The Vulnerability of the United States Economy to Electricity Price Increases

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Abstract

This study evaluates the hypothesis that low electricity costs are a catalyst for economic growth. We develop an economy-wide modeling framework using multiple regression of panel data with fixed effects to estimate sector-specific electricity price elasticity coefficients to calculate changes in employment and value added for individual states, given a specific change in the price of electricity. Our results indicate that with a 10% increase in the real price of electricity nationally, the United States will lose, or fail to create, over one million jobs and decrease annual Gross Domestic Product (GDP) by $142 billion. We demonstrate that vulnerability to electricity price increases varies substantially by industry: electricity-intensive manufacturing—including primary metals, paper, wood, chemicals, textiles, and minerals—experience the most-significant losses of productive capacity. The geographic concentrations of electricity-intensive industries can be expected to exacerbate the regional disparity of electricity price implications. The United States Environmental Protection Agency (EPA) should incorporate such economy-wide modeling of electricity price elasticity effects when evaluating the costs of proposed environmental regulations.

1. Introduction

In June 2014, the United States Environmental Protection Agency (EPA) proposed the Clean Power Plan to reduce carbon dioxide emissions from electricity generation under Section 111(d) of the Clean Air Act. Prior to implementation of any new environmental regulation, the EPA is required by Executive Orders 12866 and 13563 to conduct benefit-cost assessments called Regulatory Impact Analyses (RIA). While the EPA has acknowledged, "electricity performs a vital and high-value function in the economy," a continued bias in this and EPA analyses generally, is that consumer sensitivity to changes in electricity prices is not considered. In the RIA for the Clean Power Plan, which claims that electricity prices would increase by up to 6%, the EPA states that the analytic methods used "do not permit estimation of net economy-wide effects." The RIA dismisses the notion of indirect negative employment effects—indicating employment impacts are difficult to disentangle from other economic changes and labor market responses to regulation are complex. The EPA's employment analysis is limited to the direct changes in the labor needed in the electricity, fuels, and generating equipment sectors directly impacted by compliance with the guidelines. The RIA concludes that "overall, the peer-reviewed literature does not contain evidence that environmental regulation has a large impact on net employment (either negative or positive) in the long run across the whole economy."

[1] This study was conducted by Commonwealth of Kentucky staff at the Energy and Environment Cabinet and received no external funding or support. Aron Patrick is an Assistant Director, Adam Blandford is an Energy Analyst, and Leonard K. Peters is Secretary of the Energy and Environment Cabinet as well as Commissioner of Energy.

Modeling economy-wide effects is difficult and complex, but the consensus among economists is that higher energy and electricity prices are associated with statistically significant reductions in production, employment, and value added to the larger economy. Electricity price elasticity coefficients are the percentage change in a given response metric, i.e. employment and value added, given a 1% increase in electricity prices. Economists have employed various statistical and econometric modeling techniques applied to different datasets, each coming up with somewhat different price elasticity coefficients. However, there is consensus that the overall relationship is negative, that most sectors are relatively inelastic, and that electricity price increases will affect certain electricity-intensive manufacturing sectors more negatively. After reviewing the literature on electricity price elasticity of economic growth, we explain in the second section the empirical framework used to build upon previous models. In the third section, we discuss our estimated elasticity coefficients and their intersectoral differences. In the fourth section, we interpret our modeling in terms of changes in employment and GDP, and highlight the regional disparity of impacts. In the final section, we conclude with policy recommendations that could mitigate some of these impacts.

The 1973 oil crisis caused a severe shock to energy prices that reverberated through the United States economy, which induced a decade of research to quantify the interdependent relationship between energy prices and economic growth, especially manufacturing. Huntington and Smith (1977) developed a neoclassical model to demonstrate how energy prices affect rates of economic growth. By analyzing energy expenditures for manufacturers, including electricity, they found that output (or value added) is lower in states exhibiting higher energy prices. Huntington and Smith used their model to simulate changing energy costs in each state and concluded that energy price differentials are an important factor for regional growth. Solnick (1980) observed that "since energy intensity varies widely across the industries in the manufacturing sector, the response of these industries to energy price differences will also vary." Solnick built upon the work of Huntington and Smith and others (Early and Mohtadi, 1976) who found negative associations between energy prices and employment by estimating sector-specific elasticity coefficients for manufacturers and concluded that "in most of the manufacturing industries higher energy prices reduced employment." Other econometric models of location and employment decisions of manufacturing firms using plant-level data across the United States have also found that energy costs have significant effects (Carlton, 1983).

More recent econometric research has established a negative relationship between electricity prices and growth of not only manufacturers, but also the economy as a whole. Deschenes (2010) quantified the risk that increased electricity prices as a result of carbon regulation could encourage displacement of jobs from the US to countries without such carbon policies. His analysis of employment and electricity price data from 1976 to 2007 identified an electricity price elasticity coefficient of total employment in the range of -0.096 to -0.156. Deschenes concluded that a 4% increase in real electricity prices would reduce employment nationally by 460,000 jobs. Aldy and

Pizer (2011) found that a carbon policy that increases energy costs would decrease manufacturing production and increase imports. Aldy and Pizer identified an elasticity of -0.1 for the least energy-intensive sector and up to -0.4 for the most energy intensive producing sectors. For energy-intensive industries—iron and steel, chemical, paper, aluminum, cement, and glass—they estimated elasticities ranging from -0.333 to -0.421. Kahn and Mansur (2010 and 2013), analyzing how energy-intensive industries concentrate in counties with lower electricity prices, concluded that some electricity-intensive industries, such as metals, the price of electricity is an important factor in location choice. They estimated the following statistically significant sector-specific electricity price elasticity of employment coefficients: primary metals -1.17, wood, -0.59, paper, -0.47, nonmetallic minerals, -0.33. Kahn and Mansur then used these elasticities to simulate a carbon tax and determined that electricity price increases would most-severely impact states with carbon-intensive electricity generating portfolios and higher levels of electricity-intensive manufacturing. Morgenstern et al. (2004) found that a carbon tax would "not only have significant direct impacts on coal, and other domestic energy industries, it could adversely affect the competitiveness of a number of large energy-intensive, import-sensitive manufacturing sectors." They found that for carbon-intensive goods, production would decrease, foreign imports would increase, and American exports would decrease. They also found that if a US carbon policy were unilateral, significant leakage would occur, specifically that 26% of the carbon emissions reductions would simply occur overseas.

However, there is disagreement. Porter (1991) and Porter and Van der Linde (1995) claimed that environmental regulations could incentivize innovation that could make companies more productive and competitive. The authors offer anecdotal evidence from individual case studies of improved competiveness in response to environmental regulation to support their hypothesis. The EPA invokes the Porter Hypothesis in the RIA for the Clean Power Plan, stating that regulation could induce companies to replace equipment with cleaner and more productive machinery, lowering costs, and increasing profits. Certainly, as implied by the *law of demand*, higher energy prices encourage energy efficiency, waste reduction, and a search for alternatives and technological innovation, which can in turn increase business competitiveness. However, there seems to be no evidence that increased electricity costs are associated with net macroeconomic growth in any sector other than utility services that generate and sell electricity. Electricity price increases are adverse and harm the electricity consumer, which is further manifested in lower average value added and employment.

The consensus among US economists is that the electricity price elasticity of employment coefficients are negative. International researchers using data from China (He et al., 2010), Mexico (Sterner, 1989), and Turkey (Bölük and Ali Koç, 2010) have also found negative associations between electricity prices and indicators of economic growth. Since the EPA estimates that the proposed environmental regulation will increase electricity prices across the country by up to 6% in 2020 assuming low natural gas prices, we question the claim that "overall, the peer-reviewed literature does not contain evidence that environmental regulation has a large impact on net

employment (either negative or positive) in the long run across the whole economy." Furthermore, we suggest that by excluding the economy-wide implications of increasing electricity prices, the EPA is underestimating the costs, which biases their results in favor of environmental regulation. Even if the net effects on economic growth of higher electricity costs were positive, this still would not mean that certain geographic regions and economic sectors, particularly those with higher electricity-intensity, are not more vulnerable to electricity price increases.

