



# The Costs and Benefits of Using Regulation to Achieve Climate Goals

Sam Batkins, Dan Goldbeck, Philip Rossetti

## Summary

- Using regulation to achieve 80 percent greenhouse gas reductions would impose costs between \$588 billion and \$4.5 trillion, depending on policy goals and abatement costs, by 2050. That equals about \$10,300 for every person in the U.S.
- The economic impacts of such high regulatory costs would (conservatively) reduce GDP by between 0.6 and 2.3 percent by 2050, with a cumulative economic loss ranging between \$1.3 and \$7.2 trillion.
- By 2050, the average household will have \$41,877 less economic value than it would have absent a regulatory approach to climate change.
- A regulatory approach to deep decarbonization is expensive, especially when compared to the benchmark provided by the research community – a revenue neutral carbon tax.

## Introduction

The United States is on a path to reduce carbon emissions to address global climate change. The question remains whether future administrations will continue a regulation-only approach to reducing carbon pollution, or if the nation will adopt a more comprehensive, cost-effective method. There have been gains from past regulation in terms of reduced emissions, but these rules imposed more than \$450 billion in burdens.<sup>1</sup> Per household, these actions have imposed regulatory costs of more than \$3,350. On average, reducing one ton has cost the nation roughly \$34, but this figure will likely increase in the future.

The American Action Forum (AAF) found that simply extending the current regulatory policies will cost the nation more than \$1 trillion cumulatively by 2050. Adopting the more stringent 80 percent reduction target currently embraced in the [Democratic party platform](#), for example, will cost at least \$300 billion annually and more than \$4.5 trillion cumulatively (up to \$13,000 per capita). There will doubtless be benefits from these actions, but a sector-by-sector, regulatory approach to climate change will take future administrations decades to move rules through the regulatory process and the courts, and it will impose tremendous costs with little flexibility for states and regulated entities.

## History of Greenhouse Gas Regulation

Absent a legislative approach to climate change, the Obama Administration has implemented at least 50 regulations aimed at significantly cutting greenhouse gas (GHG) emissions. From a low of [122,000](#) fewer annual tons of GHGs (efficiency standards for “Ceiling Fan Light Kits”) to a [265 million-ton](#) reduction (Clean Power Plan (CPP)), the administration has been aggressively attempting to reduce the nation’s GHG emissions through a regulatory process often subject to legal battles. The five largest GHG regulations, including the Clean Power Plan, are projected to reduce GHG emissions by 739 million metric tons annually.

<u>Regulation</u>	<u>Agency</u>	<u>Annual GHG Reduction (in tons)</u>
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<sup>1</sup> “Regulation Rodeo,” *American Action Forum*. <http://www.regrodeo.com/>.



Clean Power Plan	EPA	<a href="#">265 million</a>
2017-2025 CAFE Standards	EPA	<a href="#">217 million</a>
2012-2016 CAFE Standards	EPA	<a href="#">130 million</a>
Phase II: Heavy-Duty Truck Standards	EPA	<a href="#">95 million</a>
Efficiency for Air Conditioners and Heaters	Energy	<a href="#">32 million</a>
<b>Total:</b>		<b><a href="#">739 million tons</a></b>

Although these reductions are quite substantial, they are far short of the Intergovernmental Panel on Climate Change’s (IPCC) recommended reductions (80 percent from 1990 levels) for keeping global average temperature rise under 2 degrees Celsius. According to the [Environmental Protection Agency](#) (EPA), the U.S. currently emits roughly 6.8 billion metric tons of GHGs annually, and achieving the IPCC’s goal would require reducing that to 1.28 billion. For policy purposes, the Obama Administration and other advocates of GHG regulations use a 2005 base year (U.S. emissions peaked in 2005), since that is a more lenient target than a 1990 base year. The 2016 Democratic party platform, as well as their presidential nominee, Secretary Hillary Clinton, have supported an 80 percent reduction from 2005 levels, which would require annual emissions of only 1.48 billion tons.

The regulations that have been pursued thus far have imposed significant costs. President Obama’s GHG actions measured in net present value costs are [\\$457.3 billion](#) (more than \$3,350 per household). This figure also uses the [lower-bound](#) estimate for the recent GHG standards for heavy-duty trucks and engines. Including the higher estimate yields more than \$525 billion in total costs. The EPA is responsible for \$283 billion of this amount, but the Department of Energy (DOE) has also imposed \$173 billion in costs via tighter efficiency standards. Through October 31, 2016, the Obama Administration has finalized [thirty](#) “economically significant” DOE standards, compared to just ten combined from the Bush and Clinton Administrations. The net result of these regulations is that every ton of GHG abated has created an average of \$34.44 in regulatory burdens, paid for by Americans. For perspective, EPA [provides background](#) on one ton of emissions: a car driven during a year releases 4.8 metric tons of CO2. Overall, America’s per capita emissions are [16.4 tons of CO2](#) annually.

The effect of these regulatory burdens begs a question: what would it cost if future presidents continue to pursue regulations as the preferred method of emissions abatement? Are there more effective abatement strategies? The nation’s promised emissions target is 26 to 28 percent below 2005 levels by 2025, and current law (and proposed) regulations put the U.S. on track to only achieve about a 13 percent reduction from 2005 levels by 2025. Even higher regulatory burdens would be needed to achieve this target, or any target beyond the Paris goal.

