The Regressive Impact on Ohio's Lower-Income and African-American Families from EPA's Proposed Regulations on Carbon Dioxide Emissions

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Executive Summary

The Environmental Protection Agency's (EPA) proposed new rules on carbon dioxide emissions (CO_2) for existing power plants will significantly increase electricity prices, especially in states such as Ohio that rely on coal-powered electricity. The higher electricity costs will fall most heavily on lower-income families and the weight of the adverse economic impact will disproportionately impact Ohio's African-American households.

Under EPA's new regulations, the average annual electricity cost would rise from 2.9 percent of the average Ohio household's income to 3.8 percent. For the average African-American household, average annual spending on electricity would rise from 4.5 percent to 5.8 percent. Lower-income African-Americans would bear an even larger burden. Households in lower-income African-American neighborhoods would be hardest hit with the cost of electricity equaling 26 percent of household income, or even higher.

In contrast to the average and lower-income households, higher-income households in Ohio would be least affected by the EPA's proposed rules. For example, in parts of Clermont County their average electricity costs would rise from a relatively modest 0.8 percent to 1.1 percent of their household income – a relatively small increase compared to the average household.

VISUALIZING THE ECONOMIC BURDEN OF RISING ELECTRICITY PRICES

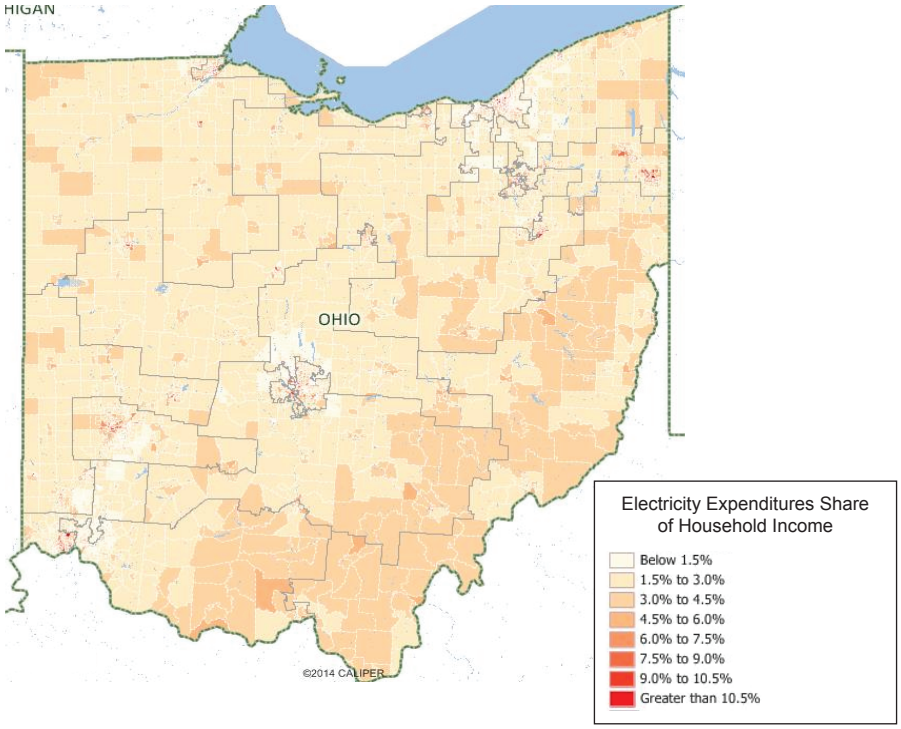
The burden imposed by high electricity prices on Ohio households, as well as the increased burden that the proposed EPA regulations would cause, can be visualized through maps, broken down by congressional districts and neighborhoods.

Map E1 presents Ohio households' average electricity expenditures relative to the average household income by neighborhood. While the average electricity expenditures in Ohio are 2.9 percent of the average Ohio household's income, the burden varies greatly depending on income levels. The regressive impact (the fact that the costs will burden lower-income households more than upper-income households) is visualized by the color scale ranging from light tan to red (less than 1.5 percent of household income to greater than 10.9 percent of household income, respectively). For example, in lower-income neighborhoods, such as parts of Summit County, the burden is currently as high as 16.1 percent of household income or almost 6 times the average.

Map E2 illustrates that the higher electricity costs that the proposed EPA regulations will induce increases the burden on families across Ohio (see darker shades of orange and red). The increased cost burden due to the proposed EPA regulations, (which increases to 3.8 percent of the average household's annual income as stated above) varies greatly depending on income levels – the proposed EPA regulations will increase the burden on lower-income neighborhoods more than upper-income neighborhoods making the burden from electricity costs more regressive.

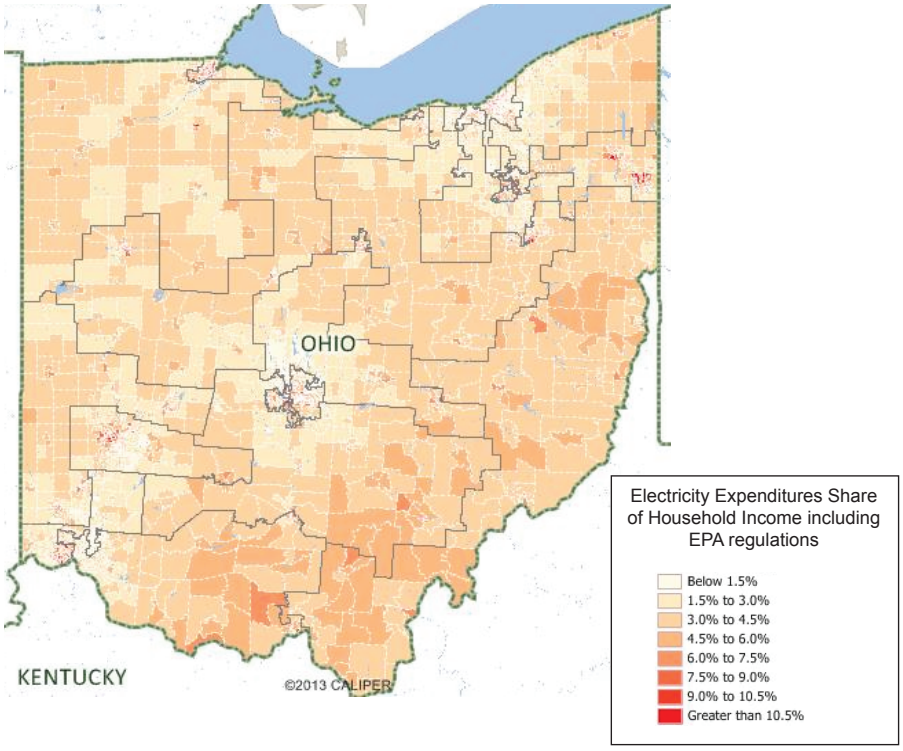
MAP E1

ANNUAL ELECTRICITY COSTS AS A SHARE OF AVERAGE HOUSEHOLD INCOME



MAP E2

ANNUAL ELECTRICITY COSTS AS A SHARE OF AVERAGE HOUSEHOLD INCOME INCLUDING THE IMPACT FROM THE PROPOSED EPA REGULATIONS



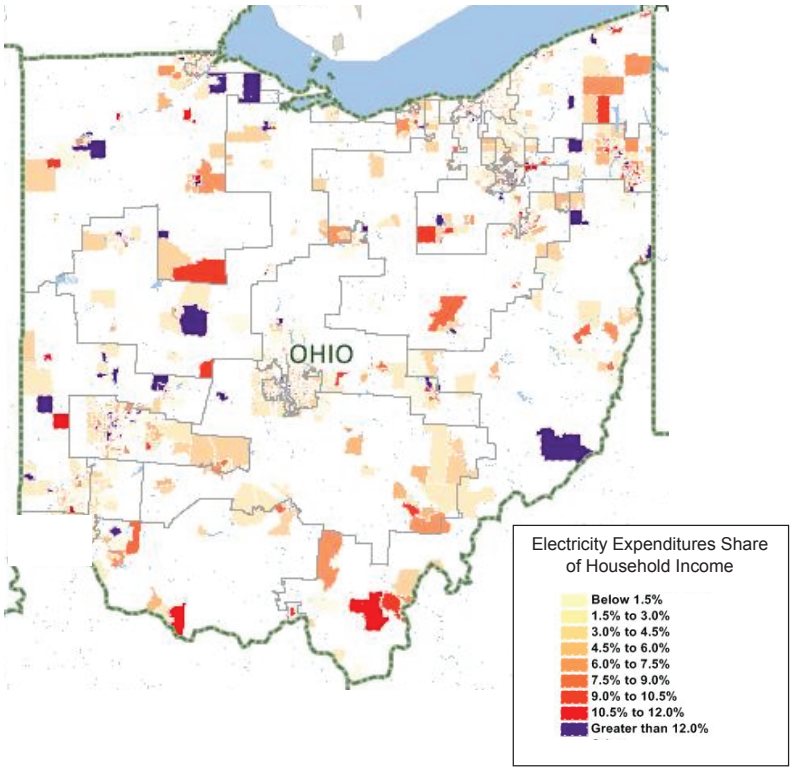
For example, the residents of Summit County that currently face electricity prices that are 16.1 percent of their average income would see their burdens increase to 20.9 percent. In parts of Clermont County, with higher average household incomes, household electricity costs would rise to a much smaller 1.1 percent of average household income from the current 0.8 percent.