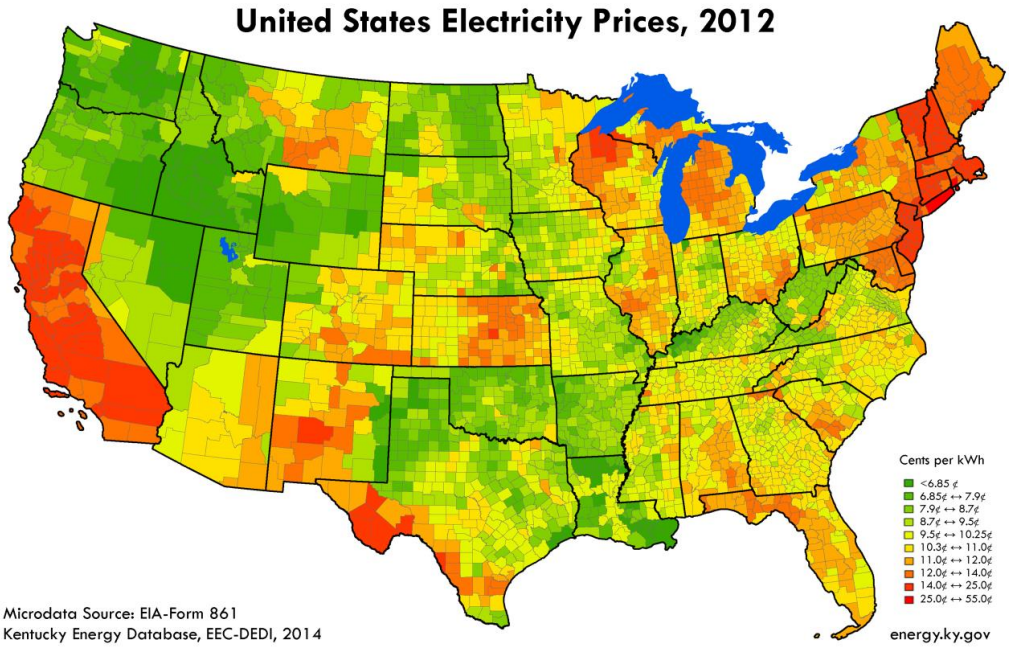
2. Empirical Framework

In this paper, we are expanding the current research base by analyzing the simultaneous responsiveness of employment and GDP across the US to changes in the real price of electricity from 1970 to 2012 by economic sector. We employed multiple regression of panel data with fixed effects to develop elasticities to calculate changes in employment and value added given a specific change in the price of electricity. The elasticity coefficients summarized in Table 2, are applicable to these 12 sectors in any state and year. This modeling framework shares several commonalities with previous research, e.g., Dechenes (2010); however, we have divided the economy, based on electricity intensity to estimate the inter-sectoral variation of electricity price responsiveness, which shows how certain economic sectors are more susceptible to changes in electricity prices. Although previous research has established the vulnerability of electricity-intensive manufacturing to electricity prices, including primary metals (Solnick, 1980; Morgenstern et al., 2004; Aldy and Pizer, 2010), we have considered an economy-wide modeling framework that shows how changes in electricity prices could transform the larger economy, not just manufacturing. While Kahn and Mansur (2013) have used highly granular county-level data to estimate employment effects for most sectors, we have created an accessible state-level modeling framework based on the relative electricity-intensity of production of each economic sector that can be applied by federal or state policy makers to estimate economic implications of changes in electricity prices.

The dependent variables of interest in this study were sectoral employment, defined as the number of full and part-time wage and salary employees by industry, and sectoral GDP, defined as the value added by the labor and capital located in each sector and state. We used employment data from the Bureau of Economic Analysis (BEA) Form SA27-SA27N. The primary independent variable of interest was the total real electricity price in each state and year expressed in dollars per kilowatt-hour from Forms EIA-861 and EIA-826. Figure 1 illustrates these data by county. The following control variables were used: real per capita personal income, from the BEA form SA1-3; educational attainment, defined as the percentage of the adult population with a bachelor's degree, collected from the United States Census American Community Survey; population, also collected from the United States Census; petroleum price, from the Energy Information Administration State Energy Data System; and year. All currency variables—the price of electricity, GDP, petroleum prices, and per capita personal income—are adjusted for inflation to 2010 US$ using the Bureau of Labor Statistics (BLS) Consumer Price Index (CPI). Prior to analysis, we also converted all variables

to their natural logarithms so that their coefficients may be interpreted as elasticities. We conducted various robustness tests on these models to control for potential endogeneity in electricity prices and economic growth by including lagged electricity prices as well as estimating electricity prices in a separate equation using an instrumental technique; however, we found that these additional steps were not necessary since they had little impact on the resulting elasticity coefficients.

Figure 1: United States Electricity Prices, 2012



We organized sectoral data by North American Industry Classification System (NAICS) codes for years 1998 forward for employment and 1997 forward for GDP, and by the Standard Industrial Classification (SIC) system from years 1970 to 1997 for employment and 1970 to 1996 for GDP. Our simplified concordance system, shown in Table 2, which utilized work by Haveman (2014), allowed our analysis to transition the NAICS/SIC divide that mars sector-specific databases, adding decades of additional data and giving greater degrees of freedom, and thus statistical significance, to inter-sectoral elasticities. We grouped sectors based on their relative electricity intensity of production from the 2010 Annual Survey of Manufacturers as shown in Table 2. The responsiveness of manufacturing sectors with electricity intensity of production greater than 0.29 kilowatt-hours per dollar of product were analyzed independently, while the responsiveness of less-intensive sectors are analyzed collectively. Likewise, we analyzed non-manufacturing service sectors having significant responsiveness to electricity prices (construction, transportation, and utilities) independently, while we modeled less-responsive sectors collectively. We have regressed data for all sectors independently; however, their inclusion as separate models is not necessary for policy makers given their similar levels of inelasticity.

Figure 3: Electricity Intensity of United States Manufacturing, 2010

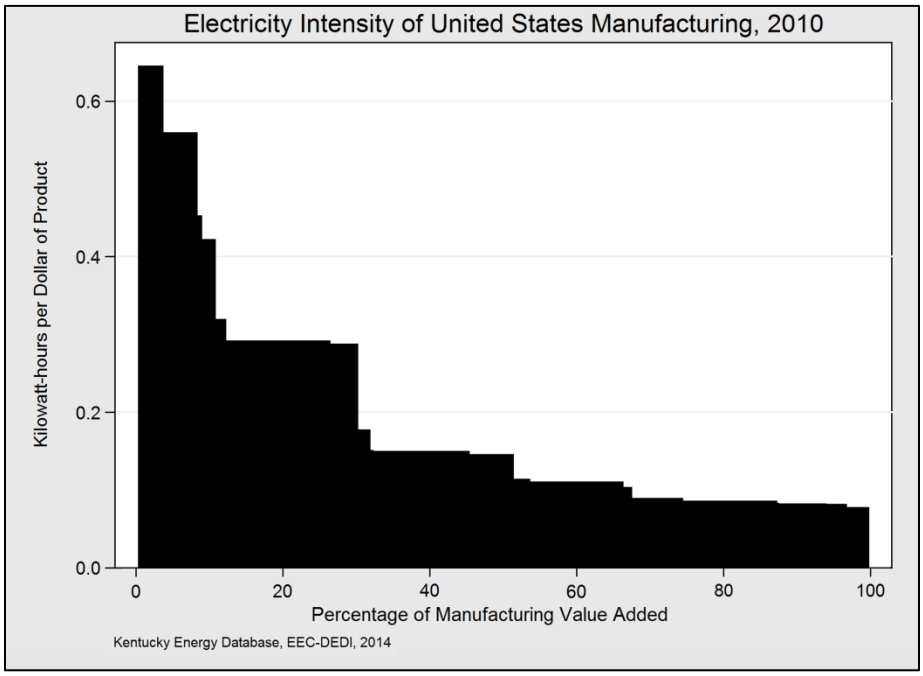


Table 1: Electricity Intensity of United States Manufacturing, 2010

	NAICS	Description	Electricity Intensity Rank	Electricity Intensity (kWh/$)	Electricity Intensity Range (kWh/$)	Total Employees (US)	Electricity Consumed (TWh)	Value of Product (Billion $)
Intensive	**Electricity-Intensive Total**		**--**	**0.530**	**0.011 ↔ 5.829**	**1,479,071**	**313.202**	**590.986**
	322	Paper Manufacturing	1	0.646	0.195 ↔ 1.501	351,931	109.771	169.954
	331	Primary Metal Manufacturing	2	0.560	0.059 ↔ 5.829	353,671	129.524	231.185
	313	Textile Mills	3	0.453	0.123 ↔ 0.506	107,661	13.183	29.109
	327	Nonmetallic Mineral Product Manufacturing	4	0.422	0.011 ↔ 1.854	336,216	38.349	90.781
	321	Wood Product Manufacturing	5	0.320	0.053 ↔ 0.957	329,592	22.375	69.957
	325	Chemical Manufacturing	6	0.292	0.038 ↔ 2.887	703,280	204.749	701.230
Non-Intensive	**Non-Intensive Total**		**--**	**0.120**	**0.021 ↔ 2.887**	**9,088,286**	**436.645**	**3,624.430**
	326	Plastics And Rubber Products Manufacturing	7	0.288	0.125 ↔ 0.621	664,641	54.331	188.583
	323	Printing And Related Support Activities	8	0.178	0.145 ↔ 0.181	468,030	14.667	82.488
	314	Textile Product Mills	9	0.151	0.145 ↔ 0.641	108,934	3.295	21.818
	311	Food Manufacturing	10	0.150	0.026 ↔ 0.736	1,364,157	97.125	646.451
	332	Fabricated Metal Product Manufacturing	11	0.146	0.062 ↔ 0.398	1,242,904	43.157	295.187
	335	Electrical Equipment and Appliances	12	0.115	0.055 ↔ 0.558	327,441	12.714	110.993
	324	Petroleum And Coal Products Manufacturing	13	0.111	0.045 ↔ 0.182	99,225	69.689	627.572
	337	Furniture And Related Product Manufacturing	14	0.104	0.036 ↔ 0.171	332,316	6.094	58.795
	334	Computer And Electronic Product Manufacturing	15	0.090	0.021 ↔ 0.268	836,475	30.611	340.683
	336	Transportation Equipment Manufacturing	16	0.086	0.029 ↔ 0.346	1,181,363	54.540	633.275
	315	Apparel Manufacturing	17	0.083	0.028 ↔ 0.296	104,457	1.135	13.643
	333	Machinery Manufacturing	18	0.083	0.042 ↔ 0.213	930,290	26.310	317.694
	312	Beverage And Tobacco Product Manufacturing	19	0.082	0.046 ↔ 0.116	132,409	10.820	131.845
	316	Leather And Allied Product Manufacturing	20	0.082	0.128 ↔ 0.131	27,609	0.413	5.049
	339	Miscellaneous Manufacturing	21	0.078	0.042 ↔ 0.271	564,755	11.746	150.353

We organized the data into a multidimensional panel, i.e. both time series and cross sectional, enabling simultaneous modeling of the relationships of multiple statistics across both space and time. Since each observation is non-random, and not independent (for example electricity prices in state *i* and year *t* are not independent of prices in state *i* in year *t-1*) we used a fixed effects model, which builds upon Ordinary Least Squares (OLS) regression by isolating the time-independent constant difference between states that is correlated with the explanatory variables. We constructed two multiple regression of panel data models with fixed effects for each of the 12 sectors for a total of 24 models, shown in Tables 3 and 4.

