Aim/Purpose

The purpose of this study was to garner a more in-depth understanding of the environmental impacts that current-day industry has on the post-industrial Rust Belt.

Background

The study was undertaken in three identified counties in Southwestern Pennsylvania. It analyzed 11 years of data assessing violations cited against the oil and gas industry and county annual particle pollution recordings.

Methodology

The research used cluster, systematic and purposive sampling techniques. Quantitative methods of data collection and analysis were used to develop a linear regression model.

Findings

Results showed a moderate correlation existed between the DEP-cited violations of the oil and gas industry and particle pollution air quality recordings. R2 or correlation coefficient and was recorded in this study at 0.466206. The regression model statistical significance (F 9.442003 = P value of 0.004159; p ≤ 0.05) which accepted of the alternative hypothesis.

Impact on Society

The research illustrates an extensive overview of the post-industrial Rust Belt and provides evidence for the need to continue to facilitate further study and open dialogue to more optimally understand the potential effects and negative consequences of short-sided economic policy that is detrimental to the environment.

Keywords

Rust Belt, Deindustrialization, Brownfields, hydraulic fracturing, Per-and polyfluoroalkyl substances (PFAS), Citizens United v. Federal Election Commission

* Corresponding Author

© The Author(s) 2020. Open Access: This article is distributed under the terms of the Creative Commons Attribution 4.0 International License. (https://creativecommons.org/licenses/by-nc/4.0/)
## Areas of Contribution

### Paper Category
- [ ] Original Research
- [x] Case Study
- [ ] Reviews
- [ ] Position Paper
- [ ] Technical Briefs
- [ ] Student Paper
- [ ] Comparative
- [ ] Opinion
- [ ] Innovation Ideas

### Type of Study/Innovation
- [ ] Radical
- [ ] Incremental/Enhancing
- [ ] Disruptive
- [ ] Breakthrough
- [x] Basic Research
- [ ] Sustaining
- [ ] Architectural
- [ ] Component/Modular
- [x] Discriminatory Bias

### Industry
- [ ] Media
- [ ] Telecom
- [ ] Consumer Financial Services
- [ ] Retail
- [ ] Technology
- [x] Policy
- [ ] Consumer Products
- [ ] Non-Profit
- [ ] Business/Professional Services
- [ ] Higher Education
- [ ] Diversity and Inclusion
- [ ] Training
- [ ] Health Care
- [x] Manufacturing
- [ ] Transportation

### Discipline
- [x] Business Technology
- [ ] Human Resources
- [x] Management
- [ ] Marketing
- [ ] Finance
- [ ] Accounting
- [ ] Computer Science
- [ ] Engineering
- [ ] Medicine / Healthcare
- [ ] Law and Justice
- [ ] History
- [ ] Philosophy
- [ ] Religion/Theology
- [ ] Mathematics
- [ ] Physics
- [ ] Digital Media
- [x] Environmental science
- [ ] Social Sciences
- [ ] Art and Culture
- [ ] Psychology/Consciousness
- [ ] Astronomy
- [x] Economics

### Human Elements Addressed
- [ ] Personality Traits
- [ ] Behavior
- [x] Equality and Equity
- [ ] Development
- [x] Environmental
- [x] Social
- [ ] Mental Wellbeing
- [ ] Consciousness
- [ ] Physical Wellbeing
INTRODUCTION

The nation’s Rust Belt was a name coined in the 1980s to capture the sharp decline of industry and manufacturing throughout the U.S. Northeast and upper portions of the Midwest that specialized in larger-scale manufacturing and ongoing transport of finished medium to heavy industrial raw materials and consumer products and goods (Chen, 2022). The Rust Belt name invokes the economic decline, ongoing population loss, and urban decay of a region in a post-industrial region, as it once was a manufacturing and production powerhouse sector of the nation with a concentration on coal mining extraction, steel fabrication, automobile manufacturing, and railroad transport just to name a few (Figure 1).

This region generally is defined as parts of Western and Central New York, Pennsylvania, Ohio, Northwestern West Virginia, Northern Indiana, northeastern Illinois, the Lower Peninsula of Michigan, Southeastern Wisconsin, and Northern segments of Kentucky, each state making up this region was influential and contributed to the rise of the nation’s economic stature (Wallenfeldt, 2023). As the nation’s core industrial manufacturing center, the region flourished due to its natural resource, overall geographical makeup along with its proximity to the water access, including the Ohio River and Great Lakes, to coincide with supporting infrastructure and railway systems that provided access for global trade. Yet, while economic growth was rapid, so too was the extensive and noticeable amount of pollution. Air, waterways, and soil were all heavily polluted throughout decades of non-existent oversight and regulation, leav-
ing residents and wildlife residing in this region, often unknowingly, exposed to a high level of environmental health determinants (Gibbons, 2017).

**History**

Beginning in the late 19th century, the Rust Belt region was an offshoot of the Gilded Age, as industrialization increased, it necessitated the demand for an unskilled labor force which was found in the influx of millions of European immigrants to the United States. The Rust Belt, rich in natural resources and an ideal geographical setting, served for decades as a magnetic epicenter for manufacturing production that sparked job opportunities and innovation (Teaford, 1993). The Rust Belt attracted a flood of immigrant populations, as these individuals served as an inexpensive labor force and were instrumental to the manpower serving the industrial facilities and production lines (McCelland, 2013). The abundant success and revenue windfalls created high levels of regional economic growth and the eventual advent of corporations producing on a global scale that included the likes of Carnegie Steel, founded by Andrew Carnegie, General Electric co-founded by corporate-financier J.P. Morgan, Good-year Rubber and Tyre Company, founded by BF Goodrich, and the Ford Motor Company, founded by Henry Ford. Great fortune became commonplace for enterprise founders in the Rust Belt, and it ultimately led to the creation of the world’s first billionaire, John D. Rockefeller, the founder of Standard Oil Company (Pilot Guides, n.d.).

Yet, the aforementioned corporate tycoons were not only economic giants but heavily influential in defining the nation’s domestic and foreign policy (Berman, 1983). Their financial might enabled unique strategic maneuvers to develop and share an overlapping board of trustee appointments in their related industries of the likes of steel, oil, sugar, and railroad trust industry. These appointments allowed a select elite group of corporate leaders to leverage their financial might to reshape the nation’s political landscape. These events enabled an unbridled ability to financially support legislators, who in part, during this period, held direct responsibility to choose the nation’s future senators, who once elected, held great influence in the selection of the nation’s presidential candidates. This type of corporate influence provided an unparalleled power to define the blueprint for the nation for decades to come.