Map E3 shows the average annual expenditures on electricity relative to the average annual income for African-American households in Ohio. African-American families are the demographic group that would be impacted the most from the implementation of proposed EPA regulations because African-Americans have lower average household incomes in Ohio.

Average electricity expenditures in Ohio are currently 4.5 percent of the annual income for the average African-American household, as compared to 2.9 percent for the average Ohio household. Similar to the statewide average, the burden varies greatly. The greater impact for lower-income African-American households is visualized by the color scale ranging from light tan to purple (less than 1.5 percent to greater than 12.0 percent respectively). For example, in some lower-income African-American neighborhoods in Cuyahoga County the burden currently exceeds 20.0 percent of household income, which is much higher than the state average and exemplifies the regressive nature of policies that raise the price of electricity.

MAP E3

ANNUAL ELECTRICITY COSTS AS A SHARE OF AVERAGE AFRICAN-AMERICAN HOUSEHOLD INCOME

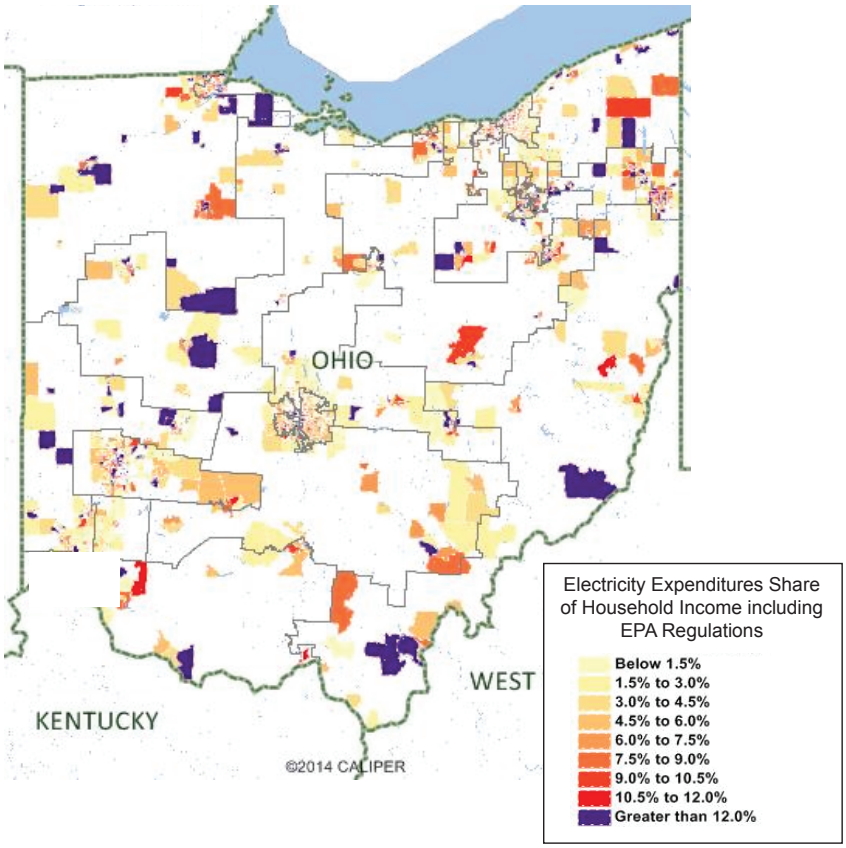


*While census tracts indicate that no sample observations or too few sample observations were available to compute a household income estimate for an African- American household.

The higher prices resulting from the proposed EPA regulations exacerbate the regressive impact. Map E4 illustrates how the proposed EPA regulations will burden African-American families across Ohio with higher electricity costs (see darker shades of orange and red). The average household spending on electricity will increase to 5.8 percent of the average African-American's household income from 4.5 percent of their annual income, and the burden varies greatly depending on income levels. Lower-income African-Americans in some neighborhoods in Cuyahoga County, for example, would see the cost of electricity increase to 26 percent of household income.

MAP E4

ANNUAL ELECTRICITY COSTS AS A SHARE OF AVERAGE AFRICAN-AMERICAN HOUSEHOLD INCOME INCLUDING THE IMPACT FROM THE PROPOSED EPA REGULATIONS



*While census tracts indicate that no sample observations or too few sample observations were available to compute a household income estimate for an African- American household.

CONCLUSION

The EPA's proposed regulations on carbon dioxide emissions will cause electricity prices in Ohio to increase significantly. These regulations will: lead to large increases in people's utility bills; impose a greater burden on lower-income households than higher-income households; and, worsen energy affordability, which is already a major concern for middle to low income households.

According to Advanced Energy for Life, "a record 115 million [people] qualify for energy assistance and more than half of Americans have said that as little as a $20 increase in utility bills would cause hardship."[1] Implementing energy regulations that further increase energy prices threatens to push more families into "energy poverty". It also threatens taxpayers with an additional tax increase in order to cover the larger number of people who will qualify to receive energy aid.

African-American households will be disproportionately affected as well. The impact on African-American families will exacerbate the economic challenges confronting this demographic group, which is already suffering from stagnant incomes and high unemployment.

Introduction

On June 2, 2014 the Environmental Protection Agency (EPA) proposed new rules requiring carbon dioxide emissions (CO_2) to be 30 percent below 2005 levels by 2030.[2] [3] The proposed EPA rules establish state-specific targets for CO_2 emissions from the power sector, set guidelines that states must follow when developing their plans to achieve their federally mandated goals, and impact 1,000 fossil fuel fired power plants and a total of 3,000 units within these plants.[4] [5]

If implemented, the EPA regulations will significantly increase electricity prices. Energy prices are regressive. The higher cost for power from EPA regulations will exacerbate the excessive financial burden currently impacting Ohio's lower-income households, and the rising costs will impose the largest negative economic impact on Ohio's African-American households.

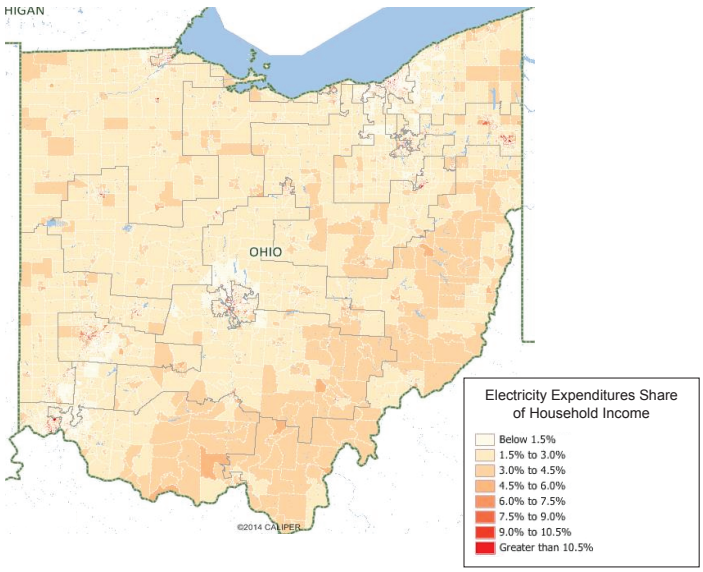
This paper contains three sections. The first section illustrates that current electricity prices are more burdensome on lower-income households and African-American households – both in Ohio and nationally. Section two explains why the EPA regulations will lead to significant electricity price increases in Ohio. Section three then demonstrates how these price increases will further burden lower-income households and African-American households in Ohio.

VISUALIZATION OF THE REGRESSIVE IMPACT OF CURRENT ELECTRICITY PRICES

Electricity expenditures disproportionately burden lower-income households.[6] Average annual electricity expenditures are currently 2.9 percent of the average household's budget in Ohio (see Appendix I for a review of the methodology).[7] But, as evidenced by the array of colors in Map 1, the expenditure burden is not distributed evenly.

MAP 1

CURRENT ANNUAL ELECTRICITY COSTS AS A SHARE OF AVERAGE HOUSEHOLD INCOME BY NEIGHBORHOOD AND CONGRESSIONAL DISTRICTS – ALL OHIO HOUSEHOLDS



