The Costs of Achieving the Obama Administration's GHG Emissions Goals

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Executive Summary

The Obama Administration made an international pledge to reduce U.S. net greenhouse gas emissions 26% to 28% below their 2005 level by 2025. It also endorsed an eventual goal of an 80% reduction in emissions by 2050.

The administration has argued accomplishing these goals will be good for the economy and create millions of good paying middle class jobs. If this all sounds too go to be true, that is because it is. And the evidence comes from the unlikeliest of sources . . . the Obama Administration.

Each year the U.S. Energy Information Administration (EIA) produces the federal government's official energy forecast. Its *Annual Energy Outlook 2016* is the agency's latest effort. In addition to its baseline Reference case—what it believes the economy and energy markets will look like under current policies—EIA produced a number of side cases. Among these is an "Industrial Efficiency High Incentives" side case. This scenario includes pretty much the Obama Administration's wish list in one form or another: CPP, tax incentives, efficiency, and, especially, an economy-wide price on carbon dioxide that starts in 2018, ramps up to $35 per ton in 2023, and rises 5% a year thereafter.

By comparing this side case to EIA's Reference case without CPP (the "No CPP Reference" case), we can get an idea of the economic and energy impacts of this combination of policies, in particular CPP and a price on carbon.

The results for 2018 to 2040 are summarized below and in Table ES-1 leave little room for doubt that the Obama Administration climate policy, which includes CPP in combination with a large price on carbon, would if implemented result in significant economic harm to consumers and businesses. Among the analytical points supporting this conclusion include the following (all dollar figures are in chained 2015 dollars):

- **Carbon Dioxide Emissions:** When compared to the administration's 2005 baseline, energy-related carbon dioxide emissions would be 30% lower in 2025—consistent with the administration's Paris goal—and 35% lower in 2040. Compared to the No CPP baseline, cumulative emission reductions total 27.5 gigatons.

- **Coal:** Most of the carbon dioxide emission reductions come from the virtual elimination of coal use in the power sector, essentially wiping out an entire industry.

- ➤ **GDP:** Annual economic losses average $231 billion, totaling $5.3 trillion over the entire period (see Figure 1). Cumulative economic costs would still run in the trillions of dollars even if one accepts the very generous, and deservedly controversial, estimates for the social cost of carbon and other monetized health benefits used by the Obama Administration to justify federal climate rules.

- ➤ **Economic Carbon Price:** The price in lost GDP averages $193 per ton of carbon dioxide reduced.

- ➤ **Jobs:** Declines in employment are large and consistently lower through 2035. Losses peak in 2023 at 1.4 million fewer non-farm jobs overall and 233,000 fewer in manufacturing (see Figure 4).

- ➤ **Electricity Prices:** Electricity prices skyrocket, soaring 18% by 2025 and 24% by 2040. Industrial users get hit hardest, with prices jumping 25% higher by 2025 and reaching 32% higher in 2040 (see Table 1).

- ➤ **Regional Electricity Prices:** The highest increases in electricity prices include the industrial and energy-producing areas of the West South Central and the East North Central Census regions (see Table 2).

- ➤ **Electricity Expenditures:** Sharp price increases completely swamp declining sales, leaving consumers with much bigger electricity bills. Consumers across all economic sectors see their electricity expenditures jump an average of 12% higher in 2025 and 14% higher in 2040. Overall, consumers will spend additional $1.2 trillion for electricity (see Table 1).

- ➤ **Fuel Prices:** By 2040, the prices for common fuels will increase anywhere from 8% (E85) to 289% (coal). Gasoline will rise 17% (see Table 3).

- ➤ **Total Non-Renewable Energy Expenditures:**[i] Consumers pay an additional 11% in energy expenditures in 2025 and 16% more in 2040. That adds up to a cumulative additional expense of $3.9 trillion (see Figure 5).

- ➤ **Disposable Income:** The decline in disposable income averages about $148 billion a year. Like higher energy prices, less disposable income will have a disproportionate impact on poor households and those on fixed incomes (see Figure 6).

➢ **Value of Shipments:** The cumulative decline in shipments amounts to $7.5 trillion ($328 billion per year) in the service sector and $4.3 trillion ($186 billion per year) in the industrial sector. Energy–intensive manufacturing takes the hardest relative hit (see Table 4).