Such instituted policy directly supported and strengthened the Rust Belt, especially its corporate industry sector growth, as limited economic and environmental controls (Nolette, 2012), and oversight further aided in production to enable the nation to yield the world’s highest gross domestic production (GDP) starting in 1890 (Library of Congress, n.d.).
This economic prosperity spawned a population that more than doubled in a fifty-year timeframe from 1850 to 1900, with seven of the ten most populated cities being located in Rust Belt states by the beginning of the 20th century (U.S. Bureau of the Census, 1998). This growth also enabled high-level innovation to take place that was instrumental in the United States’ efforts to achieve a superpower designation in the eyes of global society, as it became recognized for its inherent ability and expertise to exert influence, both economically and militarily, on a global scale (Hunter & Lynwood, 2012). Rust Belt productivity dominance continued throughout the early part of the 20th century, with several boom periods creating compounding gains in GDP production and continual population growth that was further strengthened with the advent of two world wars. Yet, while economic growth rates at the beginning of the 20th century spiked, so too were the levels of civil unrest from both a social and economic lens (Brief History of American Labor, n.d.).

**Trustbusting and Ideological Shifts**

During the early periods of the U.S. Rust Belt’s industrial boom, corporate enterprises flourished as they took full advantage of laissez-faire government oversight and intervention that coincided with a significant amount of pro-corporate policies (White, 2017). While these conditions created an extensive boom period of production, and allowed corporate enterprise the opportunity to expand capital project development and infrastructure, it created, in many cases, industrial monopolies. Industries like steel, oil, and tobacco all were classified as monopolies by the late part of the 20th century (Sabin, 2023). Industrial monopolies, by definition, eliminate competition and allow for corporate price-fixing which is detrimental to the buying public. The U.S. federal government made efforts to intercede in these matters and instituted the Sherman Antitrust Act, which was adopted into legislation in 1890 as a response to public outcry over price-fixing abuses by corporate monopolies. The Sherman Antitrust Act enabled the federal government to dissolve corporate trusts and prohibit activities that restricted opportunity for interstate commerce and marketplace (National Archives and Records Administration, n.d).

Yet, real traction was not fully gained until the nation’s 26th President Theodore Roosevelt, appointed in 1901, truly began to utilize the Sherman Antitrust Act to its fullest powers, as Roosevelt saw it as his weapon of choice to address corporate greed head-on, along with ongoing public exploitation (The Northern Securities case, n.d.). Roosevelt believed corporate trust for too long abused its power and the public interest as they believed themselves superior to the elected government officials. Yet, it was discovered that not only were these
corporations abusing the economic modalities of the nation, but also abused the nation on a social level. These types of deemed bad actions, Roosevelt believed, would ultimately result in a violent uprising by the people that could jeopardize the very fabric of American democracy (Gould, 2011). Roosevelt took decisive action against corporate trusts and directly targeted and filed suit against some of the largest corporate tycoons, including J.P. Morgan, and was successful in the dissolution of Morgan’s Northern Securities Company. The type of leadership depicted by Roosevelt began to create platforms for more equitable economies and further led to the creation of legislation to address loopholes found in the Sherman Act by instating the Clayton Act in 1914, as it not only targeted monopolies but defined certain illegal business practices and activities that are conducive to the formation of future monopolies (Boudin, 1942).

The transformation in corporate legislation also gave way to new federal labor laws that protected some of the social discourse, specifically of the working class, and drafted legislation such as the 1916 Federal Compensation Act. This act provided benefits to workers injured in the workplace, and later, the institution of the 1935 National Labor Relations Act which protected against unfair labor practices and protected workers’ rights to strike and collectively bargain (Summary of the major laws of the Department of Labor, 2002). Additional legislation included the protection of child labor, the institution of the forty-hour work week, and the five-day work week. While these types of developments were substantial in efforts to protect the working class and create safer working environments, they did slowly begin to strip some of the financial might and influential grip big corporations had on the nation and its policy.

**WORLD WAR II**

Even amid the demise of overall favorable pro-corporate legislation, institution of employee protective rights, global financial instability, and a Great Depression, the advent of the Second World War once again made the Rust Belt the vital heartbeat of the nation and the world by aiding to the Allied forces military success (Mahaney, 2020). Major manufacturing companies such as Ford Motors and General Motors Company transformed their factory floors from producing automobiles to tanks and fighter planes and innovation spawned new technologies and development (Baime, 2020). Around-the-clock shift production took place to provide the raw materials of steel, aluminum, and other goods that were critical to Allied forces’ military advancements that led to the ultimate victory over the Axis powers. The outcomes of the war further entrenched the United States’ mark on global dominance, as substantial financial gains were complemented by the fact that much of the rest of the industrialized
world, specifically Europe and parts of Asia were shackled by the direct effects of the destruction of war and whose cities required years of rebuild and reconstruction, while the U.S. infrastructure was utterly and completely unscathed (Council on foreign relations, n.d.). While other nations spent years rebuilding and reconstructing their cities, the U.S. enjoyed the opportunity to further scale innovation.

Yet, by 1953 the Rust Belt and its manufacturing sector witnessed its growth hit its ultimate peak, and at such point began to see subtle declines thereafter in production and financial gains (Leeman, 2007). It was a culmination of various global factors, including the conclusion of the war production and the effects of the institution legislation that was no longer as laissez-faire in corporate policy that limited corporate strength which saw the commencement of outsourcing and offshoring production activities to other developing nations (Ohanian, 2014). These nations, predominantly Asian countries, did not afford the worker rights protections, lacked corporate regulation and oversight, and provided low labor costs which enticed corporate sector leadership to seek refuge and financial haven. Other related issues that further led to the early stages of the Rust Belt industrial decline included the rise in robotic innovation, corporate globalization, and new production methods including just-in-time manufacturing enabled corporations highly efficient methods. Such insurmountable circumstances and events took away much of the Rust Belt’s competitive advantage which led to the rise in corporate outsourcing and offshoring of production.