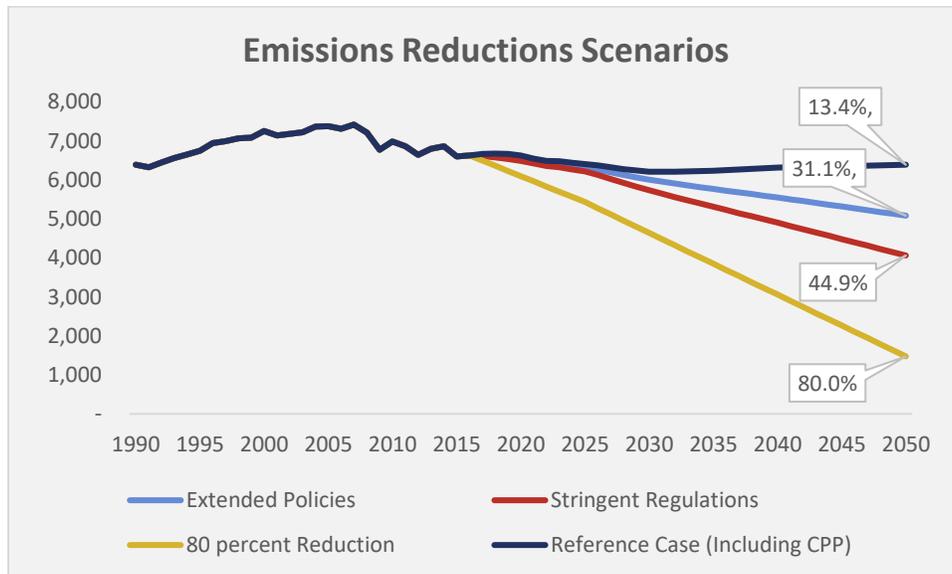
### The Burdens of a Regulatory Approach

To evaluate the costs of a regulatory approach, AAF is evaluating three different scenarios. The first is based on the Energy Information Administration’s (EIA) “Extended Policies” emissions projections.<sup>2</sup> Extended Policies are the extension or expansion of laws and regulations that the U.S. currently has, but are expected to expire in the baseline. The second scenario is a “stringent regulations” scenario, which assumes that the EPA would regulate emissions sources in a manner similar to their abatement recommendations (landfill emissions, tighter fuel efficiency for

<sup>2</sup> “Annual Energy Outlook 2016, Extended Policies Case,” *U.S. Energy Information Administration*, (August, 2016: Washington, D.C.) <https://www.eia.gov/forecasts/aeo/policies.cfm>



vehicles, different agriculture practices, etc.). The third scenario is an assumption that an 80 percent reduction of emissions by 2050 is possible via regulation, and that those regulations would deliver linear reductions in emissions. These scenarios are based on an AAF projection of GHG emissions, derived from the EIA’s projection of CO2 emissions from energy use.



If it is assumed that regulations would be able to match the cost-effectiveness of past regulations on a per-ton abatement cost (\$34.44), the regulatory burdens of each scenario (not counting the \$457.3 billion of current law burdens) would be as follows:

	2025	2050
Extended Policies Burdens (billions)	\$ 22.45	\$ 588.24
Stringent Regulations Burdens (billions)	\$ 41.14	\$ 1,100.29
80 Percent Reduction Burdens (billions)	\$ 183.17	\$ 2,703.09

While these burdens may seem quite large, they are actually optimistic. There are many ways an individual can reduce their carbon footprint, and the benefits of each method are the same regardless. The same cannot be said for the costs. The benefits of using more efficient light bulbs, or using a fan instead of an air conditioner may be the same as buying a hybrid car, but the costs are greatly disparate. It is expected that regulators pursue the lowest cost methods of abatement first, since this keeps the estimated benefits equal to or under the burdens. However, there are finite reductions that can be captured at a low cost, and achieving a much greater goal for emissions reductions would also require pursuing more expensive methods of abatement.

The actual abatement costs of such policies are difficult to determine. While there are estimates of capital costs and investments needed to pursue specific paths to an 80 percent decarbonization, there are few that estimate regulatory burdens. In lieu of estimating regulatory burdens though, it is possible to estimate the *benefits* that would be used to justify those burdens. Regulators frequently have, so far, had burdens that are roughly equal to or close to the estimated benefits, in terms of compliance costs compared to the Social Cost of Carbon (SCC). However, when



comparing domestic SCC benefits to domestic costs, the latter often exceed the former. To this effect, AAF created an estimate of burdens assuming future regulatory burdens would be equal to the SCC (standard 3 percent discount rate). The SCC increases every five years, which would allow for more stringent regulations that capture rising abatement costs. Under this assumption, the burdens would be as follows:

	2025	2050
Extended Policies Burdens (billions)	\$ 26.41	\$ 1,008.85
Stringent Regulations Burdens (billions)	\$ 49.20	\$ 1,877.39
80 Percent Reduction Burdens (billions)	\$ 221.78	\$ 4,510.59

Consider what \$4.5 trillion would mean to many Americans. Regulatory costs must be borne by some entity, and usually it’s the consumer in the form of higher prices. As AAF has detailed [in the past](#), even regulators frequently admit consumers often pay for the cost of regulation. For example, the average person pays \$100 more health insurance costs annually because of regulation and a new car will be \$3,100 pricier because of efficiency rules. After \$4.5 trillion in additional regulatory burdens, consumers could expect to pay more for energy, household goods, and a host of other products and services. The cost of using a car would rise by over \$300 per year by 2050 if the abatement costs of CAFE regulation remain unchanged. The entire suite of burdens necessary to cut emissions by 80 percent through regulation would end up costing the average American \$10,300 from 2017-2050.

These burdens would be roughly in line with the capital cost investments required for an 80 percent decarbonization by 2050. A recent [National Bureau of Economic Research](#) (NBER) paper from Professor Geoffrey Heal estimated the net capital costs for an 80 percent reduction to be \$1.3 trillion to \$5.3 trillion.

### Potential Benefits

This paper has so far focused on burdens, but regulations also have benefits. Ideally, regulations should correct for market failures. Such failures occur when a polluter has incentives to pollute to minimize costs, but the costs to others from the damage of its pollution exceeds the value they saved. Under such a scenario, regulations can capture more economic benefit than the cost of their burdens. Ideally, all regulations should achieve this. However, this is not always the case. AAF has [analyzed a sample](#) of DOE rulemakings, and all but one generated more costs than the reported GHG benefits. Across all government agencies, there have been [24 rules](#) during the Obama Administration where costs have exceeded benefits. Regulators often rely on consumer savings and “co-benefits” to justify regulations that have burdens greater than their benefits.

If future administrations continue this approach, they will likely use reductions in Nitrogen Oxides (NOx), ozone, and particulate matter (PM) to justify burdens that exceed AAF’s estimates based on the SCC. Many of the sources of GHG emissions, such as combustion engines for cars and fossil fuel power plants, generate PM and NOx. The five largest EPA rules (CPP, the 2012 and 2017 CAFE standards, and the old and new heavy-duty truck rules) are estimated to cut PM and NOx by 1.3 million tons. This has generated incredible benefits, according to agency analysis. By 2030, EPA projects a rate-based approach to its CPP will add \$20 billion in GHG benefits, but up to [\\$31 billion](#) in co-benefits, largely stemming from “reduced exposure to PM<sub>2.5</sub>



and ozone.” Generally, co-benefits exceed the social welfare gains of the target (CO2) of the regulation.