The multiple regression of panel data model with fixed effects is generally given by,

$$Y_{it} = \beta_0 + \sum_{j=1}^{k-1} \beta_j X_{jit} + \alpha_i + \varepsilon_{it}$$

where *i* and *t* index states and years, such that y_{it} is the dependent variable of interest, employment or value added by industry, in state *i* in year *t*; β_0 is the constant *y* intercept across all states; *k* is the total number of included independent variables; β_j is the coefficient for each independent variable *j* through *k; X* is a *k* by 1 vector of independent variables; X_{jit} is the of observation for each independent variable *j* through *k* for state *i* in year *t*; α_i is the time-invariant fixed effect for state *i*; and ε_{it} are the residuals, where $\varepsilon_{it} \sim N(0, \sigma^2)$, or are approximately normally distributed with a mean of zero.

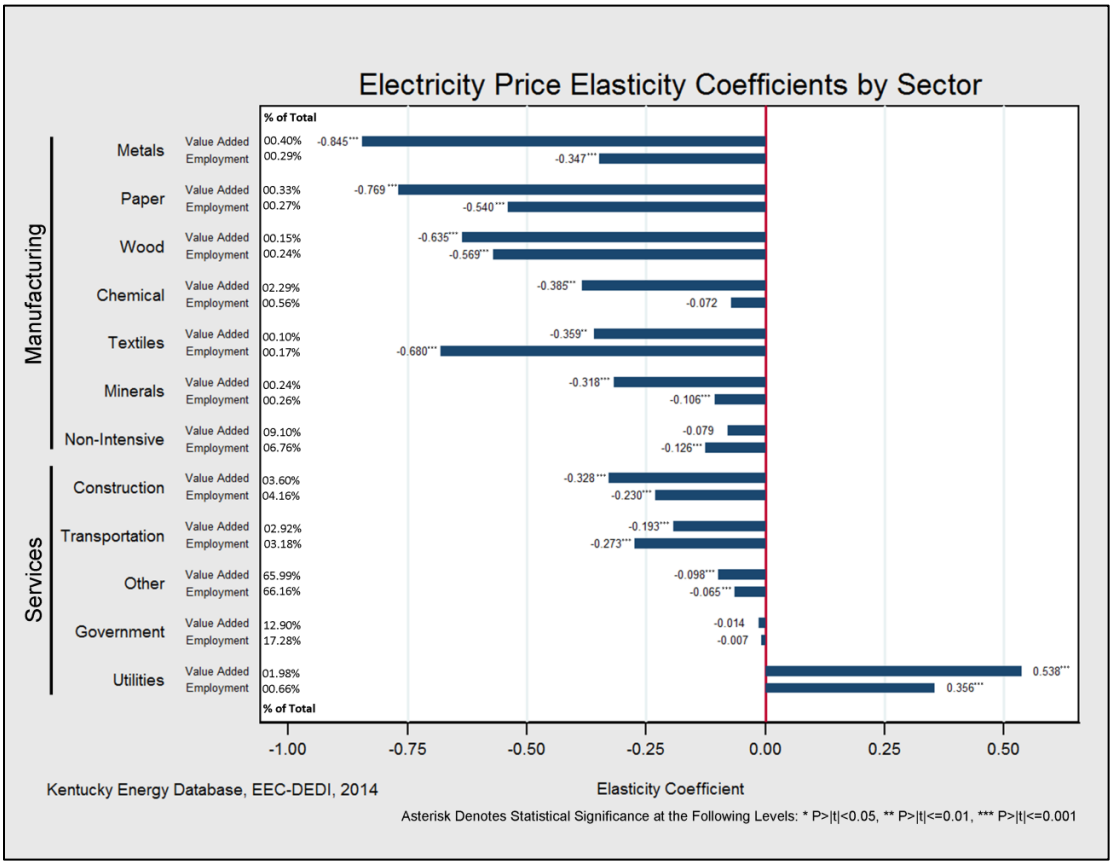
Since these elasticities are calculated using regression of national historical data, they may be generally applied to any state and year and to the US as a whole for each respective economic sector. Assuming a reliable electricity price forecast, the long-term change in employment and value-added in a given sector for each state and for different changes in the price of electricity can be calculated by simply multiplying the number of employees in that sector currently by the forecasted percentage change in real electricity prices, i.e. inflation adjusted, multiplied by the specified elasticity coefficient for that sector. For example, given the 42,732 employees working to manufacture primary metal in Indiana in 2012, and assuming real electricity prices increased by 10%, and given that the electricity price elasticity of metal manufacturing employment calculated here is -0.347, then the estimated long-term job losses resulting from the increase in electricity prices would be 1,483.

3. Results

Table 1 summarizes sector-specific electricity price elasticity coefficients along with the standard errors, significance levels, and the relative size of each sector. Figure 2 illustrates these estimated coefficients for electricity prices. We sorted the rows on the coefficients for value added from most-negative responsiveness, primary metals, to positive responsiveness, utilities. Our results indicate increases in electricity prices decrease competiveness for most industries and the economy as a

whole. However, the insulation from changes in electricity prices varies by sector with the most-electricity-intensive sectors being the most vulnerable to price increases. Figure 3 and Table 1 show the relative electricity intensity for each manufacturing sector. We find the negative association of higher electricity costs on these economic indicators to be robust and statistically significant below the 0.001 level, which is consistent with the literature. Tables 3 and 4 provide the complete models for value added and employment including coefficients and standard errors for each independent variable as well as the population and coefficients of determination for each model.

Figure 2: Electricity Price Elasticity Coefficients of Value Added and Employment by Sector



‡ Other services is the equivalent of total employment and GDP less the summation of total manufacturing (NAICS 31-33), construction, transportation, government, and utilities sectors, listed above. Similarly, non-intensive manufacturing employment and GDP is the equivalent of total manufacturing less the summation of specified intensive sectors.

Overall, value added is more responsive to changes in electricity price than employment. Because value added is the equivalent of gross sales minus intermediate inputs, any increase in intermediate inputs necessarily and immediately decreases value added. Employment dynamics appear to be more complex. During decreased business cycles, firms may resist layoffs to ensure the requisite workforce is available if business increases or a certain threshold of workers may be required for large industrial processes to occur. This is likely not the case for all sectors though. More labor-intensive sectors such as textiles exhibit more employment responsiveness.

Although not shown in Tables 1-4, using the same set of independent factors, we estimate economy-wide electricity price elasticity coefficients for total value added and employment to be -0.074 and -0.064 respectively. While these two statistically significant elasticity coefficients alone yield somewhat comparable total job and GDP impacts nationally, we do not recommend their application since they do not capture the important intersectoral, and thus interstate, variance of electricity price implications. At the other end of the spectrum, it could be possible to develop thousands of different elasticity coefficients for value-added and employment for each of the six-digit NAICS sectors. However, we believe the parsimonious modeling framework presented in this paper to be more suitable for state and federal policy makers to estimate sufficient intersectoral elasticity effects while maintaining simplicity of application with fewer data requirements.

As expected, electricity price increases are associated with greater reductions in employment or value added for manufacturing, specifically for the most electricity-intensive manufacturing processes—metals, paper, wood, chemicals, textiles, and minerals. Electricity price elasticity of value added coefficients for these electricity-intensive manufacturing sectors range from -0.318 to -0.845, whereas for the remaining group of non-intensive manufacturing sectors we find no statistically significant responsiveness to changes in electricity prices. For employment, price elasticity coefficients for intensive manufacturing sectors range from –0.106 to -0.845, and -0.126 for non-intensive. For chemical manufacturing alone, there is not a statistically significant employment response. However, electricity-intensive sectors, while more responsive to changes in electricity prices, represent 27% of manufacturing and 3.5% of total GDP nationally. Figure 4 illustrates these proportions with estimated responsiveness of value-added for each sector along the x-axis, and the size of each circle showing the relative size of each sector. Similarly, Figure 5 illustrates the size and sensitivity of each sector for employment.

While elasticities for most service sectors exhibit less responsiveness than manufacturing to changes in electricity prices, these relatively inelastic coefficients have considerable implications for total employment and GDP due to their larger size. Negative elasticity of value added coefficients range between no response in government and -0.328 in construction. Similarly, negative elasticity coefficients for employment range between no response in government and -0.273 for transportation. Two large service sectors, construction and transportation, were found to have more significant negative associations with electricity price increases—elasticity coefficients in the -0.193 to -0.328 range. In the public sector—the federal, state, and local government services that represent 13% of GDP and 17% of employment nationally—we find no statistically significant relationship between electricity prices and employment or value added and thus conclude that government expansion is uncorrelated with electricity prices. This result is intuitive given that government services generally locate where they are needed regardless of locational costs, and generally, there are limited incentives for cost minimization. For utilities, electricity price increases are associated with statistically significant growth in both value added and employment of +0.538 and +0.356 respectively.