**BOOM to BUST**

Collectively the new realities of outsourcing and offshoring began to take strong roots in the 1970s and were directed to benefit and maximize corporate profits, all but it left communities throughout the region’s Rust Belt as ghost towns. (Collins, 2019). Closures in mills and manufacturing caused ever-shrinking employment opportunities and the lack of development had a ripple effect on a multitude of socio-economic factors (Hartley, 2014). These factors created adverse conditions for communities as they coped not only with unemployment issues, but also an onslaught of population loss which sought opportunity elsewhere that caused an ongoing declining tax base, leading to a deteriorating infrastructure, and ultimately triggered social decline that included rampant opioid abuse, delinquency, blight, and the advent of generational poverty. For many communities throughout the Rust Belt, these themes have continued into the present day. Upon the entrance of the 1980s, many Rust Belt communities became all but void of opportunity as towns and cities became economically stifled by industry collapse. American Political Scientist, Francis Fukuyama
defined this the Great Disruption as the social and cultural consequences of de-industrialization and manufacturing shifting decline that transformed a once vibrant Factory Belt into a Rust Belt (Fukuyama, 1999). To coincide with the vast economic decline, was the ever-decreasing population rates in the Rust Belt. During the timeframe of 1970 to 2006, population rates depicted a stark decline in cities across the Rust Belt including Cleveland, Detroit, Buffalo, and Pittsburgh which all reported a loss of approximately 45% of their population (Hartley, 2014). As the region’s economy deteriorated and population continued to decline, so too were its environmental landscapes. The Great Disruption in many ways was also a great awakening to the decades of land, air, and water abuse and neglect that occurred due to limited or nonexistent internal controls and government oversight (Goldstein, 2014). Beginning only in the late 1950s did congressional hearings commence in reaction to an ever-increasing public concern and begin to understand how the impact of negligent corporate activity and toxic waste handling could jeopardize the nation’s environment and in part, public health (Rinde, 2017). Much of this conversation was further brought to light by marine biologist, Racheal Carson and her authored book, Silent Spring. Carson’s writings began to alert the general public about the detrimental effects and impacts of indiscriminate use of pesticides and how the improper disposal of toxins had detriment on the environment and one’s overall health and wellness (Carson, 1962). This research came much from Carson’s own lived experience residing in Springdale, Pennsylvania, a small town downstream from several major corporate industry production sites including Allegheny Steel. Her research shed new light on the lower life expectancy compared to the national average, as scientific evidence begins to illustrate how polluted air, water, and soil all played a role in detrimentally impacting one’s health and well-being. In the early 1970s, decades after the peak boom period of the Rust Belt production and manufacturing, was government oversight formally introduced through the formation of the Environmental Protection Agency (EPA). Over the next several decades, the agency began to study, identify, and bring awareness and action to the various and detrimental effects of environmental negligence by corporate industries throughout the Rust Belt and the nation (Rinde, 2017).

**The Current-Day Post-Industrial U.S. Rust Belt**

In the early to mid-90s a significant push was made to help reinvent Rust Belt cities and towns, to create post-industrial healthy and vibrant communities with new and innovative developments that capture emerging technologies, and create a cleaner and healthier environment, all that enticed the nation’s population back to the region (Nasar, 2018).
Deindustrialization, defined as the process of social and economic change that is often caused by shifting away from industrial capacity or activity, especially in the likes of heavy industry or manufacturing industry (Simeon, Lagakos, Ohanian, 2014) began to take place throughout the Rust Belt. A significant amount of effort by financial resource allocation by state and federal government was orchestrated to create a renaissance and renewal of economic and environmental opportunity and remove the stigma of cities defined by lack of employment and polluted manufacturing skylines. (Figure 2).

Yet, these efforts were ever-challenging, even with the fact that outsourcing and outsourcing production took place decades prior, as it still left behind a generation of structurally unemployable workers and thousands of abandoned manufacturing facilities and protection plants. Between 2001 and 2010, six of the largest Rust Belt states lost approximately another 1.5 million manufacturing jobs (Probst, 2023). To further exacerbate employment issues challenging the region, most of the manufacturing sites that remained were unabated from environmental hazards and toxins (Bullard, 1994). The EPA currently estimates, that there are over 450,000 brownfield sites, a name coined for former industrial or commercial sites where the presence or potential presence of a hazardous substance, pollutant, or contaminant, with a vast majority in former industrial/manufacturing Rust Belt states (Bullard, 1994), A temporarily obsolete abandoned derelict sites (TOADS), which is a specific type of brownfield that has riddled the Rust Belt and can include an onslaught of buildings or land that has been contaminated by hazardous substances, pollutants, petrochemicals, or other contaminants. TOADS hold a major risk factor and a persistent challenge for communities and their leadership as they are often difficult and expensive to remediate the land (Greenberg et al. 2000). In a published brownfield study that occurred in Baltimore, MD, a city where brownfields are common, researchers discovered that 68% of the contaminants found on the study site.
cause respiratory illnesses that include lung cancer and pneumonia (Litt, Tran, & Burke 2002). The research continues to go on to find that residents living less than a mile from a brownfield site were 27% to be diagnosed with some form of cancer, while 33% were more likely to contract lung cancer. It is challenges like these that have been extremely burdensome to the Rust Belt as these factors remain a significant barrier, and serve resistance to new residents taking root in such communities as the decades of unregulated discharges into air, water, and soil have created generational damage (Bird, 2016). To date, the EPA has invested over 2.3 billion dollars in environmental remediation of brownfields alone (Environmental Protection Agency, 2023a). While the federal government efforts have supported states within the Rust Belt with intervention and authored legislation to address environmental determinants and revitalize the economy with development initiatives, efforts for growth have shown to be challenging at best (Christensen, 2019). Various cities have attempted to forge ahead despite these persistent environmental challenges, and by utilizing various remediation and tax incentive programs, they have seen some levels of economic success and progression in their environments and air quality. These along with federal mandates beginning in the early 2000s which have curbed emission rates, with the EPA's 2007 Final Rule for Control of Hazardous Air Pollutants from Mobile Sources have reduced both conventional criteria and greenhouse gas pollutant emissions from automobiles (Environmental Protection Agency, 2007). This development has played a significant role in the reduction of hazardous ozone levels. Decades of population shrink to coincide with lower area medium incomes (AMIs) has created constant financial gaps in communities and towns throughout the Rust Belt. In part, many Rust Belt communities began to explore alternative ways to reignite the region (Casselman & Gold, 2012). The most recent lucrative alternatives explored, identified the oil and gas industry utilization of hydraulic fracturing to unearth natural gas (Schwartz, 2014). The Marcellus Shale in the Appalachian Basin has been recognized as one of the largest natural gas fields in the United States. This recognition has mobilized the current-day Rust Belt to host over a quarter million active hydraulic fracturing wells. But questions remain at what cost do these hydraulic fracturing wells pose on the environment?

**Marcellus Shale: Renaissance for a Region**

By the beginning of the 21st century, with the nation engaged on multiple war fronts in the Middle East, it turned to explore new ways to achieve energy independence from foreign oil sources (Remarks by the President on America’s Energy Security, 2011). New energy production was viewed as a game-changer in terms of resource access and overall economic vitality.
Capturing the outputs of prior efforts of the U.S. Department of Energy, the Eastern Gas Shales Project study commencing in the mid-1970s analyzed shale formations and deposits across the northern part of the country (U.S. Department of Energy, n.d.). The project studied and discovered substantial volumes of trapped natural gas. During this time, various economic and technological factors played in the delay of widespread drilling until the early part of the 21st century. But beginning in the early 2000s, Range Resources geologists utilized hydraulic fracturing techniques, commonly referred to as fracking, an unconventional extraction method of propagation of fractures in a rock layer by pressurized fluid used to extract natural gas and oil from the earth’s deep rock shale formations (King, n.d.). Drilling, in part, is required to extract the gas or oil by forcing water, sand, and a mixture of various chemicals injected into horizontally drilled wells. The outcome of these efforts causes the shale to split and crack, and provide a release of natural gas or oil. After implementation by Range Resources of its first well in Washington, PA in 2005, efforts spread across Pennsylvania and various other regions of the Rust Belt Appalachia region identified as the Marcellus Shale (Range Resources, 2010). Marcellus Shale is a large geographic area of prolific shale gas extraction of over 100,000 square miles, covering across Pennsylvania and West Virginia, and into eastern Ohio and western New York (The Marcellus Shale, Explained, 2017) and mirrors a significant portion of the defined Rust Belt region. The U.S. Geological Survey study estimated found that the Marcellus Shale contained 42,954 to 144.145 trillion cubic feet (TCF) of undiscovered natural gas; and was defined as the largest source of natural gas in the nation (Figure 3). This development opportunity saw an opportunity for an economic boom take place for not only the region but the nation, as over 123,000 jobs were created in Pennsylvania by 2022 alone (FTI Consulting, 2023). It also allowed the nation to become a net exporter of crude oil and petroleum products and by 2019 achieved levels of energy independence (U.S. petroleum exports exceeded imports in September 2019).