Using the example of those five rules, on average every 35,370 tons of GHG abated correlates to one ton of PM or NOx abatement. The average benefits from past rules per ton of PM or NOx abated has been roughly \$185,000. This means that an 80 percent reduction of GHG emissions could also abate 5.5 million tons of PM or NOx (a 32 percent reduction in annual emissions), which would generate more than \$1 trillion in clean air benefits (assuming constant ratios and values). If regulators continue their past practices of using co-benefits to justify burdens beyond the SCC benefits, then that would allow regulators to increase the burdens by potentially another \$1 trillion and still be considered net beneficial on paper.

What should be acknowledged, though, is that capturing these benefits is not guaranteed. The SCC, for example, is derived from modeling global economic trends. Not only are the benefits of the SCC not directly recaptured by those who bear the cost of abatement, but they are also predicated on an assumption that other nations will not increase emissions as the U.S. decreases emissions (a concept known as carbon leakage). For example, reduced fossil fuel consumption in the U.S. could cause prices to fall in other nations, and increase their consumption, which would offset estimated climate benefits.

Co-benefits are also contentious in regulatory impact analyses because they are not directly tied to the regulation they are justifying. As a result, some believe that co-benefits may be double-counted, since the benefit to a particular party may already be captured by another regulation. Regulators also face criticism for using simplistic means of calculating co-benefits, which assume there are additional benefits from reducing PM and NOx, even though the nation has already achieved required reductions in those pollutants. In other words, this air is already legally “clean” for PM and NOx, but regulators claim additional benefits when regulating GHG emissions. More specifically, they assert that every ton of reduction implies the same benefit, no matter how clean the air is – even if pollution levels are below the legal threshold.

The U.S. will certainly receive some benefits from regulations focused on GHG abatement, but the current methods for calculating those benefits may be overstating the gains, and leading to burdens that create—rather than correct—market failure.

### Specific Regulations and Associated Challenges

The above statements are assuming that such a regulatory approach to emissions is even possible (both technically and legally). It is a regular occurrence for regulations to be challenged in court, but it was an unusual step for the Supreme Court to stay a regulation before it reached the highest court—as occurred with the Clean Power Plan. If it is assumed that the Clean Power Plan is legal, what other regulations are likely to be pursued for GHG abatement?

If future administrations attempted to use existing regulations as a guideline for achieving an 80 percent reduction, it could take the following form (assuming \$34.44 in abatement costs):

<b>Difficulty of Achieving 80% Goal Through Regulation</b>		
<b>Regulation</b>	<b>Annual Costs</b>	<b>Percentage of 80% Goal</b>
CPP with Three Times the Carbon Savings	\$27.3 Billion	26%
80 Percent Reduction in Industrial Emissions	\$22.8 Billion	22.2%



Doubling Emissions Reductions of 2017-2025 CAFE	\$15 Billion	14.5%
Doubling Appliance Efficiency of Obama Era	\$9 Billion	8.8%
50 Percent Reduction in Aircraft Emissions	\$7.7 Billion	1.9%
Doubling Emissions Reductions of 2016 Truck Rule	\$6.5 Billion	3.1%
Eliminating Four Million Tons of Methane	\$3.4 Billion	3.3%
<b>Totals</b>	<b>\$87.9 Billion</b>	<b>79.1%</b>

Note that even with a massive increase in regulations, and assuming the same level of efficiency in abatement, the regulatory burdens are quite large. These regulations only achieve about four-fifths of the 80 percent reduction goal.

There are other potential sources of emissions that regulators could attempt to regulate. This could include landfills, farms (manure storage and fertilization use), livestock diets, hybridization of cars, and more.

It is uncertain if pursuing these regulations would be legal. Regulations are (ostensibly) not allowed to impose burdens beyond what is technologically achievable or economically justified. Is a 50 percent reduction in aircraft emissions possible in the next generation? Future administrations might consider the use of biofuels or a “Low Carbon Fuel Standard” for emissions, but that is unlikely to generate a reduction of 50 percent.

Even if a 50 percent cut were technologically and legally possible, it would likely cost more than the “on paper” burden of \$7.7 billion. Agencies must also operate within the authority granted to them by law—but the intent of those laws has been called into question. Furthermore, some laws have sections—specifically 115 of the Clean Air Act—that could allow regulators to use international agreements as a means of granting authority for regulations outside the scope of defined law. However, this section also requires reciprocity from the foreign country.

Future administrations could think big, toward an economy-wide legislative approach like a carbon tax, or attempt to add up every minor regulation and deal with the legal and technological challenges of each rule. A regulatory approach to climate change could easily necessitate hundreds of major regulations (there have already been at least 50). Generally, it takes two years to complete a major rule, absent subsequent legal intervention, so the pace of climate change would not only rush future administrations, but cramming all the rules into an implementation window that courts would approve would pose another set of issues.

### **Economic Impacts of a Regulatory Approach to GHG Abatement**

The costs of regulation are generally passed on to consumers in the form of higher prices. As such, regulations have an economic impact by causing consumers to spend more for goods and services that do not offer them any increased utility. This extra money spent for goods and services is money that would otherwise be spent on other consumption. As consumption declines, so too do the opportunities for profit, which is the motivator for production. The net effect of higher prices on consumed goods and services is an economic drag that slows growth.