Figure 4: Electricity Price Elasticity of Value Added vs. Contribution to Value Added

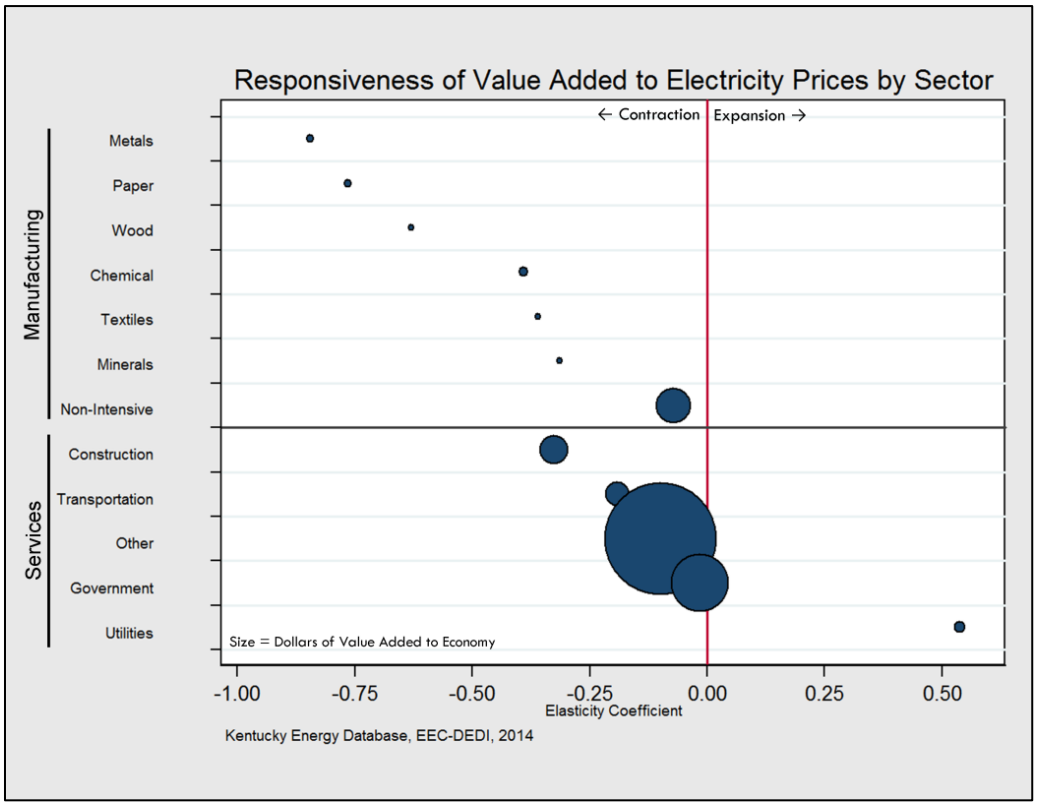


Figure 5: Electricity Price Elasticity of Employment vs. Contribution to Total Employment

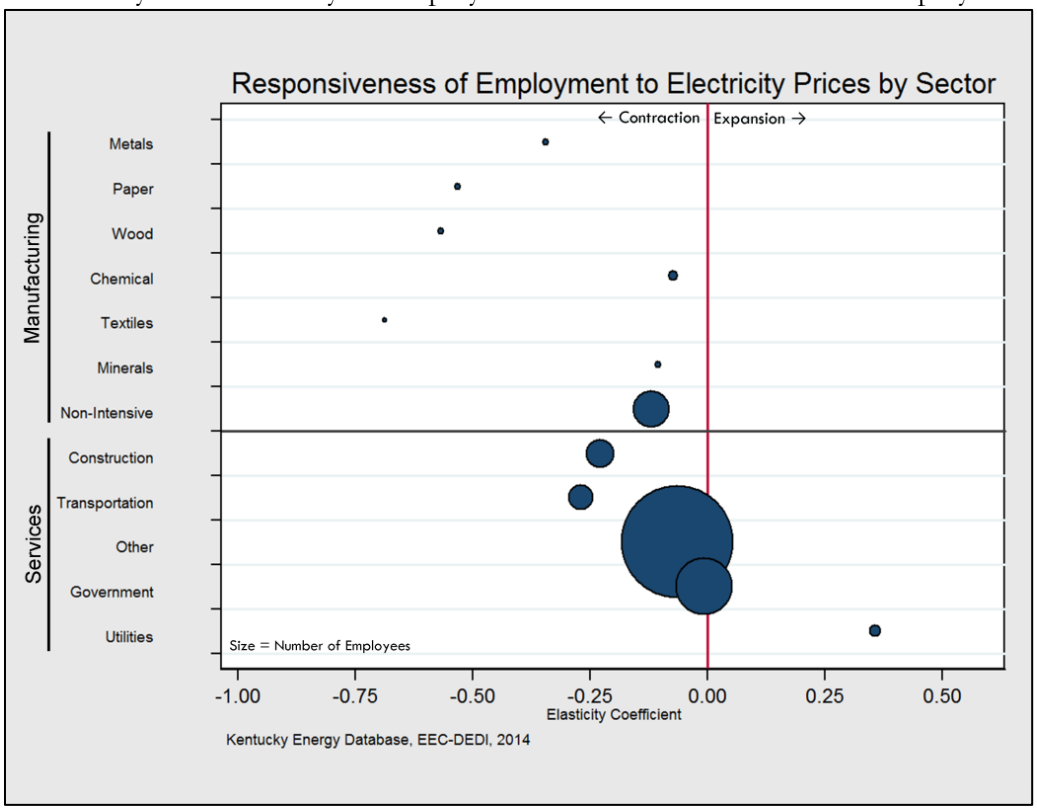


Table 2: Electricity Price Elasticity Coefficients of Value Added and Employment

	NAICS	SIC	Industries	GDP			Employment		
				GDP in 2012 (Million$)	Coefficient	Standard Error	Employment in 2012	Coefficient	Standard Error
Manufacturing	331	33	Metals	64,450	-0.845***	(0.089)	404,026	-0.347***	(0.064)
	322	26	Paper	53,428	-0.769***	(0.091)	380,121	-0.54***	(0.064)
	321	24	Wood	23,784	-0.635***	(0.059)	341,624	-0.569***	(0.041)
	325	28	Chemical	370,143	-0.385***	(0.062)	788,000	-0.072	(0.051)
	313, 314	22	Textiles	16,234	-0.359**	(0.124)	232,882	-0.68**	(0.114)
	327	32	Minerals	38,253	-0.318***	(0.039)	366,000	-0.106**	(0.031)
	†	†	Non-Intensive Manufacturing	1,468,041	-0.079	(0.045)	9,431,347	-0.126***	(0.034)
Services	23	15-17	Construction	581,073	-0.328***	(0.025)	5,797,000	-0.23***	(0.023)
	48, 49	40-48	Transport	471,637	-0.193***	(0.022)	4,435,000	-0.273***	(0.02)
	‡	‡	Other	10,650,875	-0.098***	(0.015)	92,291,000	-0.065***	(0.008)
	92	91-99	Government	2,082,837	-0.014	(0.01)	24,103,000	-0.007	(0.008)
	22, 562	49	Utilities	320,397	0.538***	(0.028)	922,000	0.356***	(0.022)

*Asterisks denote statistical significance at the following levels: * p<0.05, ** p<0.01, *** p<0.001*

† Non--intensive manufacturing is the equivalent of total manufacturing (NAICS 31-33) less the electricity-intensive industries listed above.

‡ Other services is the equivalent of total employment/GDP less the summation of total manufacturing (NAICS 31-33), construction, transportation, government, and utilities sectors, listed above.

4. Discussion

Given a uniform 10% increase in the real price of electricity nationally, our results imply that the US will lose, or fail to create, approximately one million jobs and $142 billion in GDP annually. The most vulnerable sectors to electricity price increases—metals, paper, wood, chemical, textiles, and minerals—employed 2.5 million Americans and contributed $566 billion to national GDP in 2012, and would lose 74,000 jobs and $27 billion in value added. Any geographical clustering of industries vulnerable to electricity price increases will disproportionately harm the areas where those industries are located. The employment and GDP implications of a 10% price increase are shown by individual state and sector, as well as for the United States as a whole, in Tables 5 and 6 on pages 19 and 20. Similarly, given the linearity of this model, a 25% real increase in electricity prices would be associated with a reduction in total United States employment of 2.5 million jobs and a reduction of GDP by $357 billion annually.

The least electricity-intensive sectors, services and manufacturers that are not electricity-intensive, account for 71% of the forecasted employment losses and 74% of the forecasted decrease in GDP because of their large size relative to smaller more responsive sectors. The construction and transportation sectors would lose or fail to create 255,000 jobs and $28 billion with a 10% increase in electricity prices. In our analysis, only utilities benefit from increases in electricity prices: a 10% increase in the real price of electricity would create 33,000 new jobs in electricity generation and

increase value added by $17 billion annually. Yet, the gains in the utilities sector, some of which could be called *green jobs*, would not counter the aggregate losses to the US economy.