To coincide with this achievement, much of the depressed Rust Belt region now was able to tap into new sources of revenue to support local and state governments, new employment opportunities, as well as private land owners, as land mineral rights were in high demand and purchased by the oil and gas industry. This economic thrust allowed many governments a new way to begin to address financial gaps from decades of declining tax bases, individuals to develop career paths, and private owners the opportunity to generate new forms of income through annual revenues from gas and oil royalties that totaled as much as 12.5% of the value of gas provided by a well (King, n.d.). This devel-
Development gave an economic thrust as it provided life to substantial growth for jobs, as a 2015 Harvard Business School/Boston Consulting Group analysis estimated that during the first decade of hydraulic fracturing, the nation’s shale development created approximately 2.7 million jobs and held the potential to generate an additional one million jobs by the year 2035 (Porter, M., Gee, D., & Pope, G., 2015). Yet, while Marcellus Shale became the answer to many communities’ financial troubles throughout the Rust Belt, it potentially had come with a significant environmental consequence.

**The Cost of Doing Business**

While the Marcellus Shale development created an opportunity for substantial economic gains, it has also created a substantial amount of environmental concerns amongst residents and environmental scientists alike. During the time frame of 2005 to 2009, a U.S. Congressional investigation began and uncovered energy companies that took part in hydraulic fracturing used 29 different chemical agents that were present in fracking fluids in the drilling process and were identified to be carcinogenic (Waxman, H., Markey, E., & DeGette, D., 2011). These chemical agents are utilized as friction reducers, acid corrosion inhibitors, and solvents in the drilling process in the well injection site. The hydraulic fracturing process requires the construction of onsite impoundments that provide storage for an extensive amount of fresh water. These impoundments store water before and after the completion of the hydraulic fracturing process and have been linked to inadvertent health effects on humans and wildlife (Environmental Protection Agency, 2011). The presence of certain chemical contaminants has been routinely discovered in fracking water that has been discharged back into local streams and rivers (Banerjee, 2015). In the State of Pennsylvania alone, its Department of Environmental Protection has cited 57,132 violations assessed for 208,778 oil and gas wells both conventional and unconventional well sites since 2008. according to its compliance report (DEP Greenport, 2021). A report, published by Physicians for Social Responsibility, identified that PFAS (per- and poly-fluoroalkyl substances), also termed as forever chemicals, have had widespread use in Pennsylvania fracking fluids utilized in oil and gas wells.

PFAS are coined as “forever chemicals” because their inability to break down by the environment, and ultimately accumulate in the bloodstream, pose a major health concern that has been linked to a variety of serious illnesses that include but are not limited to some types of cancers, low birth weights, ulcerative colitis, and elevated cholesterol (Horwitt, Gottlieb, & Allison, 2023). During the hydraulic fracturing process, it is estimated that between 18 and 80 percent of the hydraulic fracturing fluid injected into the well site will eventually return to
the surface (Jiangang, Al-Wadei, Kennedy, & Terry, 2014). Referred to as “flow back,” this groundwater becomes heavily contaminated by the fracturing chemical mixtures and includes a high level of dissolved salts and heavy metals pulled from deep within the earth’s surface. The outcomes include groundwater that has become contaminated by the hydraulic fracturing process including direct leakage from injection well sites to coincide with the logistical issues facing energy companies to properly dispose of the toxic and radioactive frack fluid.

A New York Times news report indicated that the level of radiation in hydraulic fracturing wastewater has been measured to be as high as 18,035 pCi/L, which is thousands of times the maximum allowed by the federal standard for drinking water (White, Park, Urbina, & Palmer, 2011). This is due to the unconventional oil and gas industries’ use of radionuclides which are an injection of radioactive tracers used to determine the injection profile and specific location of fractures. To put into context the extent of the potential number of radionuclides put in use, the Susquehanna River Basin Commission estimated that 20 million gallons per day (MGD) of wastewater was utilized during 2009 alone (PA DEP, 2009). Water pollution themes continued to be reported as a 2011 environmental study raised alarms as ballooning bromide concentrations in the City of Pittsburgh Three Rivers were reported due to Marcellus Shale wastewater discharge (Hopey, 2011). The issue is that bromide facilitates the formation of brominated trihalomethanes, commonly known as THMs. When THMs enter into water treatment plants and are exposed to the disinfectant processes, the THMs become classified as volatile organic compounds (VOCs). These types of reports depict wide concern as this type of contamination can directly impact the safety of drinking water wells, which are a vital source of water for many rural communities and have been reported contaminated throughout the Marcellus Shale region (Drollette, Hoelzer, Warner, Darrah, Karatum, O’Connor, Nelson, Fernandez, Vengosh, Jackson, Elsner, & Plata. (2015).

These environmental determinants also affect not just water quality, as the earth sciences remind us that polluted water leeches into the soil and evaporates into the atmosphere (Paterson, 2021). Hydraulic fracturing has been shown to release dangerous petroleum hydrocarbons into the earth, these include such chemicals as benzene, xylene, toluene, ethylbenzene, and xylene. Concerning air issues also include the release of Hydrogen sulfide (H2S) which is a toxic and explosive gas that may be present in oil and gas wells produced along with the hydrocarbons (Srebotnjak, & Rotkin-Ellman, 2014). Exposure to this gas requires oil and gas workers to wear protective respirators and equip-
ment. Yet, a study commissioned by the West Virginia Department of Environmental Protection, (2013), found that the oil and gas industry provide no protective service to the surrounding residents. This study depicts further evidence that a distance of over 200 yards, or two football fields from unconventional oil and gas activity, still resulted in benzene concentration exposure above what is defined as acceptable health levels by the U.S. Center for Disease Control. As the West Virginia Department of Environmental Protection (2013) report indicated, this distance of 200 yards is generally below the assigned distance setback defined by many state requirements.