The effect of regulations passing costs to consumers is similar to that of taxes, which also raise costs for consumers. If the government levies additional taxes, then it is reducing the amount of capital that the private sector has available for either consumption or production—the drivers of

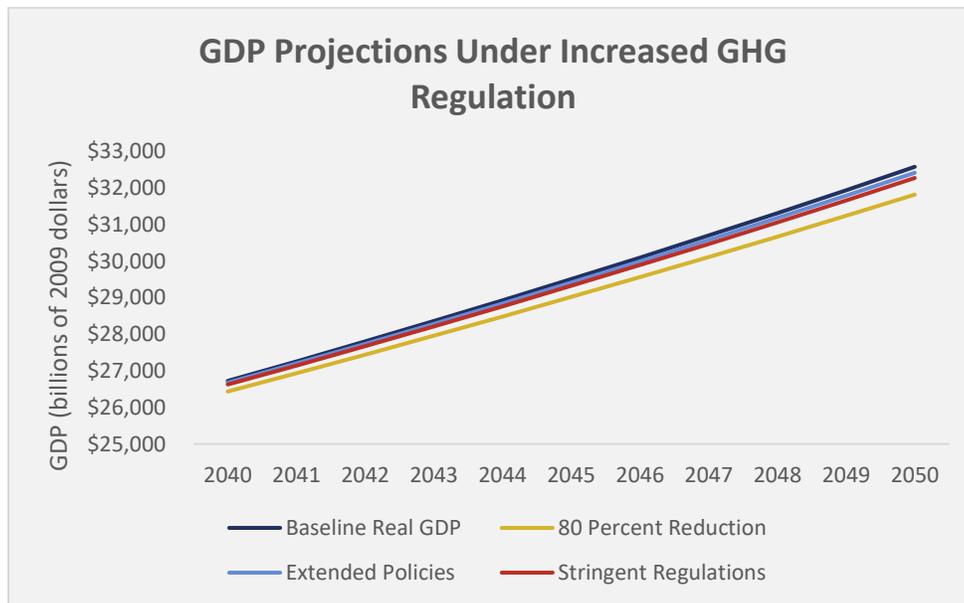


economic growth. In estimating the economic effects of regulations, it is best to model their effects as taxes.

To estimate the potential economic loss from increased stringency of regulatory policy, AAF applied a Joint Committee on Taxation’s (JCT) analysis on Corporate Income Tax (CIT) relief to AAF’s estimate of burdens.<sup>3</sup> The effects of raising or lowering the CIT should be fairly close to the effects of regulatory burdens, since how businesses respond to both the CIT and regulations are similar (passing the costs on to consumers). The JCT’s estimate of economic effects from CIT changes are conservative, so the estimate of economic effects from regulations are as well.

AAF estimates, conservatively, that the cumulative effects of further GHG regulation would reduce GDP between 2017 and 2050 by \$1.32 trillion to \$7.22 trillion (real 2009 dollars). Relative to the baseline, this would reduce the size of the economy between 0.5 percent and 2.3 percent by 2050. The Congressional Budget Office currently projects the long-term economic growth rate at 2 percent, and AAF estimates the burdens reducing emissions by 80 percent would cut this to 1.85 percent by 2050.

<i>All values in billions of 2009 \$</i>	<b>2050 GDP</b>	<b>Cumulative Economic Loss</b>	<b>Difference from Baseline</b>
<b>Baseline</b>	\$ 32,349	\$ -	-
<b>Extended Policies</b>	\$ 32,191	\$ 1,324	0.5%
<b>Stringent Regulations</b>	\$ 32,051	\$ 2,569	0.9%
<b>80 Percent Reduction</b>	\$ 31,605	\$ 7,221	2.3%



<sup>3</sup> Staff of the Joint Committee on Taxation, “Macroeconomic Analysis of Various Proposals to Provide \$500 billion in Tax Relief,” *Joint Committee on Taxation*, (March, 2005: Washington, D.C.). <https://www.jct.gov/publications.html?func=startdown&id=1189>.



Overall, the relative changes in economic size may seem quite small when compared to the baseline. However, when considering the cumulative effect of regulatory burdens during a 30-plus year period, even AAF's conservative estimate shows the potential for significant losses.

Consider the economic impact of these burdens on Americans over the long term. One could think of the increased cost of goods and services due to regulation as cutting into the money that someone can invest. Consequently, the short-term losses are small, since there is little opportunity for such an investment to grow. Reaching a 26 percent emissions reduction by 2025 would cost the average household \$1,745 in burdens, but their income flows over those 8 years would be only \$740 lower. When considering the totality of burdens out to 2050, the picture is much bleaker. Just like interest on debt, the potential losses can snowball as the economy drifts further from the projected baseline. From \$4.5 trillion in total economy-wide burdens and \$7.2 trillion in economic losses, the average household would have spent more than \$26,100 in regulatory burdens, and their total income flows would be more than \$41,800 lower than the baseline by 2050.

These estimates may be quite low though, since they only model the regulations as a tax, and do not model their impact on energy prices. They also assume a constant abatement cost, when in reality abating the last ton will be significantly more expensive than abating the first. The EIA's estimate of the CPP using an econometric model estimated a cumulative [GDP loss of \\$1 trillion](#) over 25 years, but the burden of the CPP is only \$8.4 billion annually. The EIA's estimated loss is due to reduced economic activity from energy prices, which AAF's estimate does not include. If GHG regulations increase energy costs (which they undoubtedly will), then the resulting GDP loss could be far greater than AAF's estimate.

## GHG Regulations vs. Carbon Tax

It is expected that the pursuit of increasingly stringent regulations would create higher burdens that have increasingly pronounced negative effects on the economy. It is also possible that the burdens of these regulations would exceed the benefits, which would eliminate net gains from the regulations. These negative economic effects could be avoided if the burdens of regulations were significantly lower, which would improve the likelihood that the benefits match or exceed the burdens.

GHG regulations struggle with matching burdens and benefits, since there are finite sources of emissions to regulate, and many will likely have abatement costs exceeding the benefits (the 2011 CAFE standard proved this when it cost \$85 per ton of CO<sub>2</sub> abatement, well above the \$36 per ton benefit).<sup>4</sup> As a means of reducing GHGs, regulations are inherently costly and ill-suited to capturing the greatest amount of benefits for the least amount of cost.