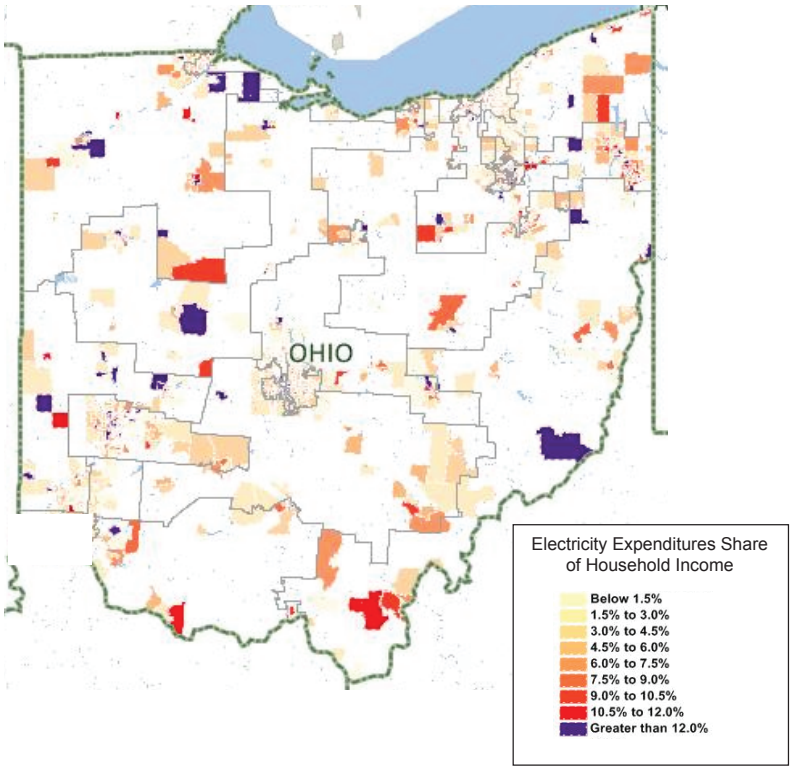
The greater impact for lower-income households is visualized across Ohio's neighborhoods by the color scale ranging from light tan to red (less than 1.5 percent to greater than 10.9 percent, respectively). As shown in Map 1, the current burden is well over 10.5 percent of the average income in some lower-income neighborhoods.[8] For instance, in some lower-income neighborhoods in Summit County, *the burden is as high 16.1 percent*. In contrast, the burden is well under 1.0 percent of the average income in some upper-income neighborhoods and as low as 0.8 percent of the average income in some high-income neighborhoods of Clermont County.

Due to lower average household incomes for African-American households in Ohio, the current average annual electricity expenditures are even more burdensome – the average African-American household's income is $41,111 compared to $48,699 for the average Ohio household.[9]

As a result, *electricity expenditures are currently 4.5 percent of the average African-American household's budget* compared to 2.9 percent for the average Ohioan's budget. The burden on the African-American community is not distributed evenly either, see Map 2. The greater impact for lower-income African-American households is visualized across regions by the color scale ranging from light tan to purple (less than 1.5 percent to greater than 12 percent respectively). For example, the electricity expenditure burden is currently well over 20 percent in several African-American neighborhoods in Cuyahoga County.

MAP 2

CURRENT ANNUAL ELECTRICITY COSTS AS A SHARE OF AVERAGE HOUSEHOLD INCOME BY NEIGHBORHOOD AND CONGRESSIONAL DISTRICTS – AFRICAN-AMERICAN HOUSEHOLDS*



*While census tracts indicate that no sample observations or too few sample observations were available to compute a household income estimate for an African- American household.

The Regressive Impact from Electricity Price Increases: A National Perspective

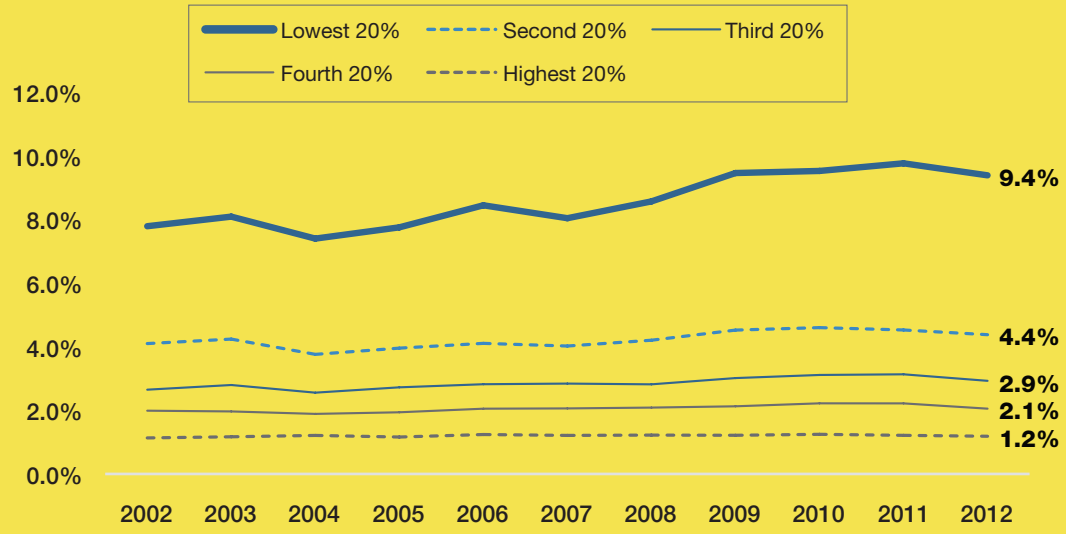
National data from the Bureau of Labor Statistics support the regressive impact of electricity prices on lower-income households' budgets. As documented by the Bureau of Labor Statistics, electricity costs are a sizeable portion of most consumers' budgets – a proportion that is inversely related to a household's income (see Figure 1). Figure 1 illustrates that electricity expenditures comprise a much larger share of lower-income households' budgets compared to upper-income households' budget – 9.4 percent of total after-tax income for the lowest income earning quintile (Lowest 20 percent) compared to 1.2 percent of total after-tax income for the highest income earning quintile (Highest 20 percent).

FIGURE 1

TOTAL ANNUAL ELECTRICITY EXPENDITURES AS A SHARE OF TOTAL AFTER-TAX INCOME

BY INCOME QUINTILE

2002 THROUGH 2012[10]



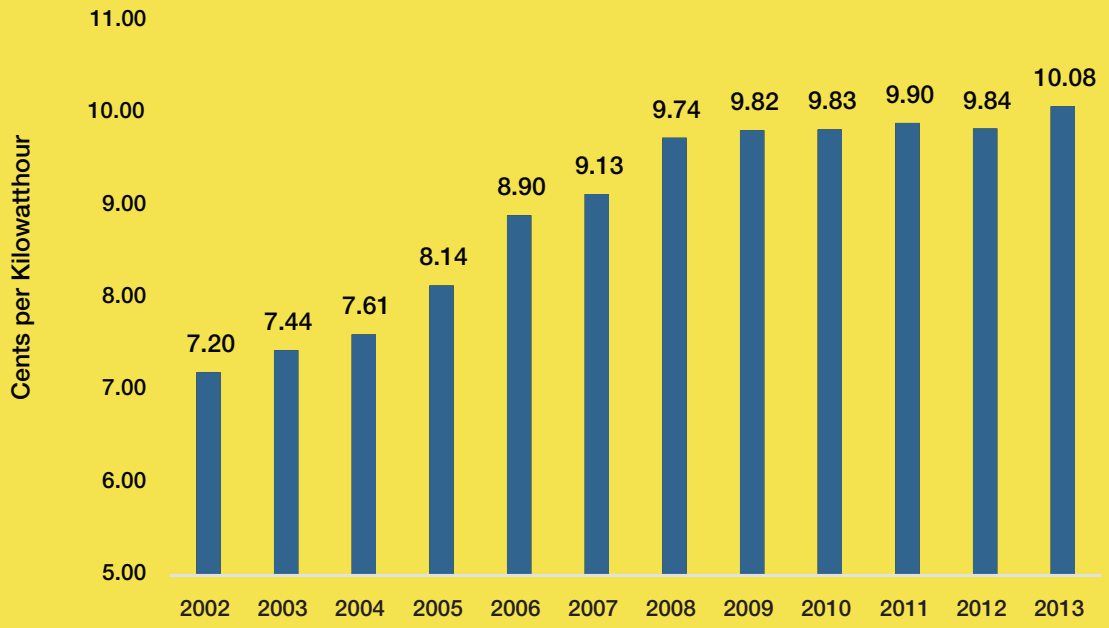
As illustrated in Figure 2, Energy Information Administration (EIA) data on average electricity prices illustrate that prices generally rose between 2002 and 2012. As evident in Figure 1, the impact from the rising electricity prices was felt more acutely by lower- and middle-income households compared to upper-income households. Electricity prices have been generally rising as a share of total after-tax income for households in the lowest 20 percent; and, while less visible in the chart, electricity prices have also been rising as a share of total after-tax income for middle-income households (defined as households in the second 20 percent

through fourth 20 percent). Epitomizing this problem, Advanced Energy for Life has documented that, "a record 115 million [people] qualify for energy assistance and more than half of Americans have said that as little as a $20 increase in utility bills would cause hardship."[11] Comparatively, as a share of the highest income households, electricity prices have been flat.

Figure 2 also illustrates that average electricity prices rose much quicker between 2002 and 2008 (2.54 cents per kilowatt-hour increase) than between 2008 and 2012 (0.34 cents per kilowatt-hour increase). Despite the slowdown in electricity price increases, the burden as a share of lower-income households continued to rise. For instance, between 2002 and 2008, the burden on the lowest income households (average electricity expenditures as a share of after-tax income) increased by 0.8 percentage points. Between 2008 and 2012 the burden on the lowest income households increased by 0.8 percentage points as well. The burden from electricity prices continued to rise despite the slowdown in electricity prices because incomes for the lowest income households declined significantly due to the 2008-09 recession – the incomes for the lowest 20 percent still had not recovered their pre-recession levels as of 2012.