Table ES-1. Summary of Impacts of EIA CPP/Carbon Price Scenario versus No CPP Reference Case: 2018-2040

Carbon Dioxide Emission Reductions	Total	Annual Average
	(Million Metric Tons)	
Power Sector	24,389	1,060
Industrial Sector	1,134	49
Total	27,489	1,195

Economic Impacts	Total	Annual Average
	(Billion Chained 2015$)	
GDP Losses	5,311	231
Electricity Expenditure Increases	1,199	52
Energy Expenditure Increases	1,625	170
Disposable Income Losses	3,396	148
Value of Shipments Losses	11,821	514
Service Sector Losses	7,548	328
Industrial Sector Losses	4,273	186

Employment	Annual Average (Thousand)
Non-Farm Job Losses	415
Manufacturing Job Losses	118

Key Energy Price Increases	Percent Increase in:	
	2025	2040
Electricity	18.9	24.1
Motor Gasoline	11.1	17.3
Distillate Fuel Oil	11.1	18.4
Natural Gas	30.0	56.7
Coal	152.9	288.9

Source: EIA Annual Energy Outlook 2016.

Introduction

In support of the UN Framework Convention on Climate Change (UNFCCC) agreement reached in Paris in December 2015, the Obama Administration pledged that the United States would cut its net greenhouse gas emissions 26% to 28% from the 2005 level by 2025, with a "best effort" to achieve 28%. The Intended Nationally Determined Contribution, or INDC, it submitted in 2015 to the UNFCCC laying out this commitment was supposed to provide "information to facilitate the clarity, transparency, and understanding of the contribution."[ii] But rather than providing a clear roadmap, the INDC leads us instead into terra incognita.

As we and others have noted,[iii] there is in fact a large "gap" between the administration's unrealistically ambitious goal and its plan to reach it—much less the 80% reduction in emissions by 2050 endorsed by the administration both in its INDC and its letter associating the United States with the Copenhagen Accord[iv] back in 2010.

This gap was confirmed by the administration with the release of the *2016 Second Biennial Report of the United States of America*,[v] which was submitted to the UNFCCC amid 2016's New Year's Eve revels. It shows announced and expected policies would get about half of the reductions promised in the INDC.

Yet inexplicably, the administration—by its own lights the most proactive ever on addressing climate change—failed to offer any analysis of how the United States would achieve its Paris pledge and the impacts achieving said goal would have on the economy, jobs, and the energy sector. But the Energy Information Administration (EIA) has done the next best thing.

Each year the energy experts at EIA, the statistical arm of the Department of Energy, issue the federal government's official energy forecast, the *Annual Energy Outlook* (*AEO*).[vi] The *AEO* for 2016 includes two baseline "Reference case" scenarios: one that includes CPP and one that does not.

In addition, EIA produced a number of side cases to isolate and analyze how certain technological or policy changes may impact projections. Among the nearly 20 alternate scenarios in this year's *AEO* is one called "Industrial Efficiency High Incentive." EIA describes this scenario as follows:

> *Uses a price on carbon dioxide emissions as a proxy for higher energy costs as a way to increase energy efficiency in all industries except refining. The carbon dioxide price is phased in gradually, starting in 2018, reaching $35.00 in 2023 (2015 dollars per metric ton), and increasing by 5% per year thereafter.*

This economy-wide carbon price would be added on top of CPP and renewable electricity tax credits, and other regulations finalized and on the books. At a rate of 5% per year, the price for a ton of carbon dioxide would reach $80 by 2040, the end year of EPA's model run.

Let us call attention at the outset to the fact that the emissions reduction trends in the output from EIA's Industrial Efficiency High Incentive side case of the Obama Administration's lofty longer-term goals. Although the energy-related carbon dioxide emission reductions in this scenario largely are consistent with the Obama Administration's 2025 Paris pledge, as we will show below the trend line in carbon dioxide reductions out to 2040 suggests that the carbon price EIA modeled would not result in an 80% reduction in total GHG emissions by 2050.

Still, the features of EIA's Industrial Efficiency High Incentive scenario represent a significant down payment on the Obama Administration's stated emission goals. Because a carbon price is almost universally agreed to be the most efficient means of reducing emissions, EIA's scenario represents a lower bound estimate of the economic costs the economy would be expected to incur to meet these wildly ambitious emissions.

This report focuses on the impacts of EIA's Industrial Efficiency High Incentive case compared to its No CPP Reference case for the period from 2018, when the carbon price is first imposed, to 2040. In this way, the combined costs and benefits of both the CPP and the imposition of a carbon price can be teased out from a reference case that does not include either. Many of the tables will have data for the years 2025—the administration's Paris pledge base year—and 2040. Also note that because the National Energy Modeling System EIA uses is an equilibrium model, trends in output data tend to approach the Reference case the closer they get to the end year (in this case, 2040).

For consistency, all dollar figures have been converted into chained 2015 dollars. Also, all carbon dioxide emissions are from fossil fuel combustion only. These emissions, however, make up about three-quarters of U.S. total gross greenhouse gas emissions, so they represent a good indicator of the direction of overall emission trends.