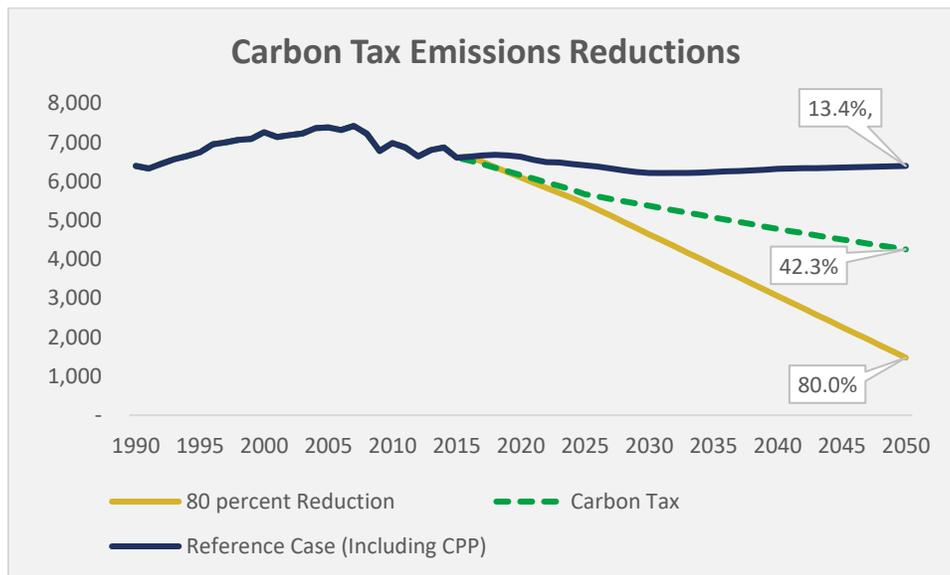
The broad literature has identified that the most economically efficient means of reducing GHG emissions is through a price on carbon, or a carbon tax. If carbon is priced in a manner that dissuades pollution, then market participants will naturally seek the lowest cost methods of abatement, and have incentives to reduce GHG emissions. Unfortunately, a carbon tax is also effectively a tax on energy, which is essential to virtually all aspects of the economy. As such, a carbon tax is a politically contentious policy since it will likely have deleterious effects on the economy if used as a tool to raise revenue.

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<sup>4</sup> AAF Estimate, \$1.5 trillion in burdens divided by 17 million metric tons of reductions.

However, the U.S. government already has taxes in place that create distortions and negative effects on the economy. If the revenue from a carbon tax is used to reduce other distortionary taxes, then the negative effect of the tax is only the difference between the distortion caused by the carbon tax and the tax it replaced.

The EIA estimated that the negative effect of a carbon tax (\$20 per ton, increasing by 5 percent annually) would be to reduce GDP by 0.2 to 0.4 percent from the baseline by 2040. However, when the same tax was assumed to be used to reduce business taxes, the economic effect was “near the reference level.”<sup>5</sup> This is consistent with the literature on carbon taxes, which indicates that if used to offset business and corporate taxes (the most distortionary taxes), the economic impact will be small, if any.<sup>6</sup> The emissions reductions associated with a \$20 per ton carbon tax (increasing by 5 percent annually) would be roughly 42 percent below 2005 levels by 2050.



A carbon tax would also eliminate the need for current law GHG regulations, and the \$457 billion in burdens associated with them. Research indicates that a revenue neutral carbon tax that reduces corporate and business taxes represents the most economically efficient means of reducing GHG emissions, while capturing any benefits that regulations are intended to achieve. Using revenues from the carbon tax to lower the corporate income tax and business taxes would also reduce the number of U.S. firms relocating to foreign jurisdictions for tax purposes, and the associated expatriation of capital.

<sup>5</sup> U.S. Energy Information Administration, “Further Sensitivity Analysis of Hypothetical Policies to Limit Energy-Related Carbon Dioxide Emissions,” *Supplement to the Annual Energy Outlook 2013*, (July, 2013: Washington, D.C.)

[https://www.eia.gov/forecasts/aeo/supplement/co2/pdf/aeo2013\\_supplement.pdf](https://www.eia.gov/forecasts/aeo/supplement/co2/pdf/aeo2013_supplement.pdf).

<sup>6</sup> Jared Carbone, Richard Morgenstern, Robert Williams, and Dallas Burtraw, “Getting to an Efficient Carbon Tax: How the Revenue is Used Matters,” *Resources for the Future*, (January, 2014: Washington, D.C.). <http://www.rff.org/research/publications/getting-efficient-carbon-tax-how-revenue-used-matters>.



## Conclusion

A regulation-only approach to GHG emissions has already imposed significant economic costs, in absence of a comprehensive legislative approach. Currently, the nation plans to spend more than \$450 billion in cumulative costs, and that figure is not enough to achieve the goals of the Paris Climate Agreement. To reach the ambitious goal of an 80 percent reduction in GHG emissions by 2050, the nation must spend an additional \$4.5 trillion cumulatively (assuming such a target could even be achieved at abatement levels under the SCC), and these costs could cumulatively reduce GDP by more than \$7.2 trillion, burdens that every household would bear. There will be clean air and climate benefits to this approach, but these costs will have a profound impact on consumers, the energy sector, and overall economic growth.

## Appendix

The following appendix explains the methodology for the American Action Forum's research on *The Costs and Benefits of Using Regulation to Achieve Climate Goals*.

### Creating Projections

In estimating the costs associated with regulatory burden, there is an inherent challenge in that estimates for abatement costs are highly variable, and there are few credible and recent assessments of abatement costs for *all* sectors of the economy. In lieu of this, AAF assumes that regulators—such as the EPA and Department of Energy—will continue their past behavior of attempting to keep regulatory burdens close to the estimated benefits. Since the EPA uses the SCC to estimate the benefits of GHG abatement, AAF applied this value to projections of carbon emissions to estimate the captured benefits from regulation.

Essential to this estimate was a projection of total GHG emissions until 2050, since multiple policy platforms have adopted the Intergovernmental Panel on Climate Change's recommended emission targets that require emissions by that year. GHG data from past to present is catalogued by the EPA, by gas, and by sector.<sup>7</sup> However, the same data inventory does not include any EPA projections for future emissions.

For future emission projections, AAF used the EIA's emissions projections from energy use, which projects to the year 2040 (including the Clean Power Plan).<sup>8</sup> This projection becomes largely linear the further out it is, as more laws are expected to expire and have less effect on the reference case. AAF used this projection, and calculated an average emissions growth rate from the energy sector from 2030-2040, and applied that growth rate to attain a projection of emissions from 2040-2050 for energy use.

After developing this new projection of energy related emissions, AAF then applied historical trends of energy use as a proportion to total emissions from the EPA's inventory (1990-2014), and determined an average ratio of energy emissions to non-energy emissions. This ratio was then

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<sup>7</sup> "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014" *U.S. Environmental Protection Agency*, (April, 2016: Washington, D.C.) <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2014>.

