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RUST BELT AMERICA: COAL USAGE AND POLLUTION RATES IN THE LEADUP TO EMISSIONS REGULATIONS

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Abstract

The coal-energy political issue was considered specific to the Rust Belt region of the US in the leadup to the 2016 Presidential Election. While the diametric difference in policy stances between the two major US presidential candidates failed to garner national attention, the eventual outcome of the election was attributed to slim vote margins in states located in this region. This study will examine the rates of coal usage by Rust Belt states via air pollution data and production rates extracted from the US Environmental Protection Agency's Toxic Release Inventory in the years leading up to the election in order to ascertain to what extent general societal trends were prompting shifts toward cleaner energy sources before and after environmental laws such as the Clean Power Plan took effect.

Keywords: sustainable energy, Rust Belt, manufacturing, coal, emissions data

Introduction

The coal energy issue was the subject of debate and an area of diametric difference in policy stances between the two major US presidential candidates during the 2016 presidential election season. Then-candidate Trump positioned the Obama administration as being anti-coal and insinuated that the numerous Environmental Protection Agency (EPA) mandates enacted during the Obama administration had cost jobs and economic prowess in these areas and contributed to the closing of factories and subsequent decrease in the standard of living of citizens there. Candidate Hillary Clinton defended the Obama policies and claimed that many states and organizations already had and should voluntarily shift their usage of energy to more sustainable models.

Coal was considered to be a regional issue specific to the Midwest-US geographic region, or Rust Belt, rather than a national issue, and despite the differences in candidate positions, it did not garner much national attention or merit much discussion in the televised presidential debates or in the national press. Nevertheless, the Rust Belt included the most battleground states, or states that either candidate could win. Hillary Clinton's eventual loss was attributed to her losing key battleground states in this region, including Pennsylvania, Michigan, and Wisconsin. Many consider the coal issue to be a key factor in Trump's winning these states.

While there were many claims during this time that coal-fired energy plants were being shut down, there has been no analysis of the direction of coal trends in these states before the Obama era EPA actions. Were these states voluntarily decreasing their coal emissions and shifting to

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more environmentally-friendly power sources before the EPA mandates, or did the EPA effectively shut down coal operations after implementation?

This study will examine the rates of coal usage by states located in the Rust Belt. A clear picture of macro coal usage in the years leading up to the anti-coal EPA regulations will indicate which candidate's talking points had the most merit. The results of this analysis might further clarify whether future government mandates would be necessary or desirable as a means to prompt a shift toward more sustainable energy sources.

Literature Review and Background

During his two terms in office, US President Barack Obama increasingly advocated for more sustainable and environmentally friendly energy sources. This policy stood in contrast to the traditional US source of power: coal. The word "coal" is often used to describe the most common type of carbon that is burned for energy purposes. Since coal is plentiful and the process of burning it to create power it is relatively cheap, it has been a popular source of energy, even though it is less clean or environmentally friendly because it releases more harmful emissions than other resources such as natural gas or oil (Harder, 2015). In recent decades, it has been deemed an "environmentally destructive industry" due to the carbon dioxide emissions from its burning (Goodell, 2007).

The Obama administration generally used executive powers stemming from the broad national authority in the Clean Air Act as an impetus for regulating and limiting the usage of coal. The Clean Air Act, a seminal environmental guideline expanded in 1970 to include a federal mandate, was launched during a time when environmental regulations were previously at the discretion of the individual states and is considered to be the most influential environmental law of all US environmental policy (Burt raw et al., 2014). Various factions have been vehemently opposed to this policy, particularly union leaders in the coal industry, who have rallied in opposition to the 2011 EPA regulations that limited the industry's ability to function efficiently (Lowery, 2011; O'Brien et al., 2016).

This series of regulations included the Cross-State Air Pollution Rule, which mandated a reduction in the amount of power plants emissions that are carried by the wind. The EPA predicted that this legislation would cut 2017 emissions levels by 20% from prior levels (Jeffrey, 2016). While this action was hailed by clean power advocacy groups, there was ardent political opposition, especially from those within the coal industry who claimed that overall consumer energy costs would skyrocket. This legislation required coal plants in the Midwest in particular to reduce various emissions, prompting utility executives and coal producers to call the EPA proposals a "train wreck" (Lowery, 2011).

This and other coal legislation stimulated legal controversy as well. In 2017, the state of Maryland threatened to sue the EPA under the Cross-State Air Pollution Rule due to coal-affected air moving through it from states in the Midwest, claiming that the coal-using power plants in the Midwest did not do enough to limit their emissions (Walton, 2017). Another

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controversial EPA act, the Mercury and Air Toxics Standards of 2012, heavily limited emissions from power plants, especially coal-based and oil-based power plants, but was struck down in 2015 by the Supreme Court, which ruled that the law should be sent back to the EPA to be rewritten because the agency had not considered the cost of implementation (Frazier, 2015).