Carbon Dioxide Emissions

Under its Industrial Efficiency High Incentive case, EIA forecasts that total U.S. energy-related power sector carbon dioxide emissions would plunge 21% below the No CPP Reference case level in 2025 and by 2040 would be 28% lower, significantly lower compared to the No CPP Reference case. In 2040, emissions would reach 3.9 gigatons[vii] from 5.4 gigatons in 2018, a drop of about 1.5 gigatons. Across the entire 23-year period, cumulative emissions reduction add up to 27.5 gigatons of carbon dioxide.

The Obama Administration uses 2005 emissions as the base year for its Copenhagen and Paris pledges. When compared to a 2005 baseline, emissions would be 30% lower in 2025—largely consistent with the administration's Paris goal—and 35% lower in 2040. To meet the 80% long-

term reduction goal, therefore, would require an additional drop in annual emissions of 2.7 gigatons between 2040 and 2050, an extremely unlikely proposition.

The vast majority of the cumulative cuts in emissions—about 24.4 gigatons, or 89%—come from the power sector. EIA's side case projection indicates that by 2025, carbon dioxide emissions from the power sector would be 63% below 2005 emissions and by 2040 76% below. In contrast to the big hit taken by power sector emissions, total industrial emissions (minus emissions from purchased electricity) over the period account for just a bit more that 4% of total emissions reductions.[viii]

Clearly, then, the power sector is much more sensitive to a price on carbon than the industrial sector. Moreover, it is fair to conclude that the carbon price would have to be substantially higher than the one EIA used in its side case if the goal is to get a cut of 80% in total net GHG emissions by 2050.

It is also true that the energy-related emissions cuts achieved in EIA's CPP and carbon price side case are still quite deep. So how does EIA see these emissions reductions being achieved? By practically eliminating coal from power production and replacing that lost electricity with renewable power.

By 2025, electricity generation from coal plummets to 76% below, and by 2040 almost 95% below, the No CPP Reference case—for all intents and purposed eliminating an entire industry (something, it should be noted, no Congress has ever authorized). Despite a sharp and short-lived rise in natural gas demand in the power sector, which peak at 21% more in 2022, natural gas demand across the entire economy remains little changed in EIA's Industrial Efficiency High Incentive side case.[ix]

Remarkably, nuclear generation shows no increase in output until 2038. Renewable generation rises sharply, however. Compared to the No CFPP Reference case, generation from these sources (which includes hydropower) is 58% greater in 2025 and 77% greater in 2040. By 2040, renewables provide about 48% of all power available to the grid.

Economic Costs

So how much would it cost to reduce emissions to the levels in EIA's Industrial Efficiency High Incentive case?

EIA data show that cutting emissions so rapidly and deeply would entail enormous costs, both in total and in a relation to each ton of carbon dioxide reduced. From 2018 to 2040, the *rate* of GDP growth under EIA's carbon price slows by about 2.2% compared to the No CPP Reference case, from an annual rate of 2.17% to 2.13%. This may seem like a small change,[x] but when maintained over 23 years, it leads to a cumulative loss in GDP of roughly $5.3 *trillion*.[xi]

Annual GDP losses range from $34 billion in 2018 to almost $359 billion in 2023 (Figure 1). The average GDP hit over the 2018 to 2040 period is an astonishing $231 billion each year.

Using the differences in GDP and carbon-dioxide for the two scenarios, we calculated the average real economic cost for

Figure 1. Annual Change in GDP Under CPP/Carbon Price Scenario: 2018-2040

each ton of emission reduction, which turns out to be considerably more than the carbon price levied by EIA in its side case. Over the 23-year period, the average economic cost per ton of carbon dioxide reduced comes to an extraordinarily high $193 per ton, with a low of $137 in 2018 and $366 in 2022.
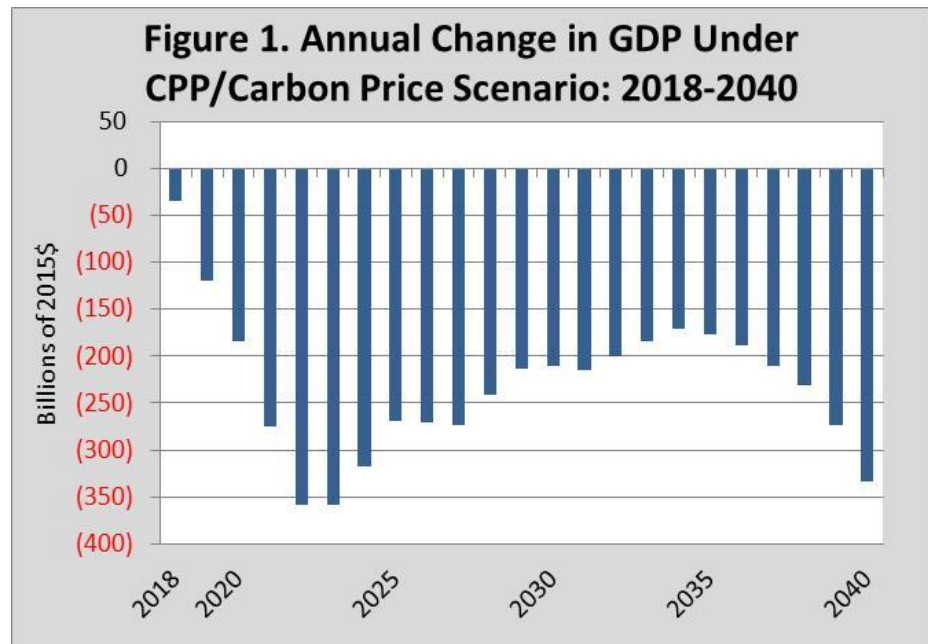
Social Cost of Carbon