<sup>8</sup> "Annual Energy Outlook 2016," *U.S. Energy Information Administration*, (August, 2016: Washington, D.C.) [http://www.eia.gov/forecasts/aeo/pdf/0383\(2016\).pdf](http://www.eia.gov/forecasts/aeo/pdf/0383(2016).pdf).

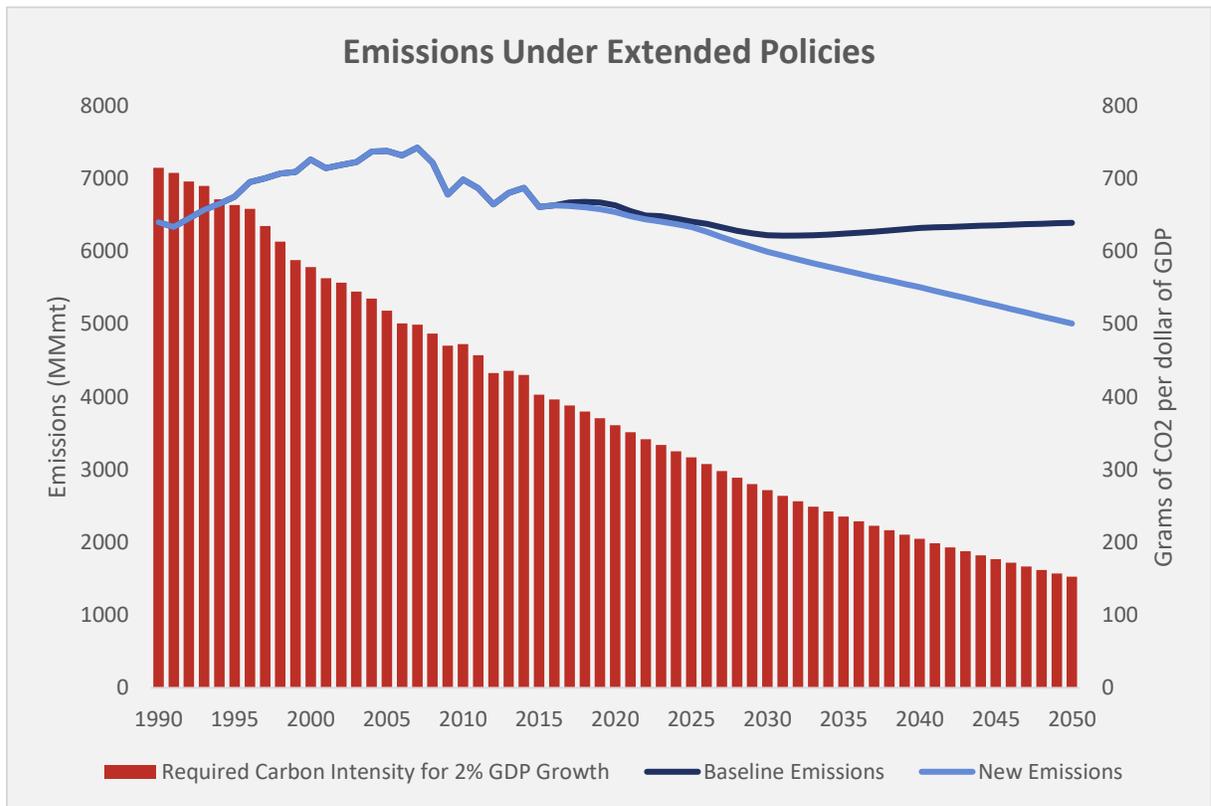


applied to the projection of energy related emissions to create a projection of total GHG emissions. This estimate then served as AAF’s baseline for all its calculations.

This new dataset can isolate emissions by source, allowing AAF to more accurately estimate the effects of specific regulations. In developing different scenarios, AAF applied estimates from the EIA’s extended policies case, as well as literature on the effectiveness of various methods of abating emissions to calculate reductions.<sup>9</sup>

In estimating the burdens and economic effects of regulations, AAF used three different scenarios which it compared to its baseline projection. The three scenarios are as follows (all reductions relative to 2005 levels):

*Extended Policies*



The extended policies scenario assumes emission reductions from:

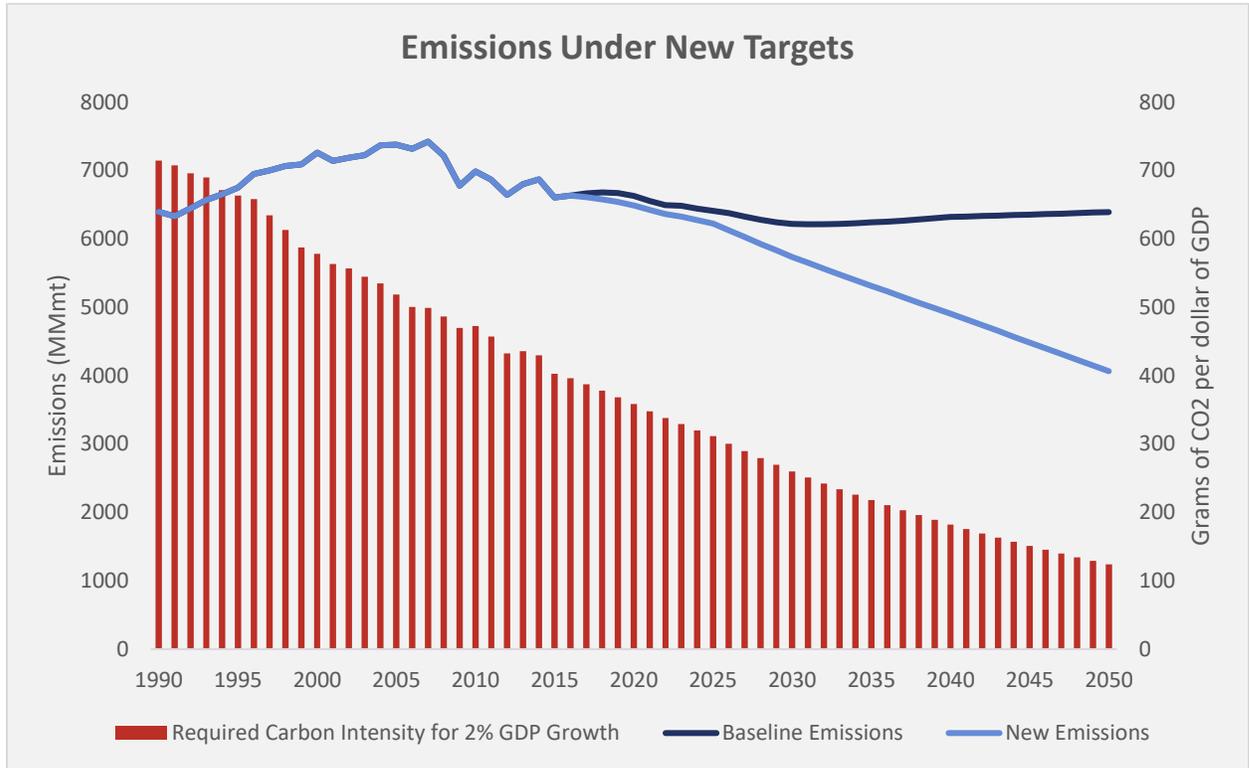
- Extending energy subsidies, including the Investment Tax Credit and the Production Tax Credit.
- Maintaining tax credits for the purchase of efficient equipment
- Updating Energy Star standards
- Updating energy codes for commercial and residential buildings in 2025 and 2034
- Increasing CAFE standards at an annual rate of 1.4 percent
- Tightening standards for heavy-duty vehicles