For primary metal manufacturing, which is the most responsive to electricity price increases in terms of value added, we estimate a reduction of $5.5 billion and 14,000 employees from 2012 levels in response to a 10% increase in electricity prices, *ceteris paribus*. The forecasts for primary metal manufacturing value added illustrated in Figure 6 use the complete models shown in Table 3 and extrapolated input factors with the red and green lines illustrating the implications of a 10% increase or decrease from 2012 state electricity prices. The geographic clustering of primary metal manufacturing in the Great Lakes region, refer to Figure 7, will exacerbate the interstate disparity of these impacts. Fully 41% of primary metal employment and 43% of value added is in Indiana, Ohio, Pennsylvania, Michigan, Illinois, and Wisconsin.

Primary metals are also critical inputs into the larger and less electricity-intensive economy further down the commodity chain. For example, machinery manufacturing (NAICS 333) and transportation equipment, including automobiles, ships, and aircraft (NAICS 336), use less electricity per dollar of product directly than primary metals. However, electricity price increases can be expected to affect them indirectly through increased metal input costs. That is, increasing the costs of the embodied energy in primary metals—the energy required to convert the raw materials into a usable product—has multiplier effects throughout the economy. Whenever the production cost of primary material inputs increases, for whatever reason, the production cost of higher value products further down the commodity chain will increase as well, which in part explains the negative association of less electricity-intensive sectors to changing electricity prices. Thus, the induced and indirect effects of decreased competiveness for intensive manufacturing sectors are inherent in the responsiveness of less-intensive manufacturing and service sectors to changing electricity prices.

Textile manufacturing was the most responsive to electricity price changes in terms of employment. We estimate a 10% increase in electricity prices would induce a reduction of 16,000 textile jobs, and a reduction of $580 million in value added from textiles, *ceteris paribus*. The forecasts for textile manufacturing employment illustrated in Figure 8 use the complete models shown in Table 3 and extrapolated input factors with the red and green lines illustrating the employment implications of a 10% increase or decrease from 2012 state electricity prices. Figure 9 displays the geographical concentration of the textile sector. The sector clusters in the interior Piedmont region of Georgia, North Carolina, South Carolina, and Virginia, where 54% of the sectoral employment and 46% of sectoral GDP is located.

Manufacturing fulfills a unique economic function in that most goods are exported, bringing revenue into a community from other economies, rather than simply circulating capital within a community. In addition, electricity-intensive manufacturing often occurs in large, vertically integrated facilities. Large manufacturers also have a more significant multiplier effect on a regional

economy because they encourage suppliers to collocate with manufacturing facilities (Bae, 2008). The concentration of electricity-intensive industries, the occupation-specific skills necessary in those industries, and factors leading to geographic immobility depress local labor markets and cause structural unemployment. As manufacturing has traditionally offered high paying jobs to those with less education (Neal, 1995), reductions in manufacturing jobs leave large groups of workers with skills that do not match available jobs. Research has found workers displaced from mass layoffs and living far from potential new jobs have significantly higher periods of unemployment. This difficulty finding work is particularly strong with those who previously worked in manufacturing and construction (Andersson et al., 2014). Moreover, if businesses must close or relocate because of cost increases, the firms that buy from or sell to those industries will face increased costs and may be at risk of relocation or closure, causing more harm to local communities. Suppliers may also face adversity if they must then compete in a smaller market for their goods, face higher transportation costs, or have unique ties to local energy-intensive manufacturers.