In a June 2013 speech, President Obama issued a call to action to the American public when he described how carbon emissions from US power plants would be further limited as he outlined his "climate action plan". This plan included goals to make it difficult to build new coal-fired power plants (Felsenthal, 2014; McCubbin, 2014), as electricity generation causes 40% of the country's carbon dioxide emissions (Burtraw et al., 2014). Later that year, the EPA severely limited the amount of carbon pollution that new power plants would be able to emit, further limiting coal as energy source (Johnson, 2013). As a result, by 2015, around 200 coal-fired power plants operating in the US had either closed or announced plans to shut down (Frazier, 2015).

In 2015, the EPA released three distinct regulations for carbon-emitting power plants "from new, modified, and existing…sources", comprising key areas of the Obama administration's Clean Power Plan (McCubbin, 2014). The controversial 2015 Clean Power Plan, through the broad executive powers of the Clean Air Act more strictly regulated greenhouse gas emissions from coal-burning power plants, which then accounted for 40% of all US carbon emissions (McCubbin, 2014). This law targeted power plants that rely on electric generators or coal as their main fuel, and was said to "have an uneven impact on the energy industry, boosting…some regions…while biting others" (Smith & Miller, 2015, p. 1). The Clean Power Plan may have been the most controversial energy-related act during the Obama administration (Rosenbaum, 2016). Critics claimed that national coal production would decrease by 242 million tons as a result (National Mining Association, 2017). As with the other coal regulations during the Obama administration, the Supreme Court ruled against it in February of 2016, when it temporarily blocked the Clean Power Plan from being implemented (Davenport & Liptak 2016). As of 2017, it was still being litigated in court (Gilmer, 2017).

The debate over coal became especially heated because it escalated during the lead-up to the US Presidential election of 2016, and the Clean Power Plan in particular drove political rhetoric around the coal issue during this time (DeBellis, 2015). The coal issue was one of the few policy issues on which each candidate's stance diverged diametrically (Kerrigan, 2018; Rushefsky, 2017). Republicans claimed that the executive authority exercised via the Clean Air Act exceeded the power of the president and was thus illegal (Guillen et al., 2016). On the day it was enacted, then-Governor Mike Pence called the 2015 Clean Power Plan act "ill-conceived and poorly constructed" (Earth Justice, 2018). By the summer of 2016, Pence, then the Republican Vice-Presidential candidate, stated at the Republican National Convention that union members "don't want a president who promises to put a lot of coal miners and coal companies out of business" (Kessler et al., 2016).

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The Democratic nominee for US President, Hillary Clinton, adopted the strategy of following the Obama administration's stance regarding coal, so it was the policy of the Clinton campaign to uphold the Clean Power Plan (Banks, 2016; Parnes & Parnes, 2017). In March of 2016, she bluntly said, "We are going to put a lot of coal miners and coal companies out of business. … Now we've got to move away from coal and all the other fossil fuels" (O'Donoghue, 2016, p. 2).

The candidates spent the most time and resources in the states that were considered tossup, or battleground states (Schultz, D. & Hunter Hecht, S., 2015). Of the 13 states one pollster considered to be battleground states, coal was utilized for about 50% of the electricity produced there (O'Donoghue, 2016). By 2016 it had been announced that 200 coal-fired power plants in 13 battleground states had closed, with 46 others announced to be closed as a result of the EPA rules (O'Donoghue, 2016). Of the 17 overall states another pollster considered to be battleground states, coal played a key role in the state-wide economy of 13; these states represented 149 electoral votes (America's Power, 2016).

Nevertheless, coal was said to be a regional political issue instead of a national one because of the heavy dependence on coal as an energy source in the Midwest (Cama, 2015). This phenomenon was not new, as Midwest labor was the main faction that strongly opposed the Clean Air Act's 1970 federal mandate (Billings et al., 2014). Biello (2016) stated that climate change/coal was the #1 issue where the candidates differed that journalists overlooked in the months before the election. But while the coal issue was certainly divisive during the presidential election season, it simply didn't garner much national attention.

The Rust Belt, also referred to as the Manufacturing Belt, consists of Midwest states, generally from Iowa to Pennsylvania (Lopez, 2004). The Rust Belt became an economic powerhouse in the twentieth century due to America's dependency on coal which was "cheaply fueling the factories of the Rust Belt and lighting up homes across the country" (Davenport, 2013).