The Shell Corporation cracker plant located in Potter Township, Pennsylvania is another example of an environmental hazard. The cracker plant that processes ethane taken from fracking operations is being cited for exceeding its annual limits of pollutants — VOCs and nitrogen oxides in just the first two months of the calendar year (Bunch, 2023). Yet, many in the oil and gas industry claim that hydraulic fracturing processes are not only vital to the nation’s economy but pose little if any environmental harm (Green, 2016). Aubrey McClendon was a co-founder of Chesapeake Energy and an outspoken advocate for natural gas and a renowned pioneer in the use of hydraulic fracturing went on the record to estimate that the industry has drilled more than 1.2 million wells nationwide and believed there were only a few confirmed cases where things have gone wrong (Goodell, 2012).

“Where is the mushroom cloud? Where are the dogs with one leg? Where are the people that have been maimed or hurt? (pg. 50)” McClendon was quoted in Rolling Stone Magazine when speaking on the potential environmental dangers of hydraulic fracturing (Goodell, 2012). The oil and gas industry have time and again stood firm on the belief hydraulic fracturing is safe and cited a variety of studies including The Health and Environment Study, commissioned by former Pennsylvania Governor Wolf’s administration and funded with taxpayer dollars showed no link between unconventional natural gas development and cancer, asthma, and birth outcomes among for children residing in southwestern Pennsylvania (Marcellus Shale Coalition, 2023).

The industry has also consistently questioned independent research for reasons that include environmental baseline measures were often never captured before hydraulic fracturing existence, other influential pollutant factors, competing industries are not considered when measuring air, soil, and water quality (Callahan, 2023), and that by-products of hydraulic fracturing are harmless because of the low concentration levels of the utilized chemical additives (Banerjee, 2015). But often what contributes to public and environmental watch groups’ concern is the lack of transparency (Soraghan, 2015), ongoing poor environ-
ment reports (PennEnvironment, 2022), and increasing rates of carcinoma in certain pockets where there is a concentration of hydraulic fracturing production (Michanowicz, Ferrar, Malone, Kelso, Kriesky, & Fabisiak, 2013). Another exposed main driver of distrust is that neither the federal nor state government agencies required energy drilling companies to disclose the chemical agents utilized in the hydraulic fracturing process. While certain states have attempted to work to create legislation requiring disclosure (Shapiro Administration, 2024), and some within the industry like Range Resources (2010) have voluntarily disclosed additives, energy drilling companies benefit and find concealment options from what is known as the Halliburton Amendment, along with exemption status from the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (Soraghan, 2015). These actions, often referred to as “loopholes”, allow energy companies partaking in hydraulic fracturing to avoid direct chemical regulation as their chemical additives are protected under trade secret exemptions and are not required to be disclosed. This protection thwarts any opportunity for environmental protection groups along with federal and state EPAs to create a comprehensive list of all chemical agents utilized in hydraulic fracturing and any potential inherent danger. These types of circumstances have left many communities throughout the Rust Belt once again in environmentally vulnerable positions. Reports and studies continue to be published including, the 2011 Congressional Report that there is the common use of 14 hydraulic fracturing fluids known to be or possible carcinogens (Urbina, 2011). Pennsylvania State Governor, appointed Attorney General at that time, Josh Shapiro presented findings to this effect in Pennsylvania’s 43rd Statewide Investigating Grand Jury report on the unconventional oil and gas industry (Pennsylvania Attorney’s General Office, 2020). This Grand Jury two-year investigation report discovered systemic failures by various government agencies overseeing industry practice and failure to fulfill acts that protect Pennsylvanians from the inherent risks of industry operations along with citing various unconventional oil and gas companies, including Range Resources and Cabot Oil & Gas — for repeated and systemic violations of Pennsylvania environmental law along with expressing grave concerns for the chemical agents utilized in the hydraulic fracturing process. Such reported findings leave communities throughout the Rust Belt left unknown states of environmental peril.

**CASE STUDY**

A case study has been developed to provide an epistemological approach to further investigate the environmental landscapes of the U.S. Rust Belt and any potential correlating effects relating to the practice of the oil and gas industry.
By its nature, case studies are employed to obtain an in-depth appreciation of complex issues, events, or phenomena of interest, in a natural and real-life context. In this specific instance, crucial components of development for a case study include the development of key insights and methodological considerations in specific relation to the design, developmental planning, analysis, and overall interpretation of the subject matter at hand. In this case study, the researcher has specifically identified the Southwestern Pennsylvania region, the birthplace of the Marcellus Shale boom, and an identified hotbed for the hydraulic fracturing industry as it is estimated to host over 30,000 oil and gas wells, and serves as a microcosm to the Rust Belt region connected specifically to the unconventional oil and gas well production industry (Jackson & Hrusko-ci, 2021). This case study further supports the region’s call for action and takes an axiological perspective of the environmental regulatory oversight of the oil and gas industry in direct relation to the annual particle pollution air analysis conducted by the U.S. Environmental Protection Agency’s Air Quality System (AQS) throughout identified counties in Southwestern Pennsylvania by the Pennsylvania Department of Environmental Protection (DEP).

**PURPOSE OF THE STUDY**

The general purpose of the proposed case study is to directly examine and analyze data to determine if potential correlations exist between the EPA’s AQS annual particle pollution levels and environmental violations cited to the gas and oil by the DEP. Particle pollution from fine particulates of matter, 2.5 micrometers or less (PM2.5), can be breathed deep into the lungs and enter the bloodstream. When one breathes unhealthy levels of PM2.5, it can increase the risk of health problems like heart disease, asthma, and is a known carcinogen (Environmental Protection Agency, 2023b). This case study was deemed warranted after analysis of the completed three studies co-published by the Pennsylvania State Government and the University of Pittsburgh study has further revealed findings that children living near unconventional oil and gas well developments from the time of their birth were two to three times more likely to be diagnosed with leukemia between the ages of 2 and 7 than those who did not reside near unconventional oil and gas well activity (Buchanich, Talbott, Arena, Bear, Fabisiak, Wenzel, S, Youk, & Min Yuan, 2023).

This case study takes a broader perspective to study air quality in light of recent developments by the Environmental Protection Agency’s (EPA) 2024 decision to lower its PM2.5 standard, from 12 micrograms per cubic meter of air to 9 micrograms, which would place multiple monitoring sites in this study in a nonattainment of compliance state (Environmental Protection Agency, 2024). The Greater Pittsburgh metro region, located in Allegheny County, ranks the
14th highest particle pollution rate across the country (Guay, 2023) and residents in Southwestern Pennsylvania face a significantly higher than acceptable risk of developing cancer as a result of ongoing exposure to toxic air pollution released by a manufacturing industrial process, energy production, and diesel transport combustion (Michanowicz et al., 2013), all conditions that exist in the hydraulic fracturing process. A regression model has been developed to identify if a correlation exists between the two defined variables. (Stake, 1995). This research utilizes recorded data to study this phenomenon, and as Yin (2009) states the case study allows for the examination of “holistic real-life events” (p. 4). Creswell (2013) defines that a case study intends to report on a single instrumental case, by utilizing multiple sources of data collection, which are synthesized and then analyzed to coded outcomes that can be utilized to create assertions and arrive at conclusions. Yet, as Creswell emphasizes, a researcher must be aware and cognizant of the limitations of such a study, due to its singularity of size and scope and provide proper disclosure. As Abercrombie, Hill, Turner & Bryan (1984) define, while a single-bound case study possesses limitations in providing insight into the broader scope of the subject and class, it holds potential in that it develops a hypothesis that can be utilized to further open study in a larger number of cases.