It is argued by the Obama Administration, however, that the value of the carbon dioxide emission reductions, as measured by the "Social Cost of Carbon" (SCC), would turn even GDP losses such as these into gains. The SCC represents an attempt to measure the health, property, agricultural, ecosystem, and other presumed impacts of emitting a ton of carbon dioxide.

Because greenhouse gases are well mixed in the atmosphere, the impacts of carbon dioxide emissions are considered to be global in nature (unlike air pollutants, whose impacts largely are local). This means that any climate costs or benefits would be felt primarily outside of the United States.

Whether it is even possible to measure the SCC with any precision remains a matter of controversy,[xii] and the closed process by which the SCC estimates were developed by the administration's Interagency Working Group on Social Cost of Carbon left a lot to be desired.

Nevertheless, for the purposes of this analysis we have set aside our justifiable doubts about SCC's value as an analytical tool and assumed that the Interagency Working Group's[xiii] central SCC estimates (using a 3% discount rate[xiv]) are accurate. Given this assumption, are the claimed SCC benefits are large enough to offset the economic losses EIA forecasts? No.

To produce a *net* climate change benefit, the SCC benefits from emission reductions must be greater than the economic cost. But as Figure 2 shows, the annual economic cost per ton of carbon dioxide (blue bars) consistently is much greater than the comparable annual Global SCC estimate (red bars). Whereas the average GDP cost is $193 per ton, the average Global SCC benefit is, at $58, about 3.3 times smaller, leaving a net average GDP cost of $135 per ton reduction.

Overall, the total cumulative cost is reduced from $5.3 trillion to $3.7 trillion. This works out to an average loss in GDP of $162 billion each year to 2040.

Most of the claimed climate benefits from decreasing emissions, however, would occur beyond U.S. borders, which means that the SCC benefits claimed for the United States must be smaller than those claimed globally. Although the Interagency Working Group tasked with developing the SCC hesitated to create a "domestic SCC," for reasons that are not entirely clear, it admitted that the domestic SCC would be a small fraction of the Global SCC, concluding:

> *[W]ith a 2.5 or 3 percent discount rate, the U.S. benefit is about 7-10 percent of the global benefit, on average, across the scenarios analyzed. Alternatively, if the fraction of GDP lost due to climate change is assumed to be similar across countries, the domestic benefit would be proportional to the U.S. share of global GDP.*[xv]

The green bars in Figure 2 indicate what the Global SCC looks like after it has been adjusted using the GDP-share method described above, clearly is more charitable option. To calculate the U.S. share of global GDP, the Department of Agriculture Economic Research Service's International Macro- economic Data Set was used, with the 2025 to 2030 trend extended out to 2040.[xvi]

As the table shows, the GDP-share method yields an average Domestic SCC of $12 per ton, ranging from about $10 to $13 per ton of carbon dioxide reduced over period from 2018 to 2040. So for each ton of carbon dioxide reduced in the United States, the average economic cost is nearly 17