The Rust Belt faces big challenges in attempting to reshape its economies and to retrain its workforces to better handle the challenges of the global marketplace (Eisinger, 1990; Brady & Wallace, 2001; Samuelsohn, 2009; Kowalski, 2016; Saunders, 2016; Williams, 2017). The Rust Belt economies were based on manufacturing, particularly those powered by the coal industry, and were built up during the peak of industry (Cooke, 2006; Biggers, 2014), so the decline of US manufacturing has been specifically intertwined with job loss attributed to plant closings in these communities (Deakin & Edwards, 1993; Chase, 2003; Brown, et al., 2008; Bernero & Peduto, 2016). Skrabec (2015, p. 197) noted that "America had never seen such a devastating loss in jobs, taxes, industry, and economic hope in such a large geographic region". The shift in jobs out of the Rust Belt has been called "one of the biggest negative shocks to affect the U.S. economy in the past fifty years" (Feyrer, et al 2007, p. 41).

Utilizing the Lopez (2004) construct of the Rust Belt spanning from Iowa to Pennsylvania, the seven states in the Rust Belt (Iowa, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and Michigan) constituted 101 of 538 total electoral votes during the 2016 Presidential election. Of

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these seven states, five were considered battleground or tossups (those other than Illinois and Indiana), constituting 70 of those 101 electoral votes (Nelson, 2018).

Coal has been a particularly widely-used source of energy in the Rust Belt states of Indiana and Ohio (McGinley, 2011). During this time, coal accounted for 69% of the electricity produced in Indiana, supporting 46,700 jobs and $11.2 billion in economic activity there (America's Power, 2016), and for 60% of the electricity produced in Ohio (Brown, 2016). Ohio was deemed to be at an "energy crossroads" and "dominating debate" during the recent presidential election cycle (Brown, 2016). Inefficient electric utility productivity and increased costs to consumers have been popularly blamed on environmental regulations since the 1970s (Gollop & Roberts, 1983; Gray, 1987; Weber & Domazlicky, 2001), particularly in the Rust Belt. Because of the effect of Obama's energy policies on energy costs in the Rust Belt, coal was said to be a "pocketbook issue", or an issue that affected voter budgets, in the lead-up to the election (Shesgreen, 2016).

Trump's campaign promises about American restoration are thought to have resonated most in the Rust Belt (Davis & Miller, 2016; Davidson, 2016) where citizens especially gravitated toward Trump due to his focus on a "decline in manufacturing" and "a fraying of social cohesion" (Davis & Miller, 2016).

Many attributed the unusually high voter turnout in the presidential election in these areas to the coal issue. Of the five tossup Rust Belt states (Iowa, Michigan, Ohio, Pennsylvania, and Michigan), most analysts in the lead-up to the election had Trump losing in the polls in Pennsylvania, Michigan, and Wisconsin (Parnes & Parnes, 2017; Nelson, 2018; Real Clear Politics, 2017; Sabato et al., 2017). Nevertheless, in light of unusually high voter turnout, Trump won all of them. Pennsylvania and Michigan voted for the Republican candidate (Trump) for the first time since 1988 and Wisconsin for the first time since 1984. Many political scholars attribute Trump's victories in these Rust Belt states in part to his campaign promises to rollback coal regulations mandated in the Clean Power Plan (Lake & Edna, 2016; Segal et al., 2016; Parnes & Parnes, 2017, Clinton, 2017; Sabato et al., 2017).

Upon inauguration, President Trump quickly began fulfilling promises made during his campaign, as he swiftly reduced regulations in the coal-heavy steel industry (Judge, 2016). In March of 2017, Trump enacted an executive order to remove environmental regulations and empower federal regulators to do away with the Clean Power Plan's restrictions on U.S. carbon emissions (Pacewicz & Mudge, 2017), mandating that the EPA "suspend, revise, or rescind four actions related to the Clean Power Plan", including reversals on stringent coal policies (WhiteHouse.gov, 2017).

The political and legal debates over coal continue today. While it is true that many coal-fired energy plants closed in the several years leading up to the election, there has been no analysis of the direction of coal trends in these states before the Obama-era EPA mandates, particularly in the Rust Belt states. Some scholars have even claimed that leaders in the Rust Belt had actively been seeking cleaner energy sources for decades since the shift from manufacturing to service (Gittell, 1990; Carter et al., 2012; Dieterich-Ward, 2015; Neumann, 2016). It remains unclear

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whether or to what extent general societal trends were prompting a shift toward cleaner energy sources before these laws took effect. There was momentum toward clean energy in numerous and varied constituencies, even within Statehouses in the Rust Belt. Were these states decreasing their coal emissions and shifting to more environmentally-friendly power sources before the EPA mandates, rather than after the EPA effectively shut down coal operations due to the implementation of laws? Analysis should focus on trends before and after 2013, since the 2011 Act, which was the impetus of further anti-coal legislation, fully took effect in 2013. A clear picture of macro coal usage in the years leading up to the anti-coal EPA regulations might further clarify whether future government mandates would be necessary or desirable as a means to prompt a shift toward more sustainable energy sources.