FIGURE 2

AVERAGE U.S. ELECTRICITY PRICES
2002 THROUGH 2012[12]



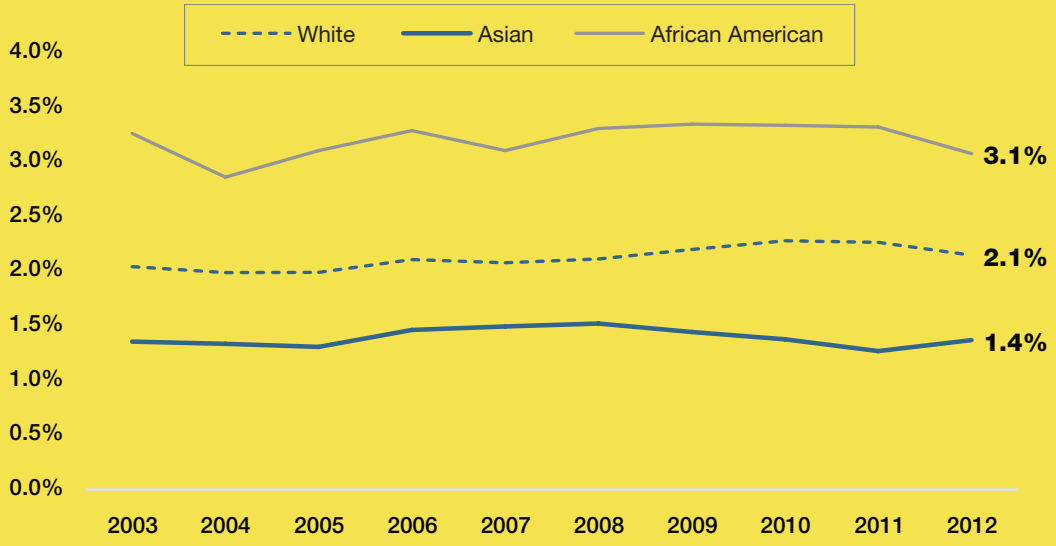
Different demographic groups will also face different burdens, with the costs being highest on African-Americans. Figure 3 presents the average annual share of after-tax income spent on electricity by racial group. The figure illustrates that electricity expenditures are a larger burden on African-American households compared to White households and Asian households.

FIGURE 3

TOTAL ANNUAL ELECTRICITY EXPENDITURES AS A SHARE OF TOTAL AFTER-TAX INCOME

AFRICAN-AMERICAN, WHITE AND ASIAN HOUSEHOLDS

2003 THROUGH 2012[13]



The burden on African-American households nationally was the greatest because these households had the highest electricity expenditures on average ($1,437) but the lowest average after-tax income ($46,666). The combination of higher than average expenditures coupled with lower than average incomes indicates that African-American households will likely be impacted by policies that raise electricity prices to a greater degree than either White or Asian households.

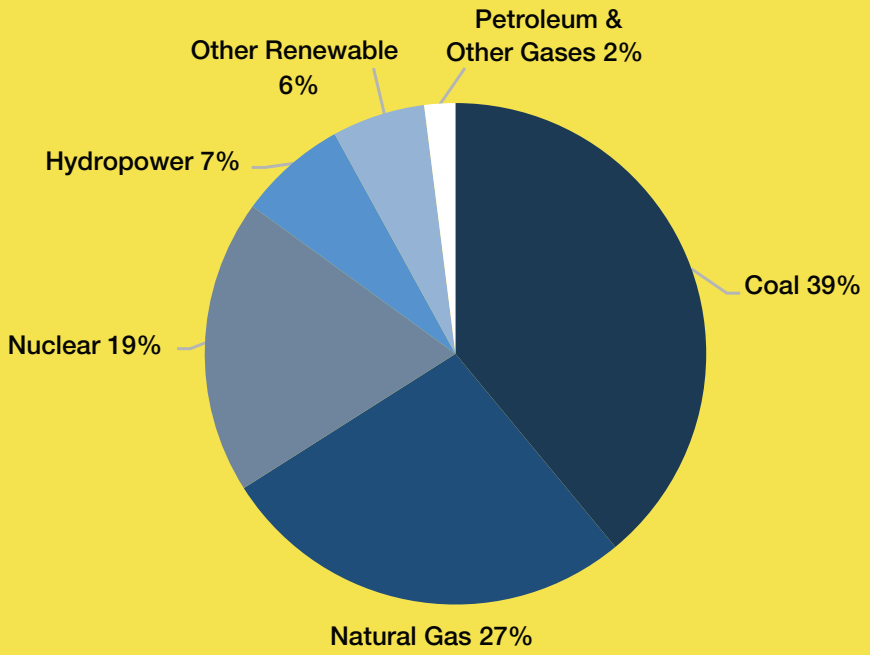
The impacts nationally are consistent with the impacts in Ohio where electricity expenditures are a larger burden for lower-income households. Together the Ohio-specific and national data confirm the notion that policies that raise electricity prices disproportionately hurt lower-income households.

EPA'S PROPOSAL ALTERS THE ELECTRICITY GENERATION MARKET AND INCREASES ELECTRICITY PRICES

The EPA's proposed regulations would require states to significantly reduce their reliance on fossil fuels, especially coal. It is simple arithmetic. Fossil fuels are currently the primary generator of electricity in the U.S. According to the Energy Information Administration, about 67 percent of total electricity in 2013 was generated from fossil fuels (see Figure 4).[14] Including nuclear power, these sources accounted for approximately 87 percent of total electricity generated.

FIGURE 4

U.S. ELECTRICITY GENERATION BY SOURCE 2013[15]



Source: What is U.S. electricity generation by energy source? http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3

Since the EPA's goal is to reduce carbon dioxide emissions and the agency has documented that "coal accounts for about 75 percent of CO_2 emissions from the [power generation] sector," regardless of the policy chosen by a state, reducing CO_2 emissions requires states to significantly reduce the amount of energy generated from fossil fuels, particularly coal.[16] To make up for the power loss from coal, states will be forced to generate power from alternative sources such as renewable energy, essentially following EPA's observation that nuclear and other renewable sources "…usually release fewer greenhouse gas emissions than fossil fuel combustion, if any emissions at all."[17]

These facts indicate that, if implemented, the proposed EPA regulations will significantly change the electricity generation infrastructure of the U.S. economy (see Figure 4). There are significant and potentially dire economic consequences from forcing a switch away from fossil fuel power generation to low CO_2 emissions power generation.

The cost of alternative power generation is a major factor for a utility when deciding which type of generation facility to build. Based on the EIA's measurement of total plant construction and operating costs,[18] the total operating costs of power plants using coal and natural gas are, generally, lower than power plants using alternative energies such as wind and solar.[19]

The proposed EPA regulations require a realignment of the current generation infrastructure away from less expensive coal-fired power plants toward more expensive alternative energy plants. The resulting higher costs for electricity generation will lead to higher retail electricity prices. Furthermore, since power plants are assets that provide electricity generation services over a long period of time (the typical lifespan of a power plant is around 40 years),[20] the decisions made to switch from lower cost generation facilities to higher cost generation facilities will have long-term consequences.

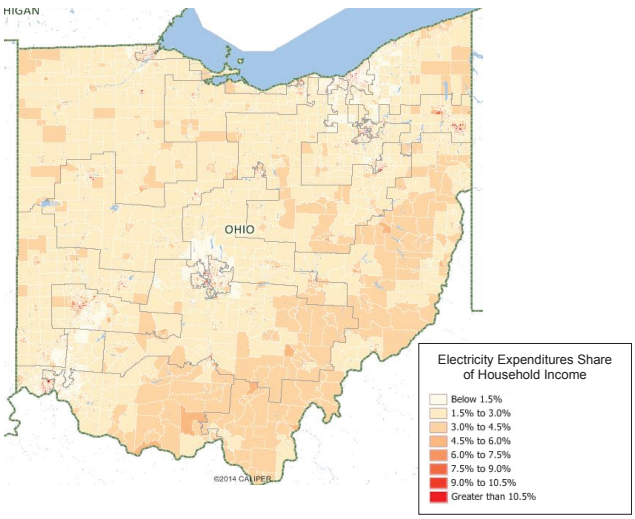
Visualization of the Increase Regressive Impact Caused by the Proposed EPA Policies

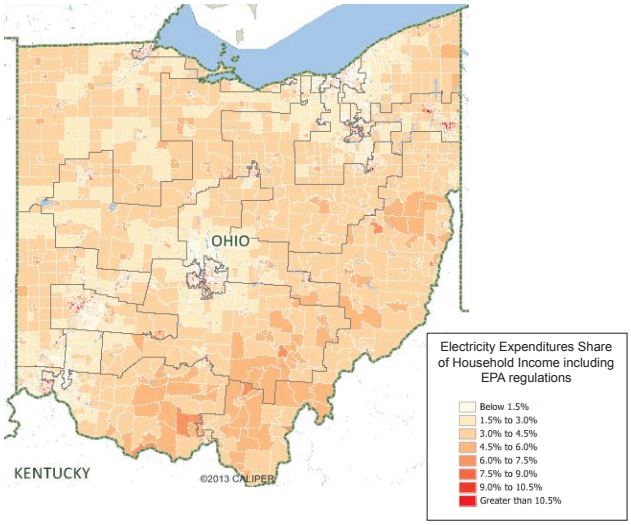
The EPA's proposed policies will significantly increase the total electricity expenditures of households in Ohio, which will impose a larger cost on lower-income Ohio households (see Appendix I for a review of the methodology). The impact from the proposed EPA regulations are illustrated in Map 3. Map 3A illustrates the current burden from electricity prices on Ohio's households by congressional districts and neighborhoods. Map 3B presents the now higher electricity costs relative to current Ohio household incomes.