**Theoretical Framework**

This research study utilizes Pfeffer and Salancik (1978) Resource Dependence Theory, which is a study of the impact of resource acquisition on organizational behavior and attempts to explain how such behavior is affected by the external resources and pursuit of transaction for possess. It is rooted in the historical nature that ex-colonial powers retained wealth at the overall expense of the impoverished working-class former colonies due to a vast range of effects of colonialism and constructs concepts based on exploitation and control. Through this lens, this research can assimilate the developed West, i.e. the industry sector has on underdeveloped nations, i.e. the labor force and residents, effectively by relegating them to a state of dependency. While such transactions may be of great benefit, they also have the potential to create dependencies, as resources that the organization needs may be limited and not readily available, or in the control of others. These types of circumstances can generate unequal exchanges of differences in power, authority, and the accessibility to future resources. A researcher utilizing research dependency theory seeks to observe and begin to understand organizational adaptations and responses to dependencies.
RESEARCH DESIGN AND METHODOLOGY

This research study will be designed as a single-bound instrumental case study. As Yin (2009) defines, case study research design allows an opportunity for the researcher to explain, describe, or further explore events in an everyday context. This method will provide the development for further understanding and explanation of a potential causal link and connective pathway to the studied phenomenon. This case study utilizes quantitative methodology as it develops a regression model based on retrieved statistical data to explore if a potential correlation exists (Creswell, 2007; Patton, 2002; Yin, 2014). Quantitative analysis can provide empirical evidence that can support or refute hypotheses within scientific research. Such analysis helps to establish causation and correlation relationships by analyzing data objectively. By utilizing regression analysis, the researcher through the use of statistical data can predict or estimate the impact of one variable on another (Taylor, 2023).

SAMPLE STUDY AND METHODS

The case study is purposive, as it has identified the sample targeted study in the birthplace of Marcellus Shale’s hydraulic fracturing, Southwestern Pennsylvania, and its three top barrels of oil equivalent (BOE) producing counties in Southwestern Pennsylvania (Allegheny, Washington, Westmoreland) that participated in the EPA’s AQS annual particle pollution studies from 2009 to 2020, the most recently released data by the agency. These counties’ EPA’s AQS annual particle pollution report findings were then analyzed against the Pennsylvania DEP environmental gas and oil violations. The independent x variable, the explanatory variable in this study will be the data retrieved from the DEP-recorded violations in the oil and gas well industry that occurred within these counties during the specified timeframe and accessed by the Pennsylvania Right to Know Act record. These recordings included documented violations in the areas of administrative, environmental, and environmental health and safety. The dependent y variable, the response variable in this study, will be data retrieved from the EPA’s AQS (2023) annual particle pollution PM2.5 air quality reports that recorded the average particle pollution that occurred in these counties during the specified timeframe. Monitoring sites are set up at multiple sites throughout a county to measure air pollutants throughout a calendar year.

RESEARCH QUESTIONS

Q: Do environmental violations recorded by the Department of Environmental Protection (DEP) in the oil and gas industry influence the region’s EPA’s AQS annual particle pollution air quality?
H₀: There is no linear relationship between DEP-cited violations of the oil and gas industry and the EPA’s AQS annual particle pollution air quality recordings.

H₁: There is a linear relationship between DEP-cited violations of the oil and gas industry and the EPA’s AQS particle pollution air quality recordings.

**Quantitative Analysis**

A quantitative analysis was completed utilizing SPSS software to determine if there was a relationship between the Pennsylvania Department of Environmental Protection (DEP) in the oil and gas industry influence the region’s EPA’s AQS annual particle pollution air quality. The analysis studied 36 air samples taken from a 12-year time frame against DEP-cited violations during that timeframe. A regression model was utilized to analyze the relationship between the count data and the independent variable. In using quantitative statistical analysis and terminology, research uses correlation to denote the association between two quantitative variables. The researcher assumes that the association is defined as linear, that is when one variable increases or decreases in a fixed amount for a unit increase or decrease in the other.

<table>
<thead>
<tr>
<th>Data Sets &amp; Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA DEP Oil &amp; Gas cited violations</td>
</tr>
<tr>
<td>westmoreland</td>
</tr>
<tr>
<td>allegany</td>
</tr>
<tr>
<td>washington</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Particle Pollution: Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>westmoreland</td>
</tr>
<tr>
<td>allegany</td>
</tr>
<tr>
<td>washington</td>
</tr>
</tbody>
</table>

\[ \mu = 11.9166667 \]
\[ \sigma = 1.743868527 \]

<table>
<thead>
<tr>
<th>SUMMARY OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression Statistics</td>
</tr>
<tr>
<td>Multiple R</td>
</tr>
<tr>
<td>R Square</td>
</tr>
<tr>
<td>Adjusted R Squa</td>
</tr>
<tr>
<td>Standard Error</td>
</tr>
<tr>
<td>Observations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>df</td>
</tr>
<tr>
<td>Regression</td>
</tr>
<tr>
<td>Residual</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Table 1: PA DEP Oil & Gas cited violations & Annual Particle Pollution
Source: (Kelso, 2024) & (American Lung Association State of the Air 2023, 2023)
SUMMARY OF FINDINGS

\[ R^2 = 1 - \frac{RSS}{TSS} \]

Multiple R, or Pearson Correlation is a measure of the strength of the linear association correlation coefficient and was recorded in this study at 0.466206, which demonstrates a moderate correlation. R squared, or coefficient of determination is a statistical measure in a regression model that determines the overall proportion of variance in the dependent variable that can then be explained by the independent variable. In this study, it can be defined that 0.217348, or 21% of the variance in the EPA’s AQS annual particle pollution air quality recordings can be accounted for by the DEP-cited violations of the oil and gas industry.

\[ SE = \frac{\sigma}{\sqrt{n}} \]

The standard error of the regression is a measure of the average distance that observed values fall from the regression lines. In this study, the standard error is 2.048598, or a 2.04 particle pollution level from the regression line.

\[ Z = \frac{X - \mu}{\sigma} \]

Significance F, or the P value, is a measure of the stated null and alternative hypothesis, with the alpha value recorded at 0.05. The P value will then reject the null hypothesis when P > 0.05 and accept the alternative P \leq 0.05. In this study, the P value 0.004159, meaning the HA (alternative hypothesis) was accepted and the DEP cited violations of the oil and gas industry and the EPA’s AQS annual particle pollution air quality recordings demonstrating statistical significance.
DISCUSSIONS AND RECOMMENDATIONS