Data, Methodology, & Results

Utilizing Lopez's (2004) construct of the Rust Belt as the region spanning from Iowa to Pennsylvania, the seven states in the Rust Belt (Iowa, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and Michigan) comprise the Rust Belt for the purposes of this study.

The air pollution data and production rates were extracted from the Toxic Release Inventory (TRI), a publicly-available EPA database that contains information on the release of toxic chemicals into the atmosphere and the waste management concentration activities reported annually by all private organizations as well as federal facilities (EPA, 2010). Trends in data were analyzed from 2009-2016, since 2009 is considered to be the first full year of recovery from the recession. Data were included from 1987 as well for comparison purposes, which was the first year the TRI published data. The number of companies emitting any chemicals in the Rust Belt states is presented in Table 1.

Table 1.

EPA- Toxic Release Inventory, All Production Companies Operating in Rust Belt

		Iowa	Illinois	Indiana	Michigan	Ohio	Pennsylvania	Wisconsin
1987		1190	4688	3038	3751	5772	4295	2602
2009		1651	3944	3327	2944	5496	4175	2813
2010		1684	4021	3388	3007	5495	4126	2920
2011		1676	4052	3445	2994	5523	4140	2951
2012		1657	4078	3474	3016	5453	4088	2895
2013		1671	4091	3524	3078	5382	4084	2901
2014		1742	4069	3539	3043	5319	4083	2912

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2015		1719	3963	3497	2991	5231	3944	2828
2016		1699	3781	3492	2959	5130	3838	2774

In order to ascertain the types of organizations using coal during the production process, the technical word "carbon" was utilized to filter the data from the "chemical" column (column AD), since this term represents various types of coal, and this is the term that the EPA uses for any formula in which this chemical element was emitted in any air pollution. Table 2 below lists the number of polluting companies emitting carbon into the air. This included companies emitting Carbon Disulfide, Carbonyl Sulfide, Lithium Carbonate, etc.

Table 2.
Number of Organizations Emitting Carbon, by state (Parent Company or Facility Name)

	Iowa	Illinois	Indiana	Michigan	Ohio	Pennsylvania	Wisconsin
1987	0	9	6	4	10	3	1
2009	1	20	14	5	33	9	2
2010	1	19	15	6	30	10	3
2011	1	18	14	5	33	10	2
2012	1	19	13	5	36	11	2
2013	1	19	14	5	33	12	2
2014	1	19	15	5	33	10	2
2015	1	18	14	6	35	11	2
2016	1	16	12	5	34	10	2

This study wished to analyze composite air pollution. Providing assistance in this analysis was Nathan Byers, from the Office of Pollution Prevention and Technical Assistance at the Indiana Department of Environmental Management, defined fugitive air emissions as "all releases to air that are not released through a confined air stream including equipment leaks, evaporative losses from surface impoundments and spills, and releases from building ventilation systems, from Section 5.1 on the TRI Form R" (personal communication, 2010).

In order to compare apples to apples for air emissions, Byers suggested combining columns: "This will be taking into account what is leaving the facility via air no matter what the process is. In this way, you can fairly compare facilities in one industry to facilities in another" (personal

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communication, 2010). Since Byers indicated that the "Total Air Emissions" column was the combination of types of air leaving a facility, "Total Fugitive Air Emissions" and "Stack Air Emissions" were added for purposes to create the "Total Air Emissions". Table 3 below shows the sum of all fugitive and stack air for carbon-emitting organizations.

Table 3.
Total Air Emissions for organizations emitting carbon, by year

	Iowa	Illinois	Indiana	Michigan	Ohio	Pennsylvania	Wisconsin
1987	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2009	0	3276595	1506840	255	5994831	93863	767
2010	0	2950575	1272481	166	4712099	32968	566
2011	0	3303696	1213842	346	5322458	60677	796
2012	0	3644017	1155143	390	4965075	154709	1027
2013	0	3782732	1187393	525	4446605	166886	800
2014	0	3566794	1102555	436	4707075	211538	224
2015	0	3970562	1064647	362	4237717	110569	207
2016	0	3714092	124290	655	6069758	72196	194

Another focus of this study is the coinciding output or total production of these carbon-emitting originations in the Rust Belt, Timothy Antisdel (2017), Specialist/Database Administrator for the EPA described how production rates can be determined. Antisdel (2017) noted that in addition to collecting air pollution rates, the EPA also "collects a production or activity index which indicates the change in production or activity at the facility from year to year", which are included in column DB. As such, average annual productivity rates (as they compare to their productivity from the prior year) for companies from Table 2 were extrapolated from the TRI. Table 4 below summarizes the average productivity rates of these organizations.