MAP 3

CURRENT AND ESTIMATED BURDEN FROM PROPOSED EPA REGULATIONS AS A SHARE OF AVERAGE HOUSEHOLD INCOME BY NEIGHBORHOOD AND CONGRESSIONAL DISTRICTS – ALL OHIO HOUSEHOLDS

CURRENT (A) INCLUDING PROPOSED EPA REGULATIONS (B)





If the proposed EPA regulations are implemented, then the average annual electricity expenditure burden in Ohio would rise from 2.9 percent to 3.8 percent. The higher burden on Ohio households can be viewed by the darker colors across Ohio in Map 3B compared to Map 3A. Importantly, lower-income households that were already overly-burdened from expensive average electricity expenditures would see their burdens increase substantially. For instance, the residents of Summit County that currently face electricity prices that are 16.1 percent of their average income would see their burdens increase to 20.9 percent. In contrast, the upper-income parts of Clermont County, the burden grows significantly less (from its current 0.8 percent to 1.1 percent).

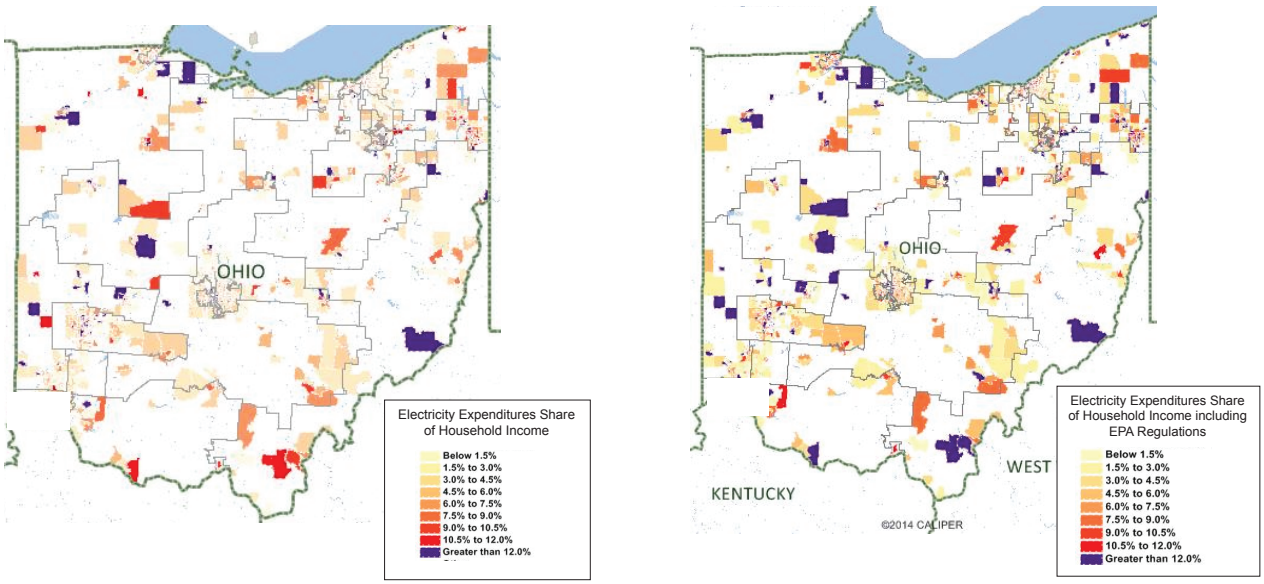
Maps 3A and 3B illustrate the current burden from electricity expenditures are highly regressive, and any increase in electricity costs due to the proposed EPA regulations will harm lower-income households to a much larger extent than upper-income households.

The average African-American household in Ohio will experience an even larger negative economic impact from the proposed EPA regulations. Map 4A presents the current burden from electricity prices on Ohio's African-American households by Congressional districts and neighborhoods and Map 4B illustrates the impact from the proposed EPA regulations in the same geographic locations.

MAP 4

CURRENT AND ESTIMATED BURDEN FROM PROPOSED EPA REGULATIONS AS A SHARE OF AVERAGE HOUSEHOLD INCOME BY NEIGHBORHOOD AND CONGRESSIONAL DISTRICTS – AFRICAN-AMERICAN HOUSEHOLDS*

CURRENT (A) INCLUDING PROPOSED EPA REGULATIONS (B)



* White census tracts indicate that no sample observations or too few sample observations were available to compute a household income estimate for an African-American household.

For the average African-American household the burden would rise even more: a 1.3 percentage point increase from 4.5 percent to 5.8 percent; the increase on the average Ohio household is 0.9 percentage points (from 2.9 percent to 3.8 percent). EPA's carbon dioxide regulations would have an even larger impact on some African-American households pushing the burden to astronomical levels for many families. For example, the households in Cuyahoga County that face a burden over 20.0 percent of household income would see their burden increase to at least 26.0 percent of household income.

Maps 4A and 4B illustrate that the current burden from electricity expenditures is currently highly regressive on Ohio's African-American community, and any increase in electricity costs due to the proposed EPA regulations will harm lower-income African-American households to a much larger extent than the average Ohio household.

Discussion: Policies that Reduce Carbon Dioxide Emissions Diminish Economic Vibrancy

There are many other adverse consequences from the EPA's proposed regulations that will diminish the economic vibrancy of the U.S.

One major concern is the impact on the ability of the power grid to supply power when and where it is needed – or what the EIA refers to as capacity value. Ensuring adequate capacity is a complex issue.

The EIA measures capacity value which, "depends on both the existing capacity mix and load characteristics in a region. Since load must be balanced on a continuous basis, units whose output can be varied to follow demand (dispatchable technologies) [e.g. coal and natural gas] generally have more value to a system [higher capacity value] than less flexible units (non-dispatchable technologies) [e.g. wind and solar, with lower capacity value]."[21] Generally speaking the capacity value of coal and natural gas plants are higher than alternative energies such as wind and solar because coal and natural gas plants produce energy, more reliably, and on demand.[22]

Another concern is a reduction in the diversity of energy sources to supply electricity (flexibility). Discouraging coal power to supply the power grid will make it more dependent on fewer energy power sources, resulting in less flexibility to deal with future energy price changes. As the EIA summarizes, "the inherent uncertainty about future fuel prices and future policies may cause plant owners or investors who finance plants to place a value on portfolio diversification."[23]

For instance, it was unclear to plant owners constructing power plants during the 1990s that the fracking revolution (the process of injecting pressurized fluids into wells in order to fracture the rocks and extract more oil and natural gas from each well) would transform the natural gas market within the next 10 to 20 years – well within the expected lifespan of any new power plant built in the 1990s.[24] Similarly, man-made global warming concerns were not a factor during the anti-nuclear movement of the late 1970s – nuclear energy being an efficient, relatively lower cost, and relatively low CO_2 emitting energy source.[25]

A diverse infrastructure creates protection against the unknown scientific, environmental, and policy changes that will likely arise over the four decade lifespan of an energy power plant. Diversity also insures against price spikes in particular energy sources. For instance, a balance between coal power plants and natural gas power plants allowed the electricity generation sector to benefit from the lower natural gas prices created by the fracking revolution. However, if the greater demand for natural gas (and resulting infrastructure constraints) begin to exert upward pressure on natural gas prices in the future, then a balance between coal power plants and natural gas power plants provides some protection against possible future natural gas price spikes.

The proposed EPA rules would effectively mandate that the U.S. power system increase its use of alternative energy sources, and reduce its use of coal energy sources, regardless of its adverse impact on the core concepts of capacity and diversity. As shown above, the proposed EPA rules also increases the average cost of electricity indicating that the proposed rules would force states to use energy sources that are currently more costly, less reliable, and (by reducing supply diversity) increase the vulnerability of the sector to sudden supply shocks.[26]

The adverse impact that the proposed regulations will have on cost effectiveness, capacity, and diversity will reduce economic efficiency and impose large costs on the economy. Importantly, studies that have estimated the economic impact from policies designed to reduce CO_2 emissions, such as the EPA's proposed rules, substantiate these conclusions.

The EPA offers no specificity regarding which carbon dioxide emissions plan will be implemented, such decisions are left to the states. However, as documented by the majority of the analyses that have examined the economic impact from policies that reduce CO_2 emissions, any policy that forces the energy sector to reduce carbon dioxide emissions – such as cap and trade regulations or carbon taxes – raise the cost of electricity and reduce the economy's vibrancy. Job growth stalls. Income growth stagnates. The growth in industrial production falters. And, rising electricity prices harm consumers. A quick summary of some of these studies can be found in Appendix II.

THE IMPLICATIONS OF HIGHER ENERGY PRICES

The EPA's proposed regulations to reduce carbon dioxide emissions 30 percent below 2005 levels by 2030 will have a negative impact on the U.S. economy and will exacerbate the economic challenges of lower income households especially those in the African-American community.

Due to the forced restructuring, the costs of electricity will rise, the reliability of the electric grid will decline, and the diversity of the power structure will narrow. The narrow energy supply sources will make the U.S. electricity generating sector more vulnerable to wild price swings and supply shocks.

Lower-income households will bear a greater burden from the rise in electricity prices than higher-income households; and, African-American households will be disproportionately affected. The impact on African-American families will worsen the economic challenges confronting this demographic group that is already suffering from lower and stagnating incomes, and high unemployment.