While this case study offered a moderate correlation between the DEP-cited violations of the oil and gas industry and the EPA’s AQS annual particle pollution air quality recordings, similar to that of the University of Pittsburgh School of Public Health Study (Buchanich, et al., 2023), a continuation of study is deemed warranted due to the evident state of the environmental landscapes of the Rust Belt region. Citizens demand a higher understanding of what environmental hazards exist not only within the gas and oil industry but within the vast array of industry production occurring in the modern-day Rust Belt. It is now imperative efforts be taken to explore collective ways to identify and address methods to reduce pollution levels to create more sustainable and equitable Rust Belt communities. Mirroring the central theme of the Shapiro Administration (2023), Pennsylvania’s 43rd Statewide Investigating Grand Jury report on the unconventional oil and gas industry that cited residents were not protected from the inherent risk of industry, we must now focus on industry-wide environmental policy adoption and practice that not only protects but insulates residents from harm and creates an opportunity for a robust human capital. Prioritizing industry economics that achieves short-term financial windfalls has shown time and again to lead to potential long-term question marks of consequence and cost. Ultimately, this research does not provide definitive solutions, yet, it is designed to open the door for further environmental research, higher levels of transparency, and candid conversations that enable innovative solutions to lay the groundwork for sustainable economic prosperity that can spawn future population growth. This research lends to reason that a future qualitative study will further give a voice to the people to better understand this phenomenon and has recommended three areas of further development to enable a stable platform for a more robust human capital and include:

1. Environmental Pollution and the science of epigenetics
2. Current-day environmental remediation, fiscal policy, and stewardship

ENVIRONMENTAL POLLUTION & THE SCIENCE OF EPIGENETICS

Throughout the Rust Belt, a multitude of environmental studies have been conducted and continue to show troubling patterns of air, water, and soil pollution. These studies are not limited to just the oil and gas industry, and they begin to infer the inherent risk of one’s exposure to hazardous environments.
This inference is unsettling in that recent scientific study in the field of human biology directly challenges the long-conceived notion that human disease is largely driven by a genetic lottery code. Human biological researchers have begun to propose evidence as to how internal and external environments can and do directly influence, and potentially alter various genetic control mechanisms (Feinberg, 2008). Also known as epigenetics, the researcher in this field defines the relationship between one’s genetic makeup and their lived environment and its impact on one's health and disease. The scientific theory espouses that one’s cells constantly adapt to fluctuating internal and external environments, and the epigenetic mechanisms within one’s cell are capable of recording fluctuations in the normal programming and reprogramming process of the gene and its expression. This theory of research is critical to begin to understand the depths of how medical researchers begin to ascertain how predetermined genotypes interact with their defined environments, which subsequently hold a major influence on one’s overall health and well-being (Thunders, 2015). In essence, hereditary links that could be expressed in one’s genetic code due to environmental influence can trigger disease and illness in such diseases that include cancer and ultimately shorten one’s life expectancy rate. With this understanding, the discovered research in the field of epigenetics possesses great substance in forward-thinking conversations and lends further credence to how environmental exposures can and do influence one’s health outcomes. Political leadership and health officials must take steps to define comprehensive baseline health assessments and monitoring for those individuals residing in close radius to oil and gas wells, TOADS, and other hazardous toxic waste sites.

**Recommendation 1** Create access to a transparent and comprehensive baseline health assessment and database that enables community leadership and health officials to make real-time adjustments or intervention steps to curb present and future hazards. From the recorded assessments and monitoring databases, efforts can be taken to determine if there are health risks due to exposure, and if so, what remedies can be taken, i.e. financial health assistance, relocation assistance, home or property modification, industry production stoppage or termination, etc.

**Current-Day Remediation Policy & Fiscal Stewardship**

The United States government through the EPA has spent over 2.3 billion dollars just to remediate brownfields contaminated by industrial environmental waste, with another 11 billion dollars allocated in 2022 through the Inflation Reduction Act to advance the goal of securing clean and healthy air, and a safe climate (Maggie Hassan: U.S. Senator for New Hampshire, 2023). Brownfield remediation is a critical component to enabling a true renaissance to take place.
in the Rust Belt from decades of corporate environmental negligence. But the first question that may arise is the local, state, and federal government’s fiscal stewardship in regards to tax dollars used to remediate community yet have potentially failed sustainable impact, and insofar are these dollars ultimately subsidizing future environmental clean-up costs for current-day industries’ negligence?

The second question is do the penalties and fines levied on industries found negligent create enough consequences to deter future negative action. With over 208,000 gas and oil wells and a recorded 157,132 DEP violations since 2008 in the State of Pennsylvania alone, the answer appears questionable at best. Since the time of the 1997 Kyoto Protocols, the carbon emission market has allowed industries to trade and buy both carbon credits and carbon offsets simultaneously in efforts to mitigate the environmental crisis (Carbon Credits, 2023). While the intentions of this carbon emission market by design is a model to mitigate the environmental crisis, transfers of these credits can create an uneven balance of exposure in highly industrial communities and regions. To further add to the complexity of this matter, Yale Journal on Regulation research questioned the effectiveness of EPA enforcement and espoused that a substantial portion of industry firms, approximately 36%, benefit from noncompliance, even after penalties are imposed (Atkinson, 2023). The research estimated that penalties imposed by the EPA would need to be four times greater than those penalties imposed to achieve the EPA’s defined policy goal of removing the economic benefits of industry non-compliance. Another alarming circumstance is the bipartisan push to cap over one million abandoned or orphaned gas and oil wells across the country that leak toxic substances. It is irresponsible actions such as these that hold the potential to undermine EPA regulatory efforts to protect communities, especially in the Rust Belt region, and leave residents with a lack of trust in the industry (Turrentine, 2021).

**Recommendation 2** Create baseline assessments of environmentally remediated soils, waterways, and air channels, and develop real-time systems that monitor, track, and trace where future exposure to environmental hazards is derived and work to immediately address the hazard. Special focus should be placed on creating strategic policy for future remediation practice, proposed taxes and penalties, and higher levels of accountability and agency enforcement power to create stoppage or termination of industry production.
Environmental hazards and health determinants have raised grave concerns among residents and health practitioners alike, hydraulic fracturing, for example, has managed to gain significant traction and host footprints throughout the Rust Belt region. Yet, some of the environmental health concerns that were once echoed and championed by political leadership have changed the course of interest over time. U.S. 45th President Joe Biden in 2019 stated he would make sure fracking and coal were eliminated and in 2020 opposed new fracking. Yet during the 2020 U.S. presidential debate, Biden stated he never opposed fracking (Lybrand, 2020). U.S. Senator John Fetterman once was firmly opposed to hydraulic fracturing while the Mayor of Braddock, PA., called it a stain on Pennsylvania and supported a moratorium, now holds support for hydraulic fracturing primarily due to its job development (Phippen, 2022). Lastly, former Pennsylvania Attorney State General, and now Pennsylvania State Governor Joshua Shapiro, who led a Statewide Grand Jury Report calling for the halting of hydraulic fracturing over environmental health concerns, has now developed alliance initiatives with CNX Resources Corporation, and its President and CEO Nicholas J. DeIuliis – a harsh vocal opponent of energy regulations, to continue hydraulic fracturing in Pennsylvania (Cartlon, 2023).