Figure 2. Annual Economic Cost and SCC Under CPP/Carbon Price Scenario: 2018-2040
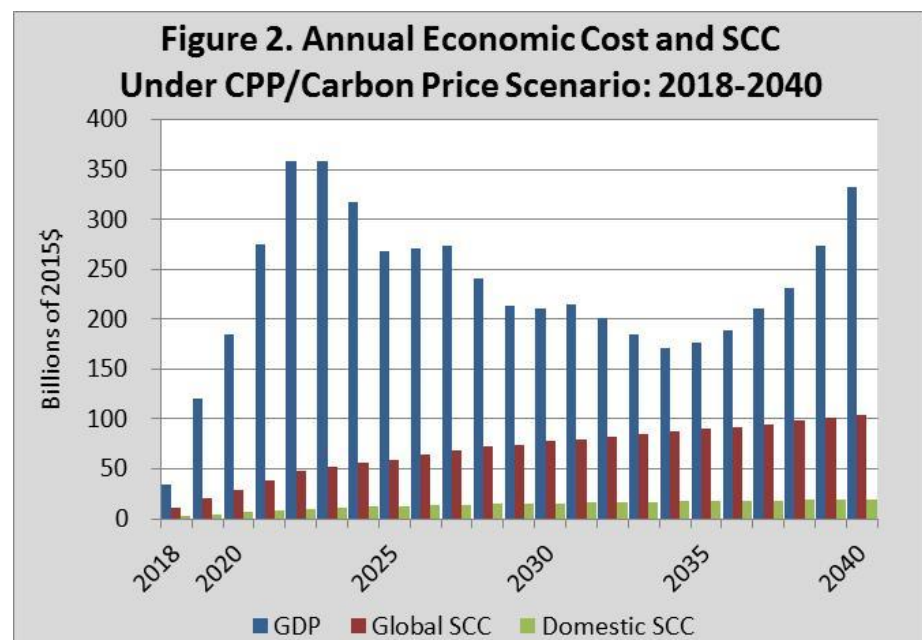
times greater than the domestic societal benefit.

Applying the Domestic SCC to revise the cost and benefit estimates calculated earlier, the cumulative net economic loss of $5.3 trillion is reduced slightly to $5.0 trillion for an average loss in GDP of $217 billion per year and an average emission reduction cost of $182 per ton of carbon dioxide.

To repeat, we believe the extravagant SCC estimates the administration has developed are not credible and should not be used in regulatory analysis. It is perhaps more telling, then, that even when using the administration's own SCC values and methods, the combination of CPP and a carbon price fails, and fails badly, as a climate change policy.

Co-Benefits

In it regulatory analysis of CPP, EPA placed an inordinate emphasis on the monetized ancillary benefits of pollution reduction to justify its rule. Again, we will leave aside the debate on how accurate the estimates of these benefits really are and accept the values EPA used in its Regulatory Impact Analysis[xvii] for the proposed and final CPP rule as a way to estimate the monetized value of the co-benefits that might result under the carbon price modeled by EIA.

EPA provides a low and a high "benefit per ton" estimate for a range of pollutants in 2020, 2025, and 2030 based on EPA's own air-quality modeling. For the purposes of this analysis, we used the midrange of the high and low estimates at the 3% discount. Interpolation was used to calculate per ton co-benefits for the intervening years from 2018 to 2029. We assume that the per ton benefits EPA uses to monetize co-benefits continue to rise at the 2025 to 2030 rate when calculating monetized per-ton co-benefits for the years 2031 to 2040.

This is an extraordinarily generous assumption considering that EPA already regulates these pollutants within an adequate margin of safety.

These estimates were used to calculate total co-benefits for these three years using the difference in pollution emission output data between the two EIA model runs. These estimates were added to the Global and Domestic SCC values to derive total annual benefit figures for 2018 to 2040 that could be set against the GDP losses. The results are presented in Figure 3.

The addition of even generous co-benefits to the SCC estimates is not enough to outweigh the GDP losses linked to CPP. We figure that total GDP losses over the period from 2018 to 2040 amount to $2.1 trillion ($76 per ton of carbon dioxide) when ancillary benefits are combined with a Global SCC and $3.4 trillion ($76 per ton of carbon dioxide) when ancillary benefits are combined with a Domestic SCC.[xviii]

Figure 3. Annual Cost and Estimated Benefit Under CPP/Carbon Price Scenario: 2018-2040
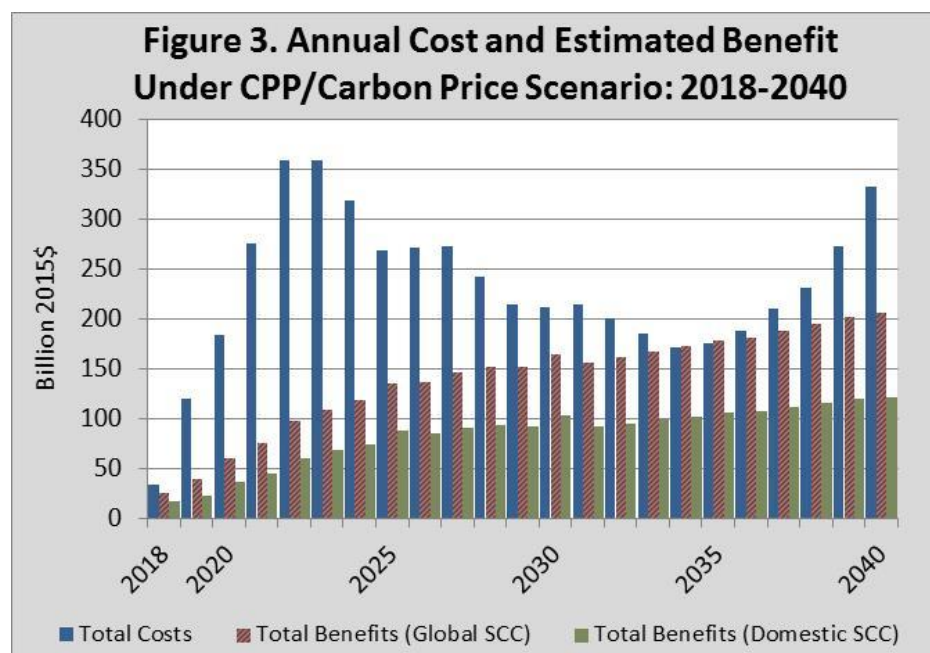
The results of this exercise suggest strongly that the policy suite examined here is a large economic loser. It should also be noted that these estimates do not include any of the negative health and other social impacts of slower economic growth and greater unemployment. If anything, the net costs are almost certainly larger than estimated here.