Figure 6: Forecast of United States Primary Metal Manufacturing GDP, 1970-2030

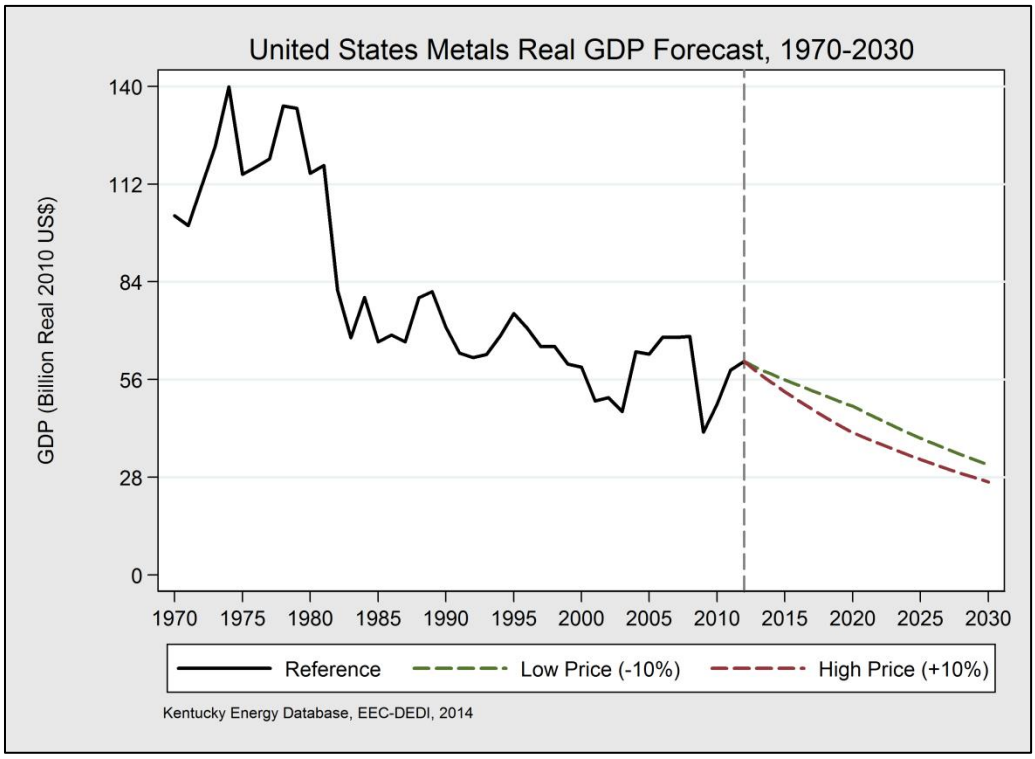


Figure 7: Map of United States Primary Metal Manufacturing Employment, 2012

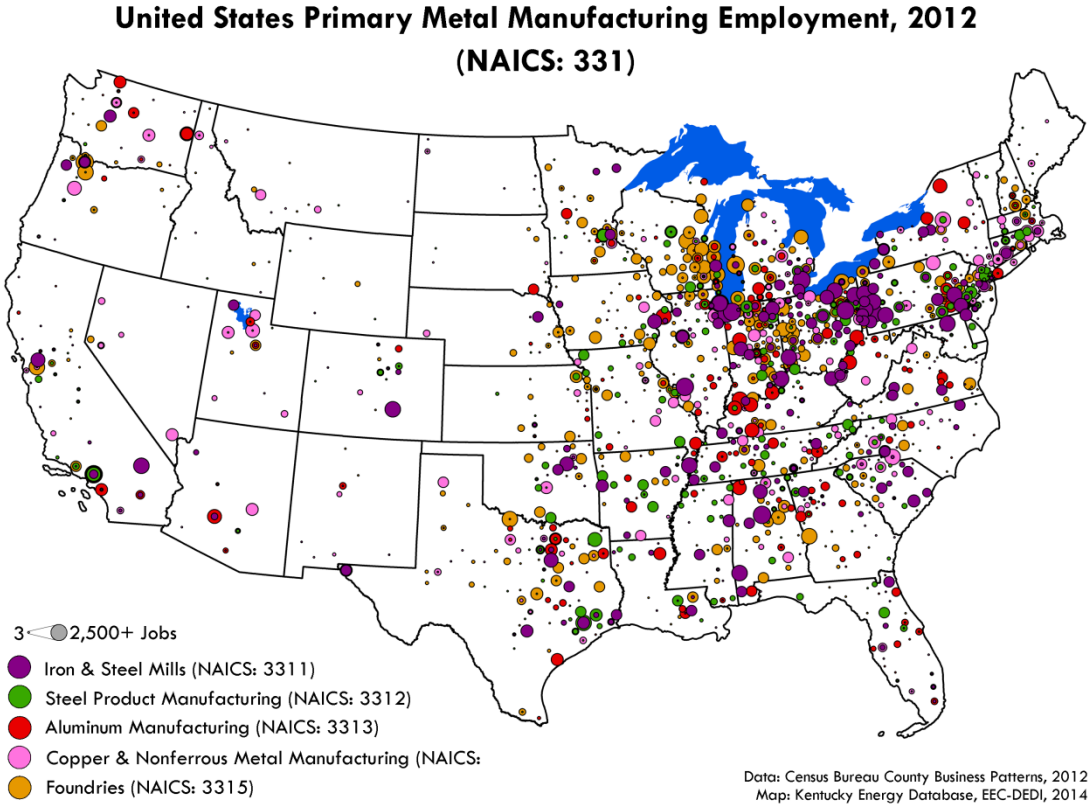


Figure 8: Forecast of United States Textile Manufacturing Employment, 1970-2030

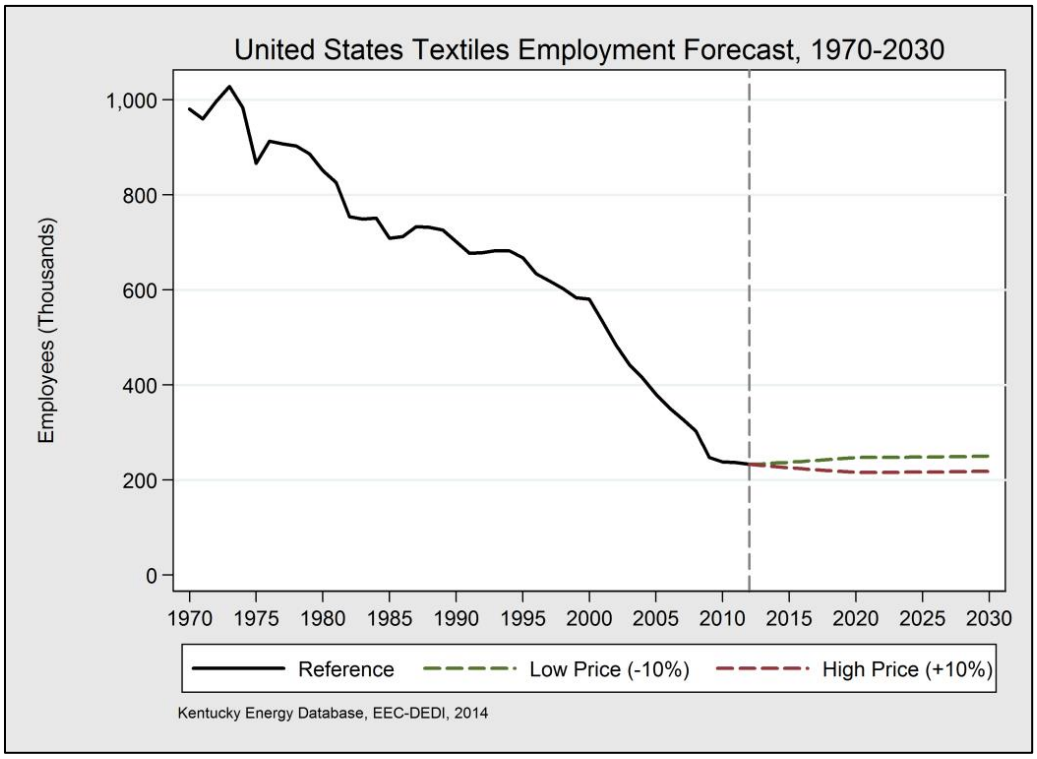
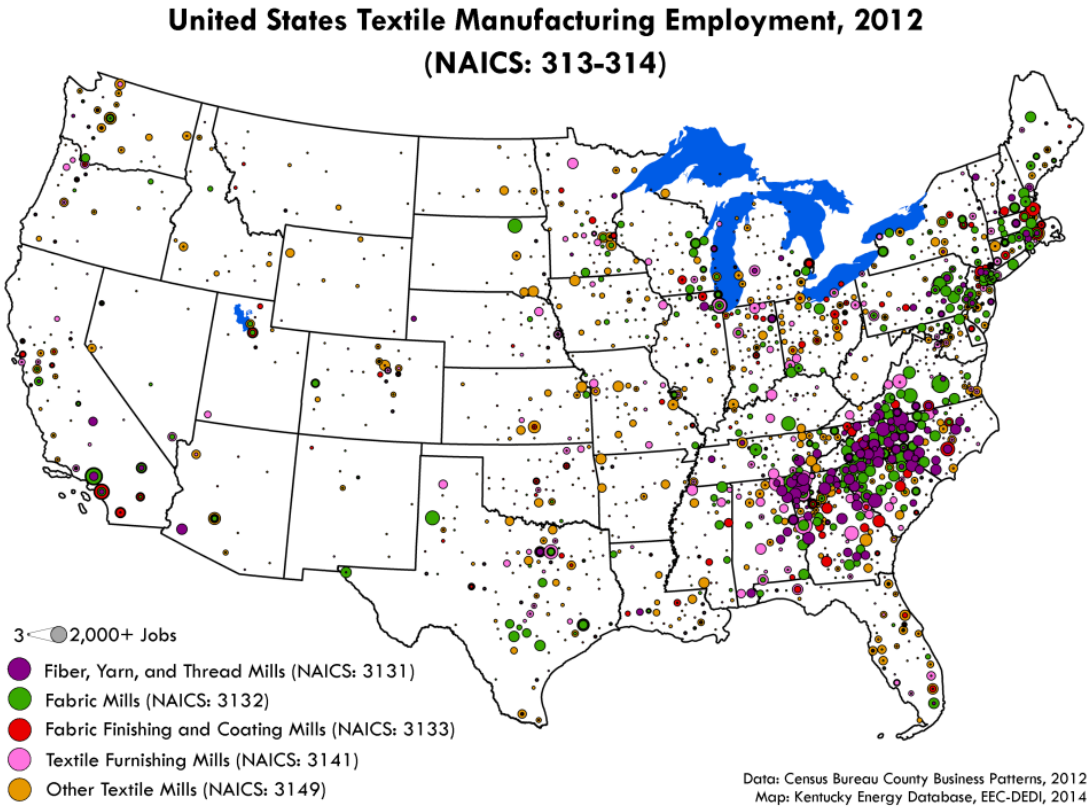


Figure 9: Map of United States Textile Manufacturing Employment, 2012



Firm-specific attributes may incent a company's continued operation, countering the aforementioned risks. Electricity is but one of many determinants of a company's viability. Businesses are less able to change location when they face high transportation costs and require vast fixed investments in the production process. Businesses are also discouraged from relocating when they benefit from agglomeration effects—the benefits of existing near skilled labor pools, the knowledge spillovers, and the abundance of intermediate goods and accessible consumers when industries aggregate in one location (Ederington et al., 2005). For example, cement production requires expensive investments in the processing plant and is not easily transportable. Firms benefiting from available factors of production such as raw materials, advanced technologies, and fixed or liquid capital are also incented to remain in their current location (Antweiler et al., 1998). Products with inelastic demand, especially those with high transportation costs, benefitting from agglomeration effects or other locational advantages, will allow these firms to endure, and pass along price increases to consumers.

Our analysis confirms that human capital factors, such as education, have a much larger effect on the national economy than energy or electricity prices and can stimulate growth enough to offset the negative effects of high energy costs. For most industries, every sector except textiles, bachelor degree attainment was a more significant, positive driver of growth than electricity prices, as specified in Tables 3 and 4. In our models for total employment and GDP growth that are not listed here, the coefficients for educational attainment of +0.376 and +0.152 respectively, which are several times the absolute value of our estimated electricity price elasticity coefficients of -0.064 and -0.074. While the independent effect of high-energy costs remains negative, the application of the education elasticity coefficients in our models imply that a 10% increase in bachelor degree attainment across the United States would increase total employment by 7.7 million jobs and GDP by $447 billion annually.

While the EPA has estimated that the Clean Power Plan will only raise electricity prices by 6% nationally, this result is contingent upon the assumption that natural gas prices will remain low and stable through the year 2030. Were natural gas prices to be higher than anticipated, the electricity price implications of the Clean Power Plan will be more severe. Furthermore, electricity prices will not change uniformly among states. Since we have employed a linear regression model, our model results necessitate a reliable electricity price forecast for each state. The elasticity coefficients are also bidirectional, such that a decrease in electricity prices would increase economic growth.

Table 3: Complete Model of Value Added by Industry

	Manufacturing GDP							Services GDP				
	Metals	**Paper**	**Wood**	**Chemical**	**Textiles**	**Minerals**	**Non-Intensive**	**Construct**	**Transport**	**Other**	**Govern-ment**	**Utilities**
Electricity Price	-0.845***	-0.769***	-0.635***	-0.385***	-0.359**	-0.318***	-0.079	-0.328***	-0.193***	-0.098***	-0.014	0.538***
	(0.09)	(0.09)	(0.06)	(0.06)	(0.12)	(0.04)	(0.05)	(0.03)	(0.02)	(0.02)	(0.01)	(0.03)
Personal Income	0.427	0.078	0.042	1.284***	-0.87**	1.838***	-0.058	2.582***	0.762***	1.269***	0.638***	0.093
	(0.22)	(0.22)	(0.15)	(0.15)	(0.31)	(0.10)	(0.11)	(0.06)	(0.05)	(0.04)	(0.02)	(0.07)
Education	1.589***	2.586***	3.392***	0.238	-1.657***	0.199*	0.504***	-0.037	0.278***	0.314***	-0.174***	0.756***
	(0.20)	(0.20)	(0.13)	(0.14)	(0.27)	(0.09)	(0.10)	(0.05)	(0.05)	(0.03)	(0.02)	(0.06)
Population	0.863***	2.136***	0.704***	0.509***	1.417***	1.511***	1.687***	1.387***	1.159***	1.118***	0.650***	0.989***
	(0.12)	(0.12)	(0.08)	(0.08)	(0.16)	(0.05)	(0.06)	(0.03)	(0.03)	(0.02)	(0.01)	(0.04)
Petroleum Price	0.399***	-0.24***	-0.226***	0.104**	-0.368***	0.033	-0.112***	0.105***	0.058***	0.061***	-0.019***	-0.248***
	(0.05)	(0.05)	(0.03)	(0.03)	(0.07)	(0.02)	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Year	-144.2***	-161.2***	-193.8***	-6.258	87.41***	-96.0***	-28.57***	-68.75***	-29.40***	-14.48***	22.59***	-7.83*
	(10.76)	(10.92)	(7.16)	(7.47)	(14.95)	(4.70)	(5.41)	(2.96)	(2.67)	(1.81)	(1.20)	(3.38)
Constant	1080***	1192***	1459***	33.6	-664.9***	693.9***	200.8***	484***	205.9***	90.4***	-177.6***	48.8
	(79.62)	(80.85)	(52.96)	(55.26)	(110.63)	(34.75)	(40.02)	(21.88)	(19.75)	(13.41)	(8.85)	(25.03)
N	2192	2193	2193	2193	2193	2193	2193	2193	2193	2192	2193	2193
R^2 Within	0.145	0.191	0.394	0.504	0.128	0.365	0.435	0.910	0.751	0.951	0.961	0.711
R^2 Between	0.578	0.583	0.121	0.642	0.520	0.836	0.897	0.957	0.853	0.983	0.883	0.904
R^2 Overall	0.540	0.550	0.140	0.556	0.472	0.812	0.866	0.932	0.845	0.976	0.881	0.887

*Asterisks denote statistical significance at the following levels: * p<0.05, ** p<0.01, *** p<0.001.*
Standard errors are shown in parentheses.