<sup>9</sup> Ibid, “Extended Policies Case,” <https://www.eia.gov/forecasts/aeo/policies.cfm>.



- Strengthening the CPP to achieve a 45 percent reduction (from 2005) in electric generation emissions by 2040

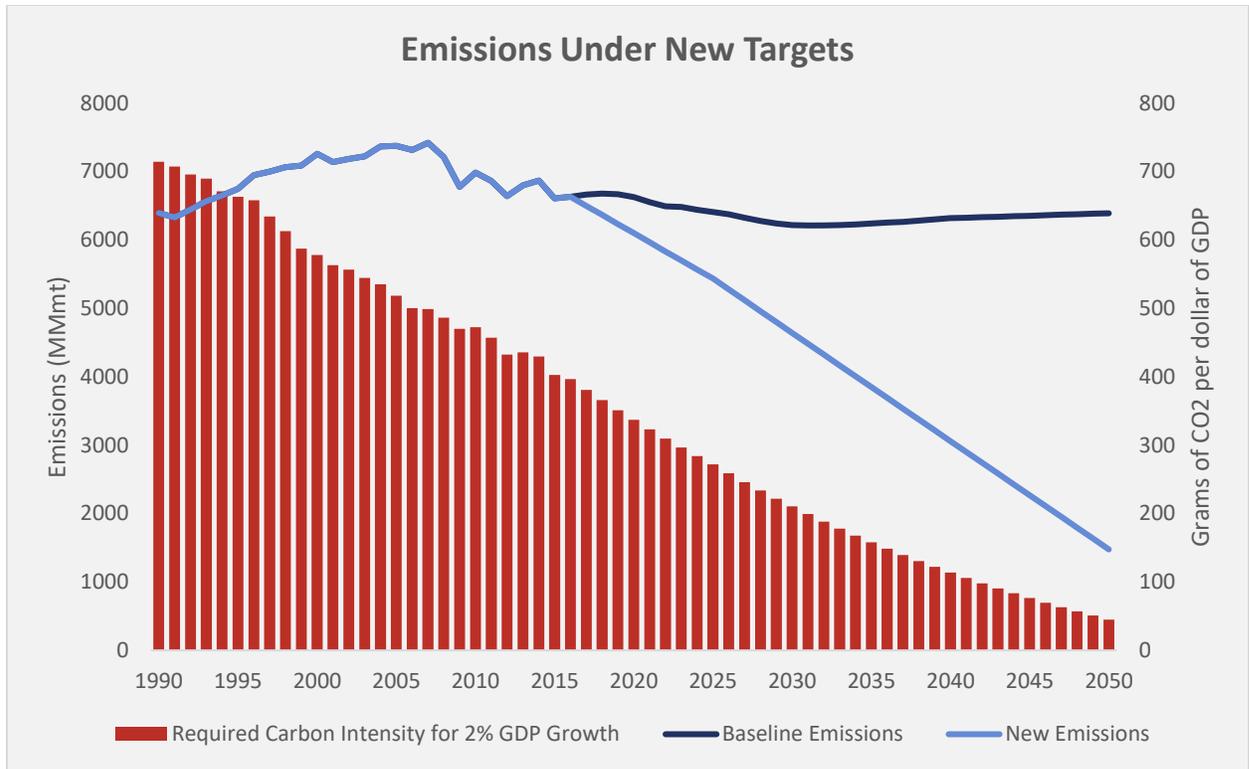
*Stringent Regulations Scenario*



The stringent regulations scenario assumes emissions reductions from the EPA’s recommended means of reducing emissions, which includes:

- Clean Power Plan requirements expanded to 45 percent reduction by 2040
- Hybridization of Cars
- Renewable Fuel Standard Increased to 85 percent ethanol requirements
- All Heavy Duty Vehicles use Compressed Natural Gas
- Hydrofluorocarbon (HFC) emissions are eliminated via regulations or better handling
- Landfill emissions are regulated in a similar manner as power plants under the Clean Power Plan, and shift to the use of gas flaring to eliminate 99 percent of landfill emissions by 2050
- Fertilizer usage in agriculture is regulated, cutting emissions from fertilizer use by 30 percent
- Livestock diets are regulated, and enteric fermentation is reduced by 30 percent
- Manure storage from agriculture sites are regulated to be covered, reducing associated emissions by 80 percent

*80 Percent Emissions Reduction by 2050*



The 80 percent reduction scenario is an assumption that such a target is achievable. It does not attempt to source where the reductions come from, it merely assumes that the policy goal can be achieved through regulation. It also assumes that, by 2025, the 26 percent emissions reduction goal from the Obama Administration is achieved.