As the studies cited in Appendix II document, the EPA's proposed policies will create additional economic challenges as well by weakening the economy's growth rate, diminishing the growth in jobs, and reducing the growth in households' income in addition to a significant widening of the income gap. If the regressive energy policies are allowed to occur, middle class and minorities will face intense budgetary pressures as rising electricity costs squeeze the incomes of these households.

This study presents a detailed review of these impacts in Ohio – with an emphasis on the negative impacts on African-American households. The negative consequences will be even more severe than what is described above once the impact that rising energy costs have on economic growth, household incomes, and the prices of goods and services are incorporated.

Appendix I: Estimating the regressive impact from the proposed EPA's CO2 emissions reduction regulations – An Ohio Perspective

Households in Ohio are examined on a census tract (neighborhood) basis, which the Census Bureau defines as "… small, relatively permanent statistical subdivisions of a county or equivalent entity … Census tracts generally have a population size between 1,200 and 8,000 people, with an optimum size of 4,000 people."[27] Within each census tract the analysis compares the average income of that census tract to the current average expenditures on electricity for Ohio households, and then the expected average expenditures on electricity for Ohio households if the proposed EPA regulations were implemented. The comparison is then further broken down to examine the impact on African-American households.[28]

The current average household income by U.S. census tract is measured by the U.S. census.[29] The average annual electricity expenditures for Ohio households are estimated based on data from the EIA.[30] EIA provides customer counts, sales, revenues and average prices (cents/kWh) for each power company operating in Ohio for residential customers, see Table A-1.[31]

The average annual electricity expenditures for Ohio households is estimated by first determining the average annual consumption of electricity for each electric utility entity that is listed in Table A-1. This calculation divides total annual sales in Megawatthours in Table A-1 by total customers in Table A-1, multiplied by 1,000 to convert the consumption figure into kWh. This figure is then multiplied by average price per kWh to arrive at an annual average expenditure per customer for each power entity in Ohio. The average annual expenditures per customer for each power entity are then averaged to calculate the statewide annual average electricity expenditures, which equals $1,352.87.

The current annual burden from statewide electricity expenditures is calculated by dividing the average household income (for all Ohio households and all Ohio African-American households) by the average annual electricity expenditures of $1,352.87. The average annual electricity cost estimate is the median burden of all census tracts.

This detailed breakdown reveals the varied distributional impacts from the proposed EPA regulations and illustrates that the increased costs associated with the proposed EPA regulations are more burdensome on lower-income households than higher-income households – see Maps 1 through 4.

The impact from the proposed EPA regulations on electricity prices in Ohio are estimated based on analyses from Luckow et al. (2013), Anspacher et al. (2011) and PJM Interconnection (2009) – the operator of the nation's largest electric grid that also serves all residential customers in Ohio.

Luckow et al. (2013) estimated the future price of CO_2 including the impact on the price of CO_2 under alternative scenarios.[32] Each scenario represents different assumptions regarding federal policies designed to reduce CO_2 emissions from electricity power plants. Under the three policy scenarios, Luckow et al. estimated that the price of carbon would be $40 per ton in 2040 under the "low case" scenario. Under the "mid case" scenario the price of carbon would be $60 per ton in 2040; and under the "high case" scenario the price of carbon would be $90 per ton in 2040. According to Luckow (2013), the mid case assumptions "represent a scenario in which federal policies are implemented with significant but reasonably achievable goals."[33]

Anspacher et al. (2011), reviewed below, found that a 17 percent reduction in CO_2 emissions compared to the 2005 levels was consistent with a carbon price between $48.48 and $60.45.[34] These estimated prices for carbon ultimately led to electricity price increases between 16 percent and 25 percent.[35] The proposed EPA regulations have targeted a 30 percent reduction in CO_2 emissions compared to 2005 levels.

Consequently, a CO_2 price of $60 per ton appears to be a reasonable, if not a conservative, assumption with respect to the expected price increase that would result from the proposed EPA regulations.

PJM (2009) estimated the impact on energy prices in its region from alternative changes in the price of carbon per ton.[36] PJM found that "at CO_2 prices of $10, $40, or $60 per short ton, typical residential customers using 750 kilowatt-hours (kWh)/month could see increases in their monthly bills up to approximately $6 ($72 annually), $23 ($276 annually), or $34 ($408 annually) respectively assuming all wholesale cost increases are passed through on a dollar- for-dollar basis."[37]

Bringing these sources together, the proposed EPA regulations will likely increase the average annual electricity expenditures by households in Ohio by at least $408 annually (or a 30 percent increase in annual expenditures).

Adding the $408 annual cost increase from the proposed EPA regulations to the current estimated annual expenditures of Ohio households ($1,352.87) provides the estimated total expenditures that residential customers in Ohio would have to pay if the proposed EPA regulations are implemented ($1,760.87).

The additional burden of electricity expenditures on all Ohio households, African-American households in Ohio, and white households in Ohio are also illustrated in Maps 3 and 4.

TABLE A-1

SALES, REVENUES, AND AVERAGE PRICE OF ELECTRICITY IN OHIO 2012 (DATA AS OF DECEMBER 12, 2013)[38]

Entity	Customers (Count)	Sales (Mega-watt-hours)	Revenues (Thousands Dollars)	Average Price (cents/kWh)
Adams Rural Electric Coop, Inc	7,403	93,465	12,972.0	13.88
Buckeye Rural Elec Coop, Inc	18,026	225,318	32,930.7	14.62
Butler Rural Electric Coop Inc - (OH)	10,815	178,553	25,960.0	14.54
Carroll Electric Coop, Inc - (OH)	10,795	124,478	16,503.0	13.26
City of Amherst- (OH)	5,272	55,809	5,324.0	9.54
City of Bowling Green - (OH)	12,682	100,872	10,859.0	10.77
City of Bryan - (OH)	5,049	46,799	4,692.6	10.03
City of Celina	6,786	71,097	6,610.0	9.30
City of Cleveland - (OH)	65,078	415,340	47,281.0	11.38
City of Columbus - (OH)	9,502	66,118	8,955.0	13.54
City of Cuyahoga Falls- (OH)	22,661	179,798	17,583.3	9.78
City of Dover - (OH)	5,772	58,606	6,397.0	10.92
City of Galion	5,742	48,532	4,720.5	9.73
City of Hamilton - (OH)	26,052	258,386	28,237.2	10.93
City of Hudson	5,663	75,895	8,318.0	10.96
City of Jackson - (OH)	3,395	34,469	4,165.0	12.08
City of Lebanon - (OH)	8,039	85,868	9,619.3	11.20
City of Napoleon - (OH)	5,111	49,976	5,416.8	10.84
City of Niles - (OH)	10,214	79,222	8,332.0	10.52
City of Oberlin - (OH)	2,751	20,633	2,252.0	10.91
City of Orrville - (OH)	6,339	78,213	7,097.0	9.07
City of Painesville	10,181	83,195	9,770.4	11.74
City of Piqua - (OH)	9,559	88,836	8,368.0	9.42
City of Shelby - (OH)	4,874	46,794	4,975.7	10.63
City of St Marys - (OH)	3,575	36,785	3,532.4	9.60
City of Tipp City	4,352	46,876	4,651.0	9.92
City of Wadsworth	11,091	98,755	12,760.0	12.92
City of Wapakoneta - (OH)	4,701	49,046	4,207.0	8.58
City of Westerville - (OH)	14,275	174,540	17,901.5	10.26

Cleveland Electric Illum Co	163,387	1,327,386	153,983.1	11.60
Clyde Light & Power	2,658	24,352	2,513.0	10.32
Consolidated Electric Coop Inc	14,321	230,983	27,171.0	11.76
Darke Rural Electric Coop, Inc	4,888	84,184	10,248.0	12.17
Dayton Power & Light Co	373,168	4,122,293	562,686.0	13.65
Duke Energy Ohio Inc	393,489	4,347,386	462,401.2	10.64
Firelands Electric Coop, Inc	8,482	120,469	15,374.0	12.76
Frontier Power Company	8,014	95,887	12,263.0	12.79
Guernsey-Muskingum El Coop Inc	14,750	163,533	22,519.0	13.77
Hancock-Wood Electric Coop Inc	10,867	149,915	20,027.0	13.36
Holmes-Wayne Electric Coop Inc	13,868	181,192	22,049.4	12.17
Licking Rural Electric Inc	23,076	305,776	41,174.2	13.47
Logan County Coop Power & Light	4,282	62,592	8,225.1	13.14
Lorain-Medina R E C, Inc	14,702	208,295	25,180.0	12.09
Mid-Ohio Energy Coop, Inc	7,077	113,833	14,120.4	12.40
Midwest Electric, Inc	10,302	170,717	20,757.0	12.16
Midwest Energy Cooperative	895	11,129	1,402.8	12.60
North Central Elec Coop, Inc	8,548	126,897	15,114.0	11.91
North Western Elec Coop, Inc	5,601	80,726	10,326.0	12.79
Ohio Edison Co	302,712	3,198,136	363,005.4	11.35
Ohio Power Co (Sub AEP?)	1,103,135	12,413,637	1,532,093.5	12.34
Paulding-Putman Elec Coop, Inc	9,005	146,223	15,889.0	10.87
Pioneer Rural Elec Coop, Inc - (OH)	15,593	244,465	32,340.2	13.23
South Central Power Company	106,437	1,425,880	164,242.0	11.52
The Toledo Edison Co	87,420	830,972	96,999.6	11.67
Union Rural Electric Coop, Inc	8,176	123,148	15,406.0	12.51
Village of Minster - (OH)	1,205	14,738	1,281.0	8.69
Village of Yellow Springs	1,873	14,457	1,488.0	10.29
Washington Electric Coop - (OH)	8,200	82,079	12,431.7	15.15

