456	65,739	896,590	105,238
2019	966,148	18,567	1,581,815	406,877

(EIA, 2020)

After the 1980s, the stakeholders' identification of the “best” technology began to shift from coal to sources that are renewable, or at minimum cleaner burning, than the black smoke often associated with the burning of coal. This shift drove the innovation, improvement, and implantation of different energy sources. Public pressure on lawmakers saw clean air ordinances, financial incentives to switch to natural gas, wind, solar, and an overall more diverse methodology for energy production. The changes in energy production left the coal mining community marginalized as the stakeholders took technological innovation in a new direction.

Clean energy:

What constitutes clean energy? There is a broad range of clean energy technologies ranging from carbon based natural gas and wood to solar based wind and photovoltaic. The singular threads that bind the technology of clean energy together are their differing methods of process sustainability and net carbon output. Natural gas, while not a true clean energy source, is more efficient than coal power and produces less carbon dioxide making it a green “transitional” energy source and is therefore considered in the effects of clean energy for the time being.

Biomass, waste to energy, and wood are another group of options, while being some percentage renewable, are more carbon dioxide neutral than coal or oil but are easier to implement on economies of scale like the coal and petroleum they are replacing. Wind, solar, and geothermal power are able to be completely carbon neutral but are harder to generate the same volume per power plant. Hydro electric and nuclear power plants are considered clean energy but their negative image due to environmental disasters have set them apart in the minds of the shareholders shaping technological advancement. (USDE, 2020)

Usage of clean energy:

As the stakeholders have retooled their desires from electricity at any cost into electricity from cleaner sources, there has been a shift of capital and labor towards new technologies and away from the older sources of power. A significant number of people support wind, solar, and other cleaner energy sources to do away with dirty industry all together and divert the capital accordingly (Pew Research, 2016).

As the usage of clean energy increases the need for older sources of energy decreases. Utilization of wind has increased by almost 300 million megawatt-hours in thirty years(EIA, 2020). Solar, biofuel, waste to energy, and geothermal also account for a large portion of the clean energy market. In the same time that the clean energy market has risen, the amount of coal burned peaked in 2007 and has steadily decreased from 2.16 million gigawatt-hours to 966 million megawatt-hours in 2019.

Comparing the two trends shows an inevitable end to coal mining. Even if coal was free and readily available, neatly piled in a warehouse at the powerplant, the public's focus is trending towards renewable energy and therefore the coal industry is going the path of the hitching posts that once lined the streets of the world's cities. Using western europe as a model

for a future with heavy clean energy usage you can see that coal power is rare and wind/solar farms are the norm. In coastal countries like the Netherlands, there has been a huge shift to using wind energy off-shore where winds are always good year round and the negative effects like noise are less of a hassle. Clean energy has been classified as the “best” technology on the grounds of either having a lower or zero impact on the environment, being infinite or at least in greater abundance than the old sources, or both.

There is also a monetary component to the construction of a technology. In the case of coal, its biggest competitor and the source of coal’s loss of market share is natural gas. Natural gas, according to the International Energy Agency (IEA), typically saves \$22 per MWh over coal (IEA, 2019).

Adverse Effects of Technological Advancement:

Appalachian communities have seen a rising unemployment class. No mining jobs means no money for secondary economic routines like stores, entertainment, or services to improve personal property. According to the Appalachian Regional Commission in 2016 the mean unemployment rate in the worst sections of coal country, Kentucky and West Virginia, can be 1.5 up to 4 times as high as the national average.(ARC, 2020) According to the EIA the number of coal miners, mainly in Appalachia has dropped by 42% between 2011 and 2016. As the people leave so does their culture and society. In our modern world, it does not make sense to keep making horse drawn carriages when cars have won the public’s hearts, minds, and pocketbooks.

Communities, like Appalachia, usually have a latency period after a technological shift before they can either adapt, leave, or die out. West Virginia has been affected severely, compared to the other Appalachian states, as a significant percentage of the state is located in the

mountains and taxes on the revenues on coal provided a large section of the state and local budgets. Boone County, WV as an example over a 5 year period shows a decrease in revenue of \$4 million from 2012-17 (Morris, Kaufman, Doshi, 2019). The higher unemployment also has an effect on revenues as there are fewer people to pay taxes at the higher brackets. Without coal dollars, the state cannot pay for governmental or societal machines needed for the smooth operation of society, as there is no money. No new roads, bridges, tunnels, schools, etc; these are the effects of the shift in technologies for these rural communities.

It is difficult to argue the merits of the stakeholder's determination as to the best technology. Who in their right mind would want dirty air, water, and unhealthy futures for their children, but that does not mean that there are not marginalized groups. As the carriage-makers of 1900 America found out, technological advancement means the abandonment of the old ways. The Appalachians, who for so long have had coal mining as their bread and butter, have become marginalized by the majority of the stakeholders in American society. With no foundation level economic creation by mining, the miners have three choices: stay and wait for the jobs return, move to another region or state and start a new career, or retire (if they are old enough). Moving to a new region has been the main form of cultural drain on the region as most families send their children to universities or the military and never return permanently to their homeland. Retiring is not a long term strategy for the region as eventually everyone dies off. Waiting for jobs to return has left the region destitute and impoverished with no way out. In the past the miners were used to mines closing and reopening under new management and have treated the technological shift the same way.. Another example from WV on population change comes from the West Virginia Policy group, which published that for southern WV the total population change in certain counties can be up to 17%. (O'leary, 2019).