Other Impacts

The GDP losses described above reflect in part the large ripple effects of higher energy costs. Some of these impacts, measured as the difference between EIA's No CPP Reference case and its Industrial Efficiency High Incentive case are described below.

Employment

Figure 4 illustrations how non-farm employment would plunge under a large carbon price. By 2023, there would be nearly 1.4 million fewer jobs (233,000 of which would be lost just in manufacturing.

While jobs recover somewhat in the

Figure 4. Annual Change in Employment Under CPP/Carbon Price Scenario: 2018-2040
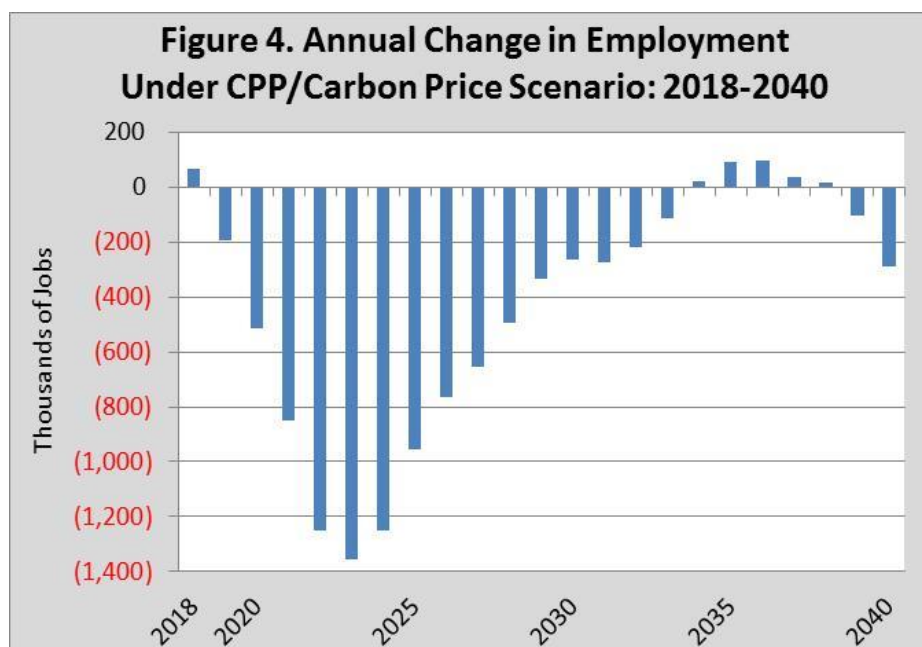
2030s, by 2040 they are again trending lower than in the No CPP Reference case. Indeed, of the nearly 20 *AEO2016* side cases, the Industrial Efficiency High Incentive case shows the largest and most persistent job losses.[xix]

Electricity Prices and Expenditures

We have noted elsewhere how the administration has boasted that while its CPP may increase the *price* consumers pay for electricity, electricity *bills* would decrease because of lower demand driven by energy efficiency. So while you might be paying a higher rate, you would be consuming less and, because of that, paying less.

In an earlier report assessing the economic impacts of the CPP,[xx] we showed that EIA data indicated that both the price people pay for electricity *and* their bills would both rise under CPP. In the carbon price side case examined here, we find the same thing—higher prices and bills.

Electricity prices skyrocket in the Industrial Efficiency High Incentive, soaring 19% above the No CPP Reference case by 2025 and 24% above by 2040. Industrial users are on the receiving end of the largest increases, with prices jumping 25% higher by 2025 and reaching 32% higher by 2040, but percentage price rises in double-digits hit all economic sectors (Table 1).

Table 1. Increases in Electricity Rates and Electricity Expenditures Under CPP/Carbon Price Scenario

Sector	Percent Change in:		Billion 2015$ from 2018 to:	
	2025	2040	2025	2040
U.S. Total	18.9	24.1	350	1,199
Residential	16.2	20.4	136	433
Commercial	18.1	24.3	127	426
Industrial	25.1	32.0	85	327
Transportation	16.6	22.1	2	13

Source: EIA Annual Energy Outlook 2016.