Table 4: Complete Model of Employment by Industry

	Manufacturing Employment							Services Employment				
	Metals	**Paper**	**Wood**	**Chemical**	**Textiles**	**Minerals**	**Non-Intensive**	**Construct**	**Transport**	**Other**	**Govern-ment**	**Utilities**
Electricity Price	-0.347***	-0.54***	-0.569***	-0.072	-0.68***	-0.106***	-0.126***	-0.23***	-0.273***	-0.065***	-0.007	0.356***
	(0.06)	(0.06)	(0.04)	(0.05)	(0.11)	(0.03)	(0.03)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
Personal Income	-0.254	-1.16***	-0.042	0.408**	-1.25***	0.772***	-0.775***	1.577***	0.081	0.22***	0.059**	-0.004
	(0.16)	(0.16)	(0.10)	(0.12)	(0.28)	(0.08)	(0.08)	(0.06)	(0.05)	(0.02)	(0.02)	(0.05)
Education	0.839***	1.459***	2.449***	0.646***	-0.413	0.305***	1.077***	0.101*	0.607***	0.618***	0.147***	0.411***
	(0.14)	(0.14)	(0.09)	(0.11)	(0.25)	(0.07)	(0.08)	(0.05)	(0.05)	(0.02)	(0.02)	(0.05)
Population	0.763***	2.19***	0.301***	0.696***	2.003***	1.403***	1.444***	1.29***	1.235***	0.94***	0.665***	0.82***
	(0.08)	(0.08)	(0.05)	(0.07)	(0.15)	(0.04)	(0.04)	(0.03)	(0.03)	(0.01)	(0.01)	(0.03)
Petroleum Price	-0.101**	-0.223***	-0.192***	-0.059*	-0.114	-0.045**	-0.191***	-0.003	-0.098***	-0.068***	-0.041***	-0.129***
	(0.04)	(0.04)	(0.02)	(0.03)	(0.06)	(0.02)	(0.02)	(0.01)	(0.01)	(0.004)	(0.004)	(0.01)
Year	-81.27***	-85.33***	-134.9***	-48.95***	12.98	-78.1***	-60.87***	-46.69***	-24.22***	-3.739***	0.299	-11.99***
	(7.69)	(7.70)	(4.91)	(6.01)	(13.74)	(3.72)	(4.12)	(2.81)	(2.47)	(0.93)	(0.91)	(2.61)
Constant	615.5***	633.5***	1024***	364.5***	-105.1	572.4***	458.2***	330.4***	174.5***	24.14***	-0.607	86.47***
	(56.91)	(57.02)	(36.33)	(45.12)	(101.7)	(27.53)	(30.47)	(20.81)	(18.25)	(6.91)	(6.747)	(19.34)
N	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193	2193
R^2 Within	0.262	0.305	0.441	0.072	0.134	0.451	0.422	0.761	0.787	0.979	0.915	0.549
R^2 Between	0.653	0.645	0.019	0.692	0.521	0.839	0.869	0.951	0.946	0.986	0.928	0.905
R^2 Overall	0.621	0.626	0.034	0.669	0.481	0.824	0.852	0.930	0.934	0.986	0.926	0.891

*Asterisks denote statistical significance at the following levels: * p<0.05, ** p<0.01, *** p<0.001.*
Standard errors are shown in parentheses.

5. Conclusion

In a competitive global marketplace, private industry and electricity-intensive manufacturers, more specifically, have a clear incentive to minimize costs and maximize profits by locating in regions where they can count on electricity costs being low. Our analysis of macroeconomic data finds that higher electricity prices are associated with lower levels of value added and employment while low electricity prices stimulate economic growth. Electricity-intensive manufacturing—including primary metals, paper, wood, chemicals, textiles, and minerals—are the most responsive to changes in electricity prices, and the geographic clustering of these industries will likely exacerbate the regional disparity of electricity price implications.

We propose that the economy-wide modeling framework presented in this paper could be used by federal and state policy makers to evaluate the implications of electricity price increases on both employment and value added by industry. Using this framework, we estimate that a 10% increase in electricity prices nationally would eliminate over one million jobs and decrease annual GDP by $142 billion. The potential for planned electricity price increases to cause further offshoring of productive capacity in electricity-intensive industries that are vital to the United States economy and national security, such as primary metal production, warrants more careful examination. The EPA should incorporate such considerations and economy-wide modeling of electricity price elasticity effects when evaluating the costs of environmental regulation.

The United States economy can, and will, continue to grow in spite of increasing electricity costs—most economic sectors exhibit less responsiveness to electricity prices than other more significant determinants of economic growth. We find, for example, that a 10% increase in educational attainment across the United States would increase total employment by 7.7 million jobs and GDP by $450 billion annually. Therefore, in addition to developing strategies to mitigate the vulnerability of certain regions and vital economic sectors to government-planned electricity price increases, the US should continue to mitigate these negative effects by improving education, workforce development, and labor mobility.

Table 5: Employment Simulation Results by State and Industry of a Hypothetical 10% Electricity Price Increase (Change in Employment in Full Time Jobs)