Appendix II: A Brief Overview of the Economic Impact from Policies that Reduce Carbon Emissions

A 2009 study by the EIA found that the national cap and trade regulation that was under consideration at that time would have increased "…the cost of using energy, which reduces real economic output, reduces purchasing power, and lowers aggregate demand for goods and services. The result is that projected real gross domestic product (GDP) generally falls relative to the Reference Case."[39]

In a separate study, the Beacon Hill Institute estimated that the impact from the Waxman-Markey proposed cap and trade regulations in 2009 would impose a net cost on the economy through 2050 of $3.42 trillion, and retail energy and gas prices would nearly double.[40]

The Heritage Foundation estimated the economic impacts in 2029 from a cap-and-trade proposal that requires CO_2 emissions to decline between 60 percent and 80 percent.[41] The Heritage Foundation also found that "the estimated aggregate losses to Gross Domestic Product (GDP), adjusted for inflation, are $4.8 trillion. By 2029 the job losses in the manufacturing sector will be nearly 3 million."[42] In a 2013 analysis, the Heritage Foundation estimated that regulations similar to the proposed EPA rules would cost the U.S. economy nearly 600,000 jobs as of 2023, reduce a family of four's annual income by more than $1,200, raise natural gas prices by 28 percent, artificially shrink the supply of coal, and reduce GDP by $2.23 trillion.[43]

Commenting on the negative impact created by a carbon tax, the Congressional Budget Office (CBO) noted that carbon taxes raise the price of fossil fuels and therefore:

> …tend to increase the cost of producing goods and services—especially things, such as electricity or transportation, that involve relatively large amounts of CO_2 emissions. Those cost increases would provide an incentive for companies to manufacture their products in ways that resulted in fewer CO_2 emissions. Higher production costs would also lead to higher prices for emission-intensive goods and services, which would encourage households to use less of them and more of other goods and services.
>
> Without accounting for how the revenues from a carbon tax would be used, such a tax would have a negative effect on the economy. The higher prices it caused would diminish the purchasing power of people's earnings, effectively reducing their real (inflation-adjusted) wages. Lower real wages would have the net effect of reducing the amount that people worked, thus decreasing the overall supply of labor. Investment would also decline, further reducing the economy's total output.[44]

Back in 1998 the EIA estimated the economic consequences from imposing the restrictions mandated by the United Nation's Kyoto Global Warming Treaty, and found that had the U.S. abided by the Kyoto Protocol total U.S. economic growth would have suffered significantly.[45] The actual forecast varied depending upon what the government was assumed to do with any windfall revenues it would raise. The EIA study forecasted that implementing cap-and-trade with a tax offset via a personal income tax rebate would reduce economic growth by 4.2 percent compared to the baseline case. Implementing the cap and trade proposal with a payroll tax rebate

would reduce economic growth by 1.9 percent compared to the baseline case.

Aspacher et al. (2011) examined the economic impact from a 17 percent reduction in CO_2 emissions compared to 2005 finding that "…real household consumption declines 0.20 percent in the Nuclear Growth scenario and 0.37 percent in the Nuclear Restricted scenario. Demand for electricity declines as the price of electricity rises in both scenarios relative to the base case scenario. In the Nuclear Growth scenario there is a price of $48.48 on CO_2 emissions while in the Nuclear Restricted scenario the price on CO_2 emissions is $60.45 per ton."[46] Furthermore, "The price of electricity is projected to be about 16 percent higher in the Nuclear Growth scenario and nearly 25 percent higher in the Nuclear Restricted scenario. GDP and electricity supply shrink in both scenarios, with bigger decreases in the Nuclear Restricted scenario."[47]

The U.S. Chamber of Commerce (2014) estimated the impact from rules similar to the proposed EPA regulations finding that such "rules threaten to suppress average annual U.S. Gross Domestic Product (GDP) [growth] by $51 billion and lead to an average of 224,000 fewer U.S. jobs every year through 2030, relative to baseline economic forecasts."[48]

With respect to the uneven distribution of the costs from policies designed to reduce CO_2 emissions, the CBO (2013) noted:

> The costs of a carbon tax would not be evenly distributed among U.S. households. For example, the additional costs from higher prices would consume a greater share of income for low-income households than for higher-income households, because low-income households generally spend a larger percentage of their income on emission-intensive goods. Similarly, workers and investors in emission-intensive industries, who would see the largest decrease in demand for their products, would be likely to bear relatively large burdens as the economy adjusted to the tax.[49]

It is the uneven distribution of these impacts that drove the regressive impact on Ohio's low-income households and African-American households presented in this paper.

About the Author

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Dr. Winegarden has 20 years of business, economic, and policy experience. Dr. Winegarden's policy studies evaluate the economic implications from changes in fiscal and regulatory policies, with a primary focus on the energy and healthcare industries. His columns have been published in the Wall Street Journal, Chicago Tribune, Investors' Business Daily, and Forbes.com.

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Previously, Dr. Winegarden worked as a business economist in Hong Kong and New York City; and a policy economist for policy and trade associations in Washington D.C. He was previously economics faculty at Marymount University, has testified before the U.S. Congress, and is asked to present his research findings at policy conferences and meetings.

Dr. Winegarden received his Ph.D. in Economics from George Mason University.

Endnotes

1 "Changing the Fate of 3.5 Billion" Advanced Energy for Life; https://www.advancedenergyforlife.com/article/changing-fate-35-billion.

2 Some industry experts question whether the EPA's regulatory approach is compatible with the multi-state structure of current energy markets. If such concerns are warranted, then the proposed regulations could paralyze electricity markets as the EPA would be mandating a technologically unfeasible regulatory structure. Due to the current structure of the energy markets, Commissioner Philip Moeller of the Federal Energy Regulatory Commission (FERC) raised questions regarding the states' ability to successfully execute a state-specific carbon-dioxide emissions reduction plan; see: "Answers to Preliminary Questions for the Federal Energy Regulatory Commission from the Committee on Energy & Commerce Subcommittee on Energy & Power," July 29, 2014; http://docs.house.gov/meetings/IF/IF03/20140729/102558/HHRG-113-IF03-Wstate-MoellerP-20140729-SD001.pdf).

Specifically, Commissioner Moeller stated "It is not clear to me how State compliance plans could be implemented in electricity markets."

Furthermore, Commissioner Moeller voiced skepticism that energy capacity under the EPA plan will be sufficient as of its first target date of 2020: "I am skeptical of EPA's contention that the modeled capacity increases are feasible by 2020. This is partly due to the fundamental manner in which the proposed rule would change the way that electricity is dispatched. Increased demand under the proposed rule will be addressed by adding more gas-fired generation. It's unclear what role these new plants will play in markets that have security constrained economic dispatch. Because these plants will be dispatched on merit, the owners of such plants are less likely to sign long-term contracts for gas supply. Long-term contracts (usually signed by local gas distribution companies) have provided the financial underpinnings of pipeline expansion. The new demand for pipeline gas will be from this class of generators, and it is not clear how the necessary infrastructure will be deployed and financed."

3 FACT SHEET: Clean Power Plan by the Numbers, Cutting Carbon Pollution from Power Plants; http://www2.epa.gov/carbon-pollution-standards/fact-sheet-clean-power-plan.

4 FACT SHEET: Clean Power Plan by the Numbers, Cutting Carbon Pollution from Power Plants; http://www2.epa.gov/carbon-pollution-standards/fact-sheet-clean-power-plan.

5 "Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units" A Proposed Rule by the Environmental Protection Agency on 06/18/2014; https://www.federalregister.gov/articles/2014/06/18/2014-13726/carbon-pollution-emission-guidelines-for-existing-stationary-sources-electric-utility-generating. See also: http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule.

6 See the electricity expenditure data and total after tax income data from: "Consumer Expenditure Survey" Bureau of Labor Statistics; http://www.bls.gov/cex/.

7 Author calculations based on data from the U.S. Census (www.census.gov), and Energy Information Administration (www.eia.gov). Average is measured by the median due to a number of large outliers that skew the mean (or arithmetic average) higher. The mean burden is 3.5 percent.

It is important to note that the current (and prospective) expenditure burdens measure the average (and likely future) costs of electricity relative to the average income in neighborhoods across Ohio. The measures do not include the impact from energy assistance programs (such as the Ohio Home Energy Assistance Program (HEAP)), any economizing behaviors, or assistance to help reduce energy use through efficiency programs (such as the Ohio Weatherization Assistance Program). As such, the dollar value may be significantly higher than actual Ohio families can afford to pay. The purpose of the metric is to provide a consistent benchmark to compare the average electricity costs to incomes for households across Ohio.

8 Formally, by census tract.

9 Calculated based on the average household income by census tract from the U.S. Census, www.census.gov.

10 Author calculations based on electricity expenditure data and total after tax income data from: "Consumer Expenditure Survey" Bureau of Labor Statistics; http://www.bls.gov/cex/.