These sharp price increases completely overwhelm the declines in sales brought on by greater efficiency and less economic activity, leaving consumers with much bigger electricity bills. EIA's forecast indicates that consumers across all economic sectors see their electricity expenditures leap 12% higher in 2025 and 14% higher in 2040 (Table 1). Over the 23-year period being examined here, that converts in an additional $1.2 trillion more being spent for electricity compared to the No CPP Reference case, an entirely needless drain on families—especially low- and fixed-income families—and businesses.

As Table 2 shows, the price increases vary widely among Census regions,[xxi] reflecting in part the regional variation of energy resources used to generate power. Moreover, some regions already have very high electricity prices (the Pacific region, for example) so the percentage increase may look more modest compared to the percentage increase in another region (the West South Central region, for example) that has relatively low electricity prices. Regions that

Table 2. Regional Increases in Electricity Prices Under CPP/Carbon Price Scenario		
Census Region	Percent Change in:	
	2025	2040
U.S.	18.9	24.1
New England	14.6	19.3
Middle Atlantic	13.6	20.6
East North Central	22.7	31.7
West North Central	18.9	24.1
South Atlantic	19.1	20.2
East South Central	25.7	24.0
West South Central	22.3	34.7
Mountain	22.5	22.8
Pacific	7.1	9.6

Source: EIA Annual Energy Outlook 2016.

today use a lot of coal, hydropower, and increasingly natural gas to produce electricity tend to have lower electricity rates than other regions.

The regions that would be expected to suffer the highest increases in electricity prices include the industrial and energy-producing areas of the West South Central region (Arkansas, Louisiana, Oklahoma, and Texas) and East North Central region (Illinois, Indiana, Michigan, Ohio, and Wisconsin). Nevertheless, no part of the country escapes a significant increase in the price of electricity.

Fuel Prices

Not unexpectedly, the price for common fuels also would jump sharply in a carbon price regime (Table 3). Similar to what we saw for electricity, consumer *bills* for fuels would be higher, too, as lower demand would not be enough to offset the rising costs, leaving consumers facing both higher costs and higher expenditures.

As one would expect, the price of coal jumps the highest under a carbon price and by 2040 is almost four times higher (289%) than without the price on carbon, while the price of metallurgical coal doubles. All other fuels except E85, a blend of 15% gasoline/85% ethanol, experience at least double-digit percent increases compared to the No CPP References Case.
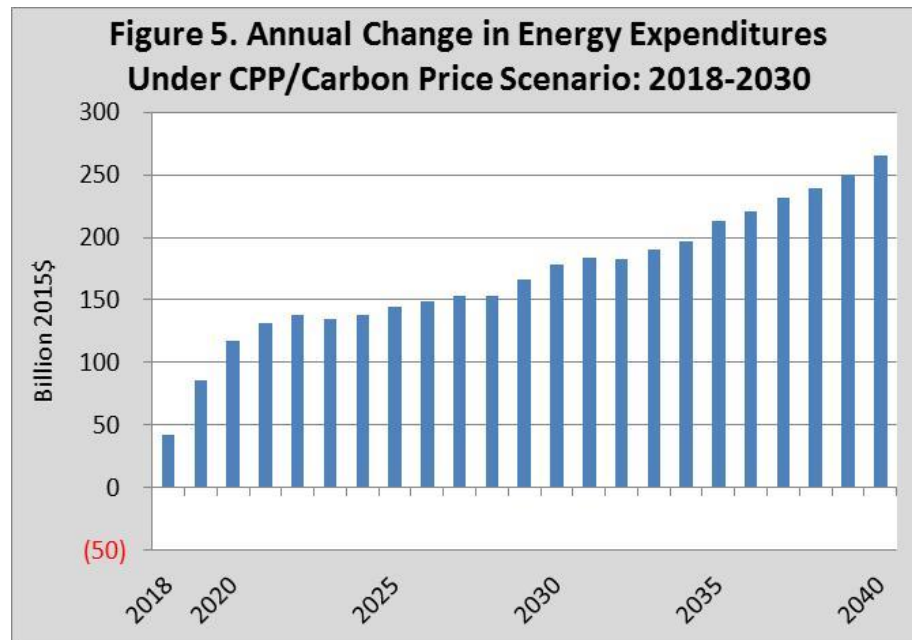
Energy Expenditures

EIA *AEO* model runs also produce estimates of non-renewable energy expenditures.[xxii] As you would expect, the relative changes in this metric are on a

Table 3. Increases in Energy Prices Under CPP/Carbon Price Scenario		
Fuel	Percent Change in:	
	2025	2040
Propane	12.0	22.1
E85	4.9	8.2
Motor Gasoline	11.1	17.3
Jet Fuel	14.9	21.9
Distillate Fuel Oil	11.1	18.4
Residual Fuel Oil	21.9	30.9
Natural Gas	30.0	56.7
Metallurgical Coal	56.5	106.0
Other Coal	152.9	288.9
Electricity	18.9	24.1

Source: EIA Annual Energy Outlook 2016.