Interpretation:

Technologies have different interpretations according to which group is asked. While nuclear power is viewed by its supporters as a good, the “best” technology, with claims of clean energy and high efficiency this is not the case to its detractors. Those against view nuclear power as the “best” technological option, citing disasters like Chernobyl as proof of their side's righteousness. Everytime a nuclear plant is proposed, protests to its construction begin almost immediately from its detractors, their interpretation of the technology is negative.

To supporters of clean energy technologies like wind turbines, solar panels, wave power stations, geothermal plants are good, they are the “best” in their book. To the coal miners, clean energy sources may be the better alternatives but the secondary effects add up to make clean energy a bad thing, in their eyes. When a wind turbine farm was proposed on a mountain ridge near Bluefield VA/WV the local government passed ordinances that ended up prohibiting their development, killing the project. (Owens, 2010) The interpretation of the coal miners of clean energy is negative, they do not believe it is the “best” technology available.

Technological Closure:

The bifurcation the Appalachians have, as compared to the rest of the general population of the US, in their opinion of clean energy will eventually close. As stated earlier in the document, it's hard to argue that dirtier air, unhealthy children, and more expensive energy sources are a good idea in the long run. Shifts in Appalchian perception of clean energies' economic downsides for their industry will eventually fade. Either through population decline, adaption to the change, or introduction of a new technological innovation; one of two possibilities will occur. Either the communities will learn and adapt to the new norm and find a way to prosper given the negative impacts of clean energy adoption; or the community will

become more marginalized than they already are. If there are fewer people, or their opinion carries less weight, able to bring awareness of the negative effects, then they will become more marginalized than they already are. Either way, the matter will close.

Conclusion:

The future of energy production in this country, and probably around the world, is trending towards cleaner energy technologies. The stakeholders - whose monetary capital, voting power, and perception of the best technology - have shifted their priorities towards renewables and have marginalized the Appalachians from discussion. The miners who used to be participants in the construction of coal technology are being left behind as society moves to construct a new technology using cleaner energy.

Is clean energy to blame for the woes of the Appalachian mining community? Not wholly. Natural gas, while cleaner burning than coal, is not a true clean energy but through public perception as a cleaner and cheaper alternative has eaten away at coal's market share and cost has supplanted the coal mines and the livelihoods of the Appalachians.

Stakeholders have moved on from coal by constructing two technological routes, natural gas as a transition and clean renewables as the future of energy production.

References

Appalachian Regional Commission, (2016), *Relative Unemployment Rates in Appalachia, 2016*,

Retrieved from: <https://www.arc.gov/map/relative-unemployment-rates-in-appalachia-2016/>

Encyclopedia.com (2020, Nov 22) *Social Construction of Technology* Retrieved from:

<https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/social-construction-technology>

IEA, 2019 Retrieved from:

<https://www.iea.org/data-and-statistics/charts/difference-in-the-levelised-cost-of-electricity-between-natural-gas-ccgt-versus-coal-plants-supercritical-in-the-united-states-2013-2017>

Lasson, K. (1972, March), *A History of Appalachian Coal Mines*, Published by University of Baltimore Law, Retrieved from:

https://scholarworks.law.ubalt.edu/cgi/viewcontent.cgi?article=1789&context=all_fac

Morris, A. Kaufman, N. Doshi, S. (2019, July) *The Risk of Financial Collapse in Coal-Reliant Communities*, Brookings Institute, Columbia University, Retrieved from:

https://www.brookings.edu/wp-content/uploads/2019/05/Morris_Kaufman_Doshi_RiskoffiscalCollapseinCoalReliantCommunities-CGEP_Report_FINAL.pdf

O'Leary, S. (2019, April 12) *The Where and the How of West Virginia's Population Decline*, West Virginia Center on Budget & Policy, Retrieved from:

<https://wvpolicy.org/the-where-and-the-how-of-west-virginias-population-decline/#:~:text=Between%202010%20and%202018%2C%20West,or%20a%20decline%20of%202.6%25.&text=Urban%20counties%20saw%20their%20population,population%20much%20faster%20than%20anticipated.>

Owens, C. (2010, February 2) *No to Windmills: Board Blocks Turbine Project*, Bluefield Daily Telegraph. Retrieved from:

<https://www.wind-watch.org/news/2010/02/02/no-to-windmills-board-blocks-turbine-project/>

Pew Research Center, (2016, October 4) Page 2, Retrieved from:

<https://www.pewresearch.org/science/2016/10/04/public-opinion-on-renewables-and-other-energy-sources/>

U. S. Department of Energy, *Clean Energy*, Retrieved from:

<https://www.energy.gov/science-innovation/clean-energy>

U. S. Energy Information Administration (2020, September) Monthly Energy Review September

2020 P. 129, Retrieved from: https://www.eia.gov/totalenergy/data/monthly/pdf/sec7_5.pdf

Thank you