11 "Changing the Fate of 3.5 Billion" Advanced Energy for Life; https://www.advancedenergyforlife.com/article/changing-fate-35-billion.

12 U.S. Energy Information Administration; http://www.eia.gov/electricity/data.

13 Author calculations based on electricity expenditure data and total after tax income data from: "Consumer Expenditure Survey" Bureau of Labor Statistics; http://www.bls.gov/cex/.

14 See FAQ: "What is U.S. electricity generation by energy source"; http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3.

15 See FAQ: "What is U.S. electricity generation by energy source"; http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3.

16 "Sources of Greenhouse Gas Emissions" Environmental Protection Agency; http://www.epa.gov/climatechange/ghgemissions/sources/electricity.html.

17 Ibid.

18 A key cost measure used by the Energy Information Administration (EIA) is the levelized cost of electricity (LCOE). LCOE "…is often cited as a convenient summary measure of the overall competiveness of different generating technologies. It represents the per-kilowatthour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle. Key inputs to calculating LCOE include capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each plant type." While comparing plants can be difficult (especially comparing fossil fuel power plants to alternative energy power plants), LCOE provides important comparative information regarding the total costs of physically operating alternative units. (2014) "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2014" *Annual Energy Outlook* April 17; http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

19 (2014) "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2014" *Annual Energy Outlook* April 17; http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

20 Nuclear reactors are licensed to operate for 40 years, http://www.eia.gov/tools/faqs/faq.cfm?id=228&t=21; the average lifespan for a coal-fired power plant is also 40 years, see: http://qz.com/61423/coal-fired-power-plants-near-retirement/; and the average age of recently retired natural gas power plants was 48 years, http://blogs.scientificamerican.com/plugged-in/2011/12/14/natural-gas-leading-the-retirements-board/.

It has also been documented that a large percentage of the nation's coal-fired power plants (like much of the U.S. infrastructure) is approaching the end of its lifespan. See for instance, EIA (2102) "27 gigawatts of coal-fired capacity to retire over next five years" *Today in Energy,* July 27; http://www.eia.gov/todayinenergy/detail.cfm?id=7290; Woody, Todd (2013) "Most coal-fired power plants in the US are nearing retirement age" *Quartz*, March 12; http://qz.com/61423/coal-fired-power-plants-near-retirement/.

21 Ibid. The EIA further notes that "the LCOE values for dispatchable and nondispatchable technologies are listed separately in the tables, because caution should be used when comparing them to one another." In other words, the due to the lower capacity value of alternative energy, it

22 (2014) "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2014" *Annual Energy Outlook* April 17; http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

23 (2014) "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2014" *Annual Energy Outlook* April 17; http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

24 Clayton, Mark (2013) "Natural gas 'fracking' has flipped US energy map, study says" *Christian Science Monitor*, October 9; http://www.csmonitor.com/Environment/2013/1009/Natural-gas-fracking-has-flipped-US-energy-map-study-says.

25 (2014) "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2014" *Annual Energy Outlook* April 17; http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

Interestingly, the concerns for the global climate was just the opposite of today back in the 1970s. As a 1974 Time Magazine story noted: "As they review the bizarre and unpredictable weather pattern of the past several years, a growing number of scientists are beginning to suspect that many seemingly contradictory meteorological fluctuations are actually part of a global climatic upheaval…when meteorologists take an average of temperatures around the globe they find that the atmosphere has been growing gradually cooler for the past three decades. The trend shows no indication of reversing. Climatological Cassandras are becoming increasingly apprehensive, for the weather aberrations they are studying may be the harbinger of another ice age." "Another Ice Age?" (1974) *Time Magazine Archive Article: Science.* June 24th.

26 See the LCOE and Capacity values estimated by the EIA for alternative energy power plants compared to coal and natural gas power plants: (2014) "Levelized Cost and Levelized Avoided Cost

of New Generation Resources in the Annual Energy Outlook 2014" *Annual Energy Outlook* April 17; http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

27 "Geographic Terms and Concepts - Census Tract"; https://www.census.gov/geo/reference/gtc/gtc_ct.html.

28 According to the U.S. Census, 83.2 percent of Ohio residents are white, and 12.5 percent are African-American. Because these two groups comprise 95.7 percent of Ohio's populations this study focuses on these two demographic groups. See: http://quickfacts.census.gov/qfd/states/39000.html.

29 http://www.census.gov/main/www/access.html.

30 U.S. Energy Information Administration; www.eia.gov.

31 U.S. Energy Information Administration; www.eia.gov.

32 Luckow Patrick, Stanton Elizabeth A., Biewald Bruce, Fisher Jeremy, Ackerman Frank, and Hausman Ezra (2013) "2013 Carbon Dioxide Price Forecast" *Synapse Energy Economics,* November 1 (Minor corrections February 2014); http://www.synapse-energy.com/Downloads/SynapseReport.2013-11.0.2013-Carbon-Forecast.13-098.pdf.

33 Luckow Patrick, Stanton Elizabeth A., Biewald Bruce, Fisher Jeremy, Ackerman Frank, and Hausman Ezra (2013) "2013 Carbon Dioxide Price Forecast" *Synapse Energy Economics,* November 1 (Minor corrections February 2014); http://www.synapse-energy.com/Downloads/SynapseReport.2013-11.0.2013-Carbon-Forecast.13-098.pdf.

34 Anspacher Jeffrey, Osborne Stefan, Richards Julian (2011) "The Effect of CO_2 Emissions Reduction on the U.S. Electricity Sector" Office of Competition and Economic Analysis: International Trade Administration, May; http://www.usitc.gov/research_and_analysis/documents/Effect_CO2_Emissions_Reduction_Electricity_Sector.pdf.

35 Ibid.

36 (2009) "Potential Effects of Proposed Climate Change Policies on PJM's Energy Market" *PJM*, January 23; http://www.pjm.com/~/media/documents/reports/20090127-carbon-emissions-whitepaper.ashx.

37 (2009) "Potential Effects of Proposed Climate Change Policies on PJM's Energy Market" *PJM*, January 23; http://www.pjm.com/~/media/documents/reports/20090127-carbon-emissions-whitepaper.ashx. Based on the EIA data, the average annual consumption was 11,508 kWh, or 959 kWh per month. This value is larger than the 750 kWh monthly consumption assumed in the PJM study. Consequently, the $408 annual estimated cost increase estimated by PJM in 2009 is a conservative estimate, and the actual annual impact would likely be larger.

38 2012 Utility Bundled Retail Sales- Residential: Data from forms EIA-861- schedules 4A & 4D and EIA-861S, Energy Information Administration, http://www.eia.gov/electricity/data.cfm#sales.

39 (2009) "Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009" Energy Information Administration, August, SR/OIAF/2009-05; http://www.eia.gov/oiaf/servicerpt/hr2454/pdf/sroiaf(2009)05.pdf.

40 (2009) "The Economic Effects of Proposed Cap-and-Trade Legislation" The Beacon Hill Institute; http://www.beaconhill.org/BHIStudies/Waxman-Markey09/Waxman-Markey-USOverview.htm.

41 Specifically, "The typical cap-and-trade proposal seeks to reduce CO_2 emissions by 60 percent to 80 percent by 2050 where the comparison year is usually 2005. The Center for Data Analysis at The Heritage Foundation did an analysis of the costs of meeting the goals of the Lieberman-Warner bill, S. 2191, last spring." Kreutzer David W. (2009) "The Economic Impact of Cap and Trade" Testimony before The Energy and Commerce Committee U.S House of Representatives, April 22; http://www.heritage.org/research/testimony/the-economic-impact-of-cap-and-trade.

42 Kreutzer David W. (2009) "The Economic Impact of Cap and Trade" *Testimony before The Energy and Commerce Committee U.S House of Representatives*, April 22; http://www.heritage.org/research/testimony/the-economic-impact-of-cap-and-trade.

43 Loris Nicolas D., Dayaratna Kevin D., and Kreutzer, David W. (2013) "EPA Power Plant Regulations: A Backdoor Energy Tax" *Heritage Foundation: Backgrounder*, No. 2683, December; http://thf_media.s3.amazonaws.com/2013/pdf/BG2863%20update.pdf.

44 (2013) "Effects of a Carbon Tax on the Economy and the Environment" Congressional Budget Office, May; http://www.cbo.gov/sites/default/files/cbofiles/attachments/44223_Carbon_0.pdf.

45 (1998) Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity. Energy Information Administration October (SR/OIAF/98-03).

46 Anspacher Jeffrey, Osborne Stefan, Richards Julian (2011) "The Effect of CO_2 Emissions Reduction on the U.S. Electricity Sector" Office of Competition and Economic Analysis: International Trade Administration, May; http://www.usitc.gov/research_and_analysis/documents/Effect_CO2_Emissions_Reduction_Electricity_Sector.pdf.

47 Ibid.

48 (2014) "Assessing the Impact of Potential New Carbon Regulations in the United States" *Institute for 21st Century Energy: U.S. Chamber of Commerce*.

49 (2013) "Effects of a Carbon Tax on the Economy and the Environment" Congressional Budget Office, May; http://www.cbo.gov/sites/default/files/cbofiles/attachments/44223_Carbon_0.pdf.