While it is plausible that more information and data may have come to light regarding the health and safety of hydraulic fracturing, there are also real questions that need to be raised regarding political influence from the corporate donor base. Let us not forget, that corporate influence was once a dominant force in the landscapes of the Rust Belt region, and a fair question now is if it has returned? This topic becomes more relevant when one explores Citizens United v. Federal Election Commission U.S. Supreme Court and ruling and the U.S. Court of Appeals decision in SpeechNow.org v. FEC in 2010 (Campaign Legal Center, 2015). These rulings provide Super PACs access to unlimited spending to corporations to finance and tilt power toward extremely wealthy donors and corporations enabling stronger support and promotion of their identified candidate of choice (Ever-Hillstrom, 2020). This type of privilege can enable the opportunity to define future legislative policy. In 2022, there were a recorded 2,476 super PACs with $2,737,855,088 total amount raised by super PACs and $1,365,474,321 total spent by super PACs (Bustillo, 2023). The oil and gas industry spent approximately $124.4 million lobbying the federal government in 2022, and in the narrow 2022 state campaign races, the oil & gas industry has allocated spending that is estimated to average $4.3 million per Senate seat and a total of $490,000 per U.S. House of Representatives seat through channels of direct contributions, funding for the party committees, and the funding provided by super PACs.
Additionally, while the oil and gas industry was typically seen with a one-party focus, it has continued annually since 2020 to increase bi-partisan contributions (Sayki & Cloutier, 2023). These efforts have purpose and merit, for example, the questioned power exerted by the industry when the EPA retreated from the study of three high-profile investigations of reported water contamination potentially caused by oil and gas development. From 2008 through 2012, the EPA sampled and found contaminated sources of water in Pavillion, WY, Dimock, PA, and Parker County, TX (Sinding, 2014). The EPA halted further study or disciplinary action as the department stated no baseline could be defined for water studies and that this contamination could have existed prior. Yet, even when there has been traction to conduct a comprehensive environmental study with the oil and gas industry, efforts collapsed and leaked documents revealed that the EPA and Chesapeake Energy jointly drafted and outlined talking points shared with the press, according to EPA emails (Banerjee, 2015). It is these patterns that resemble many of the corporate expansive powers present in the late 19th and early 20th century, and the trustbusting initiatives that then followed suit by the likes of leaders such as Theodore Roosevelt. This current-day laissez-faire approach permitted specifically in the gas and oil industry warrants further attention and full transparency.

A comprehensive investigation and decisive action that holds the $332 billion (annual revenue) oil and gas industry responsible when found negligent and drive punitive penalties up to and including ceased and desist directives when deemed necessary (Statista Research Department, 2023).

**Recommendation 3** A continuation of grassroots community bi-partisan dialogue that institutes policy reform and places the power back in the hands of the people. This is especially relevant in political elections, as currently, 14 states across the nation have adopted Small Donor Public Financing that matches small public donations and enables candidates who historically have faced barriers in private wealth-base politics, as they often stand as opposition to the industrial complex. Gaining traction on these fronts is critical to creating even playing fields in the placement of grassroots-led legislators.

**CONCLUSION**

This research has provided an observational humanistic discussion on the history of the nation’s post-industrial Rust Belt while providing a case study that illustrates levels of evidence that warrant further study and commencement of open-channel dialogue to understand the potential effects and negative consequences of short-sided legislative policy. It is of significant note that this re-
search attempted to reframe from polarizing terminology such as global warming, as it often comes with politically polarizing connotations. Instead, this research focused on the shared burden societies are faced with and the common struggles that challenge the growth of our human capital, which this researcher believes is the greatest strength and asset of a nation. In part, it is with great hope that this common thread of humanity will open genuine dialogue and collective action for shared environmental responsibility and stewardship for current and future generations.

**Limitations of the Study**

While extensive research was able to retrieve and study an exhaustive amount of information, yet, there were some unavoidable elements of limitation. The first area of limitation is the fact that this research study only focused on the oil and gas industry violations identified as the independent variable. Research has continued to indicate that a vast amount of air pollution is caused by a diverse array of physical, biological, and chemical agents released into the atmosphere from a multitude of industries (World Health Organization, n.d), yet this fact should not skirt the potential hazard and the partial role and responsibility of the oil and gas industry. Additionally, this segment of the research study further defines certain conditions or restrictions that were beyond this researcher’s control. These specific conditions or restrictions that held research study limitations, might have also held influence on the results. One particular issue was that record requests were not a streamlined process. State reporting across the Rust Belt was found often limited in scope and unorganized, as many states have different standards for the gas and oil industry reporting on various elements of development and production, and many states often do not differentiate various aspects of development and production, such as reporting whether a well was unconventional or conventional. Additionally, accessing information was often restricted or exempt from disclosure purposes. Other limitations included the limited population and other industry scope of the study due to accessibility. These conditions were all factors in the limitations of this case study.

**References**


Brief history of american labor - mirror site of unionweb history - originally from the American federationist. (n.d.). https://www.albany.edu/history/history316/LaborMovementHistory1.html


https://world101.cfr.org/contemporary-history/world-war


Environmental Protection Agency. (2024). *National Ambient Air Quality Standards (NAAQS) for PM.* EPA. https://www.epa.gov/pm-pollution/national-ambient-air-quality-standards-naaqs-pm


Range Resources. (2010). "Range Resources Announces Voluntary Disclosure of Marcellus Shale Hydraulic Fracturing"


Statista Research Department. (2023). Oil and gas industry revenue in the United States from 2010 to 2022.


West Virginia Department of Environmental Protection. (2013). Division of Air Quality, “Air, Noise, and Light Monitoring Results For Assessing Environmental Impacts of Horizontal Gas Well Drilling Operations (ETD-10 Project),” Charleston, WV.


**AUTHOR’S BIOGRAPHY**

**Dr. John Tamiggi** currently is appointed as a leadership executive with Habitat for Humanity, a college professor at Point Park University, and a published social researcher invested in the growth and development of robust and dynamic organizations. Possessing a vibrant leadership background that coincides with prestigious academic achievements, his works emphasize continually bridging innovative scholarly research to strategic-based development that institutes a synthesis of socio-economic equity with organizational sustainability.

*The views expressed are solely the perspective of the author and do not necessarily represent the views or policy of Point Park University.*