State	Total	Metals	Paper	Wood	Chemical	Textiles	Minerals	Non-Intensive	Construc-tion	Transpor-tation	Other	Govern-ment	Utilities
USA	**-1,010,740**	**-14,038**	**-20,561**	**-19,468**	**0**	**-15,841**	**-3,894**	**-118,369**	**-133,522**	**-121,262**	**-596,569**	**0**	**32,784**
AL	**-15,247**	-637	-656	-752	0	-701	-68	-2,178	-1,897	-1,521	-7,524	0	687
AK	**-2,328**	-1	-42	-16	0	-5	-3	-156	-391	-545	-1,304	0	135
AZ	**-17,774**	-143	-126	-183	0	-76	-55	-1,664	-2,767	-1,995	-11,351	0	586
AR	**-9,956**	-361	-544	-545	0	-70	-36	-1,447	-1,130	-1,497	-4,708	0	381
CA	**-107,706**	-696	-1,155	-1,131	0	-1,171	-301	-13,426	-14,040	-11,735	-67,677	0	3,624
CO	**-16,577**	-86	-80	-162	0	-107	-73	-1,396	-2,759	-1,751	-10,705	0	542
CT	**-11,862**	-134	-192	-68	0	-124	-24	-1,775	-1,229	-1,146	-7,586	0	415
DE	**-2,923**	-22	-44	-17	0	-6	-6	-261	-442	-288	-1,952	0	114
DC	**-3,427**	0	-1	-1	0	-1	-1	-8	-325	-111	-3,057	0	79
FL	**-54,343**	-151	-489	-503	0	-380	-168	-3,205	-8,160	-6,038	-36,694	0	1,446
GA	**-32,478**	-248	-1,009	-845	0	-3,113	-147	-2,951	-3,371	-4,622	-17,144	0	972
HI	**-4,118**	-1	-2	-11	0	-12	-8	-148	-695	-687	-2,749	0	196
ID	**-4,754**	-25	-88	-294	0	-14	-11	-568	-704	-511	-2,704	0	166
IL	**-44,052**	-692	-1,057	-337	0	-264	-136	-5,985	-4,505	-6,674	-25,776	0	1,374
IN	**-24,772**	-1,485	-538	-701	0	-256	-130	-4,703	-2,979	-3,227	-11,535	0	782
IA	**-12,221**	-285	-202	-446	0	-56	-52	-2,212	-1,539	-1,572	-6,208	0	351
KS	**-10,038**	-85	-109	-88	0	-123	-49	-1,808	-1,310	-1,316	-5,540	0	391
KY	**-14,781**	-406	-484	-529	0	-163	-71	-2,150	-1,604	-2,389	-7,402	0	420
LA	**-14,787**	-109	-387	-333	0	-77	-59	-1,207	-3,013	-2,045	-8,202	0	644
ME	**-4,758**	-11	-386	-242	0	-122	-12	-428	-609	-431	-2,643	0	126
MD	**-17,600**	-73	-149	-111	0	-94	-38	-1,066	-3,410	-1,848	-11,489	0	677
MA	**-23,890**	-121	-476	-129	0	-384	-57	-2,635	-2,753	-2,069	-16,005	0	739
MI	**-29,994**	-752	-610	-463	0	-197	-106	-5,726	-3,055	-2,839	-17,332	0	1,085
MN	**-20,792**	-215	-566	-603	0	-169	-91	-3,232	-2,261	-2,192	-12,139	0	675
MS	**-8,546**	-114	-207	-516	0	-156	-32	-1,375	-1,152	-1,103	-4,265	0	374
MO	**-19,959**	-261	-399	-424	0	-154	-81	-2,499	-2,485	-2,461	-11,837	0	642
MT	**-3,118**	-5	-9	-149	0	-14	-13	-156	-549	-400	-1,973	0	150
NE	**-7,598**	-45	-88	-97	0	-46	-27	-1,027	-1,005	-1,434	-3,973	0	143
NV	**-8,544**	-49	-42	-53	0	-35	-26	-400	-1,236	-1,363	-5,596	0	257
NH	**-4,662**	-96	-64	-86	0	-126	-20	-691	-528	-344	-2,851	0	146
NJ	**-27,506**	-169	-574	-119	0	-273	-105	-2,066	-3,106	-4,142	-17,903	0	953
NM	**-5,140**	-14	-29	-49	0	-11	-18	-310	-980	-527	-3,440	0	238
NY	**-60,027**	-369	-892	-398	0	-526	-161	-4,544	-7,491	-6,334	-41,417	0	2,105
NC	**-31,868**	-265	-859	-889	0	-2,396	-143	-3,903	-4,090	-3,012	-17,060	0	750
ND	**-3,353**	-4	-6	-93	0	-14	-18	-266	-701	-581	-1,829	0	159
OH	**-40,429**	-1,394	-1,037	-639	0	-354	-270	-6,433	-4,312	-4,725	-22,441	0	1,176
OK	**-11,029**	-164	-151	-100	0	-56	-74	-1,475	-1,675	-1,237	-6,632	0	534
OR	**-13,463**	-288	-261	-1,126	0	-80	-45	-1,629	-1,644	-1,374	-7,367	0	352
PA	**-46,032**	-1,385	-1,288	-1,044	0	-530	-215	-5,229	-5,379	-6,053	-26,308	0	1,398
RI	**-3,342**	-52	-63	-31	0	-38	-6	-407	-382	-268	-2,188	0	94
SC	**-14,605**	-204	-687	-413	0	-1,289	-72	-1,894	-1,848	-1,376	-7,618	0	796
SD	**-3,121**	-22	-41	-117	0	-26	-16	-437	-480	-288	-1,793	0	99
TN	**-22,794**	-339	-794	-632	0	-413	-127	-2,963	-2,496	-3,853	-11,558	0	382
TX	**-82,888**	-779	-930	-1,099	0	-588	-343	-8,679	-13,940	-11,159	-48,108	0	2,738
UT	**-9,669**	-154	-149	-102	0	-84	-51	-1,169	-1,649	-1,274	-5,312	0	276
VT	**-2,262**	-5	-39	-102	0	-12	-17	-332	-338	-194	-1,320	0	96
VA	**-26,843**	-147	-419	-721	0	-520	-86	-2,210	-4,211	-2,892	-16,302	0	666
WA	**-22,190**	-195	-442	-709	0	-185	-93	-2,970	-3,306	-2,440	-12,529	0	678
WV	**-5,053**	-159	-33	-308	0	-9	-32	-325	-849	-528	-3,083	0	273
WI	**-23,543**	-620	-1,668	-920	0	-211	-89	-4,567	-2,229	-2,516	-11,305	0	583
WY	**-1,977**	-2	0	-22	0	-8	-10	-77	-513	-332	-1,134	0	121

Table 6: GDP Simulation Results by State and Industry of a Hypothetical 10% Electricity Price Increase (Change in Value Added in Millions of Real 2010 US Dollars)

State	Total	Metals	Paper	Wood	Chemical	Textiles	Minerals	Non-Intensive	Construc-tion	Transpor-tation	Other	Govern-ment	Utilities
USA	**-142,789**	**-5,447**	**-4,108**	**-1,510**	**-14,237**	**-583**	**-1,217**	**0**	**-19,079**	**-9,091**	**-104,741**	**0**	**17,222**
AL	-1,850	-330	-194	-64	-159	-18	-21	0	-255	-100	-1,030	0	320
AK	-524	0	0	-1	0	0	-2	0	-75	-123	-375	0	52
AZ	-2,224	-96	-18	-11	-72	-2	-17	0	-397	-156	-1,801	0	346
AR	-1,193	-144	-144	-39	-42	-2	-10	0	-144	-94	-738	0	164
CA	-17,995	-175	-213	-94	-1,646	-31	-92	0	-2,141	-938	-14,436	0	1,773
CO	-2,376	-29	-10	-11	-118	-5	-22	0	-353	-142	-1,956	0	270
CT	-2,115	-46	-37	-4	-208	-7	-7	0	-231	-89	-1,719	0	232
DE	-574	-6	-19	-1	-70	-2	-2	0	-54	-17	-454	0	50
DC	-685	0	0	0	-5	0	0	0	-42	-7	-690	0	59
FL	-6,567	-50	-112	-48	-198	-11	-40	0	-1,059	-447	-5,492	0	888
GA	-3,948	-74	-272	-66	-237	-139	-51	0	-488	-345	-2,798	0	522
HI	-547	0	0	-1	-2	-1	-2	0	-131	-59	-449	0	98
ID	-476	-4	-11	-24	-21	0	-2	0	-77	-33	-368	0	64
IL	-6,311	-219	-173	-28	-631	-7	-46	0	-746	-492	-4,621	0	653
IN	-3,566	-582	-63	-40	-1,050	-6	-38	0	-386	-195	-1,547	0	342
IA	-1,484	-88	-48	-32	-202	-2	-20	0	-200	-101	-948	0	158
KS	-1,055	-19	-10	-6	-94	-2	-12	0	-155	-104	-818	0	164
KY	-1,618	-152	-96	-30	-140	-4	-19	0	-211	-158	-991	0	182
LA	-2,776	-54	-122	-28	-859	-2	-19	0	-400	-181	-1,372	0	262
ME	-511	-2	-66	-21	-20	-3	-3	0	-75	-23	-349	0	52
MD	-2,693	-26	-19	-11	-254	-5	-12	0	-478	-131	-2,134	0	376
MA	-3,697	-43	-58	-9	-292	-13	-19	0	-449	-135	-3,043	0	364
MI	-3,305	-307	-88	-32	-211	-7	-39	0	-413	-207	-2,516	0	516
MN	-2,572	-51	-140	-64	-114	-6	-26	0	-378	-158	-1,961	0	325
MS	-851	-56	-51	-40	-72	-5	-8	0	-175	-68	-557	0	182
MO	-2,386	-86	-113	-28	-236	-4	-22	0	-310	-172	-1,731	0	317
MT	-345	-1	0	-13	-4	0	-4	0	-71	-39	-271	0	57
NE	-952	-18	-12	-6	-126	-1	-6	0	-142	-144	-612	0	115
NV	-1,134	-9	-6	-3	-12	-2	-8	0	-179	-104	-935	0	123
NH	-531	-19	-6	-7	-11	-5	-7	0	-76	-20	-450	0	69
NJ	-5,029	-56	-85	-8	-824	-10	-33	0	-554	-310	-3,742	0	595
NM	-643	-2	-6	-2	-10	-1	-4	0	-115	-46	-541	0	84
NY	-11,138	-71	-115	-31	-674	-22	-51	0	-1,282	-465	-9,614	0	1,187
NC	-4,522	-100	-133	-67	-1,255	-84	-50	0	-512	-193	-2,548	0	421
ND	-425	0	-1	-8	-4	0	-6	0	-83	-51	-341	0	71
OH	-4,775	-504	-148	-52	-592	-14	-87	0	-552	-309	-3,323	0	806
OK	-1,303	-32	-42	-10	-49	-1	-24	0	-212	-119	-1,070	0	257
OR	-1,487	-104	-76	-105	-28	-2	-18	0	-210	-96	-1,068	0	220
PA	-6,286	-616	-294	-69	-603	-17	-61	0	-710	-356	-4,257	0	695
RI	-480	-37	-8	-2	-23	-5	-2	0	-72	-16	-356	0	41
SC	-1,546	-88	-179	-34	-176	-54	-23	0	-238	-77	-985	0	309
SD	-376	-5	-5	-6	-19	-1	-4	0	-51	-19	-306	0	40
TN	-2,854	-140	-201	-45	-240	-13	-37	0	-317	-257	-1,736	0	131
TX	-13,027	-366	-175	-87	-1,947	-15	-110	0	-2,217	-1,030	-9,113	0	2,033
UT	-1,537	-336	-41	-4	-105	-2	-19	0	-204	-85	-824	0	84
VT	-209	-2	-5	-6	-4	0	-4	0	-37	-10	-182	0	42
VA	-3,570	-38	-75	-56	-192	-35	-26	0	-525	-215	-2,788	0	380
WA	-3,109	-76	-103	-70	-57	-5	-29	0	-441	-215	-2,436	0	322
WV	-718	-55	-4	-19	-121	0	-9	0	-102	-42	-438	0	72
WI	-2,509	-133	-310	-63	-183	-9	-40	0	-290	-149	-1,627	0	296
WY	-384	0	0	-1	-25	0	-3	0	-62	-49	-284	0	41

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