*Calculating Burdens / Benefits*

The difference in emissions between the baseline projection and the new projection under different scenarios was then applied to a value for an appropriate estimate. Note that this method is only applicable if it is assumed that the value of each ton reduced from the baseline is uniform. If variable abatement costs had been available, AAF would have calculated this differently, and it is not encouraged to apply a uniform abatement cost to the delta unless it is an appropriately weighted average.

AAF created two sets of estimated regulatory burdens. The first set uses the average cost of GHG abatement from past regulation, \$34.44 per ton.<sup>10</sup> This estimate involves calculating the reductions each year from the baseline, assuming that each reduction cost \$34.44, and then cumulatively adding each year for an estimated total burden.

	2025	2050
Extended Policies Burdens (billions)	\$ 22.45	\$ 588.24

<sup>10</sup> \$34.44 per ton is the value yielded when dividing the total burdens of GHG regulations by the total tons of abated CO2.



Stringent Regulations Burdens (billions)	\$ 41.14	\$ 1,100.29
80 Percent Reduction Burdens (billions)	\$ 183.17	\$ 2,703.09

The second set of estimates used the same method, but instead of using the average abatement cost from past regulations (\$34.44), it used the EPA’s estimated SCC at a 3 percent discount rate.<sup>11</sup>

	2025	2050
Extended Policies Burdens (billions)	\$ 26.41	\$ 1,008.85
Stringent Regulations Burdens (billions)	\$ 49.20	\$ 1,877.39
80 Percent Reduction Burdens (billions)	\$ 221.78	\$ 4,510.59

Since the EPA has attempted to keep costs and benefits roughly aligned, and since abatement costs increase as low cost abatement opportunities are exhausted, this set of estimates is likely more accurate. However, this is an estimate of the *benefits*. For reasons explained in this report, AAF believes that the burdens will likely exceed the estimated benefits.

### Macroeconomic Impacts

AAF estimated the effect of these regulations on GDP by treating the estimated burdens (using SCC values) as taxes. To model this, AAF used a 2005 estimate of economic benefits from tax relief that was written by the staff of the Joint Committee on Taxation.<sup>12</sup> This report assumed that \$500 billion in tax relief from the Corporate Income Tax (assuming a neutral Fed policy and no revenue offsets) would yield \$63.38 billion in economic growth over ten years. AAF used the data from the report, breaking down cost and growth on a year-by-year basis. On average, AAF found that over the 10-year period every dollar of tax relief yielded 14.74 cents in economic growth. This estimate was used specifically due to its conservative nature, meaning that the resulting economic impact would likely be lower than reality (preferable to an overestimation of consequences).

AAF took this estimated growth and applied it to the estimated burdens. The assumption is that, similar to CIT relief, a dollar in burdens would reduce economic growth by 14.74 cents. AAF used CBO data to create a projection of economic growth out to 2050 (assuming no change in business cycles), and then estimated the reduced size of the economy (from the previous year) based on the estimated burdens.<sup>13</sup> So \$100 billion in burdens would make the economy \$14.74 billion smaller than the baseline. That resulting year then has the CBO’s projected growth rate applied to it, and the regulations of the next year are then appropriately applied. This is so the

<sup>11</sup> “Social Cost of Carbon,” *U.S. Environmental Protection Agency*, (December, 2015: Washington, D.C.). <https://www3.epa.gov/climatechange/Downloads/EPAactivities/social-cost-carbon.pdf>.

<sup>12</sup> Staff of the Joint Committee on Taxation, “Macroeconomic Analysis of Various Proposals to Provide \$500 billion in Tax Relief,” *Joint Committee on Taxation*, (March, 2005: Washington, D.C.). <https://www.jct.gov/publications.html?func=startdown&id=1189>.

<sup>13</sup> “10-Year Economic Projection,” *Congressional Budget Office*, (August, 2016: Washington, D.C.). [https://www.cbo.gov/about/products/budget\\_economic\\_data#4](https://www.cbo.gov/about/products/budget_economic_data#4).



## RESEARCH

burdens are cumulative, since if each year was taken individually from the baseline it would artificially inflate the growth rate beyond CBO projections. These estimates are done in real values, not nominal, since the EPA's SCC as well as AAF's \$34.44 per ton estimate are in real dollars.

The result of AAF modeling the GDP loss from increased regulation was a cumulative loss between \$1.32 trillion (for the extended policies scenario) and \$7.22 trillion (for an 80 percent reduction).



<i>All values in billions of 2009 \$</i>	<b>2050 GDP</b>	<b>Cumulative Economic Loss</b>	<b>Difference from Baseline</b>
<b>Baseline</b>	\$ 32,349	\$ -	-
<b>Extended Policies</b>	\$ 32,191	\$ 1,324	0.5%
<b>Stringent Regulations</b>	\$ 32,051	\$ 2,569	0.9%
<b>80 Percent Reduction</b>	\$ 31,605	\$ 7,221	2.3%

These estimates, though, are likely far lower than what would be realized. If regulations increase energy prices, then economic activity will be reduced. Modeling the economic effects of changes in energy prices is typically done via econometric modeling, which can predict how changes in one sector of the economy may impact others, and then yield economy-wide estimates.

The EIA used an econometric model with the estimated effects of the Clean Power Plan, and found that \$8.4 billion in annual burdens (EPA estimate) yielded \$1 trillion in cumulative GDP loss over 25 years.<sup>14</sup> This is roughly a 4.7:1 ratio of economic loss to burden. With that ratio, and AAF’s estimated burdens, the cumulative economic loss would then be between \$2.8 trillion and \$21.48 trillion. However, AAF does not propose such an estimate, since the economic impact of regulations on the electricity sector may not be comparable to other sectors.

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<sup>14</sup> “Regulatory Impact Analysis for the Clean Power Plan Final Rule,” *U.S. Environmental Protection Agency*, (October, 2015: Washington, D.C.). [https://www3.epa.gov/ttnecas1/docs/ria/utilities\\_ria\\_final-clean-power-plan-existing-units\\_2015-08.pdf](https://www3.epa.gov/ttnecas1/docs/ria/utilities_ria_final-clean-power-plan-existing-units_2015-08.pdf); “Analysis of the Impacts of the Clean Power Plan,” *U.S. Energy Information Administration*, (May, 2015: Washington, D.C.). <https://www.eia.gov/analysis/requests/powerplants/cleanplan/pdf/powerplant.pdf>.