Table 4.
Average Annual Production of the Sample Set of Organizations, by year

	Iowa	Illinois	Indiana	Michigan	Ohio	Pennsylvania	Wisconsin
1987	0	0	0	0	0	0	0

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2009	0	0.778	0.809286	0.904	0.816364	0.652222	0.72
2010	0	1.37	7.715333	1.4	0.972	0.975	0.876667
2011	0	1.052778	0.928571	1.088	0.890303	1.052	1.16
2012	0	0.887895	0.913846	1.062	0.996571	0.75	0.905
2013	0	0.872105	0.891538	1.138	0.900606	1.323636	1.075
2014	0	0.931053	0.862	2.102	0.802121	1.194	0.895
2015	0	0.831111	0.809286	0.871667	0.894857	0.865455	0.975
2016	0	0.943125	0.894167	0.862	0.776765	0.878	1.03

In order to obtain a comparable method for assessing pollution as it relates to output, or pollution efficiency, variables for both pollution and productivity must be included. As such, the total air pollution, or the sum of the fugitive and stack air from Table 3, was utilized as the numerator and the average productivity rates from Table 4 were utilized as the denominator in order to ascertain a "pollution efficiency rate". Since the 2011 coal legislation took effect in 2013, the analysis of pollution efficiency rates compared rates from 2009-2012 to those from 2013-2016.

Results

Table 5 below shows the average production of companies emitting carbon both before and after the Clean Power Plan fully took effect in 2013. The total production of those organizations from 2013-2016 decreased sharply from 1.24 to .984 compared to the production of organizations from 2009-2012, or a 20.41% reduction from the previous period.

Table 5.
Average Annual Production of Sample Set, before and after pollution legislation took effect

Year	Avg. Prod'n	Comparison
2009	0.779978667	
2010	2.218166667	
2011	1.028608667	
2012	0.919218667	1.236493167
2013	1.033480833	
2014	1.131029	
2015	0.874562667	
2016	0.897342833	0.984103833

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Table 6 shows the average total emissions (fugitive plus stack) of carbon-emitting organizations both before and after the legislation fully took effect. The total emissions of those organizations decreased from 9,916,045 lbs. in the period 2009-2012 to 9,634,703 lbs. in the period 2013-2016, or a reduction of 2.8% from the previous period.

Table 6.
Total Air Emissions of the sample set, before and after legislation took effect

Year	Emissions	Comparison
2009	10,873,150	
2010	8,968,855	
2011	9,901,815	
2012	9,920,361	9,916,045
2013	9,584,941	
2014	9,588,623	
2015	9,384,064	
2016	9,981,185	9,634,703

Since this study sought to utilize the "pollution efficiency rate" to ascertain production as it compares to emissions, the average production from Table 5 was divided by the total emissions from Table 6 for all companies in the sample set both before and after the respective legislation took effect, as seen in Table 7 below. As such, the pollution efficiency rate decreased (got worse) at a rate of 18.1% from the prior period.

Table 7.
"Pollution Efficiency Rate", before and after legislation

Before/After	Productivity/emissions
2009-2012	1.25E-07
2013-2016	1.02E-07

Organizations using coal and operating in the Rust Belt had to make some changes to their organizational models in light of the legislation of 2011. This study found that after the Clean Power Plan was implemented, production decreased sharply as emissions decreased slightly. These factors contributed to a notable decrease in their pollution efficiency rate.

Together, the seven Rust Belt states examined in this study constituted 101 of 538 total electoral votes during the 2016 Presidential election. Of these seven states, five were considered battleground or tossups (those other than Illinois and Indiana), constituting 70 of those 101 electoral votes (Nelson, 2018). The numerous claims in the lead up to the 2016 presidential election that coal-fired energy plants in the Rust Belt were being victimized by national anti-coal

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legislation may have some follow-up dialogue based on the sharp decreases in production after the implementation of the Clean Power Plan. Future studies should examine the macro productivity rates of companies that were using cleaner energy sources in the years leading up to and after the anti-coal EPA regulations.

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