Figure 5. Annual Change in Energy Expenditures Under CPP/Carbon Price Scenario: 2018-2030

similar scale to those for electricity. Energy expenditures are estimated to be 11% more in 2025, rising to 16% more 2040 with the CPP and carbon price. As a result, consumers would be expected to pay an average of $170 billion more each year (Figure 5), totaling from 2018 to 2040 a total additional expense of $3.9 trillion.[xxiii]

As a result of slower growth and higher energy expenditures, the amount of GDP devoted to energy in 2040 ticks up from 5.3% in the No CPP Reference case to 6.2% in the Industrial Efficiency High Incentive case.

Disposable Income

Higher energy prices and bills will a strain on tighter budgets under the carbon price in the Industrial Efficiency High Incentive side case. When compared to the No CPP Reference case, this scenario results in nearly $3.4 trillion less disposable income over the 2018 to 2040 period.

From $30 billion more disposable income in 2018, this metric quickly heads into negative territory in 2020 and declines steadily thereafter to a $271 billion loss in 2040 (Figure 6).

Over the entire 23-year period, the decline in disposable income averages out to about $148 billion

Figure 6. Annual Change in Real DPI Under CPP/Carbon Price Scenario: 2018-2030
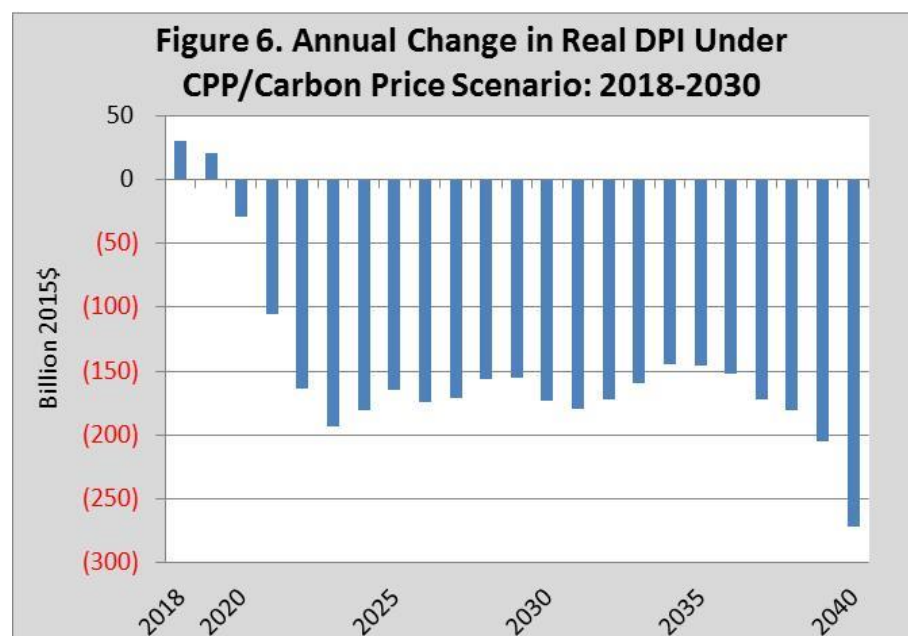
a year, or about 0.77%, lower. Like higher energy prices, less disposable income will have a disproportionate impact on poor households and those on fixed incomes.

Service Sector and Industrial Output

Higher energy costs also crimp service sector and industrial production, which EIA measures as "value of shipments." This is another example, like GDP and disposable income, where a seemingly small relative change can mask very large impacts.

Service sector shipments, for example, average about 1.0% lower in the Industrial Efficiency High Incentive case versus the No CPP Reference case from 2018 to 2040. The cumulative loss, however, is very large ($7.5 trillion), as is the average annual loss ($328 billion) (Table 4).

Sector	Billion 2015$			
	Annual Average from 2018 to:		Cumulative Total from 2018 to:	
	2025	2040	2025	2040
Total Shipments	(565)	(514)	(4,523)	(11,821)
Service Sector	(353)	(328)	(2,824)	(7,548)
Ag, Mining & Construction	(35)	(41)	(279)	(947)
Manufacturing:	(178)	(145)	(1,420)	(3,326)
Energy-Intensive	(78)	(89)	(625)	(2,045)
Other	(99)	(56)	(796)	(1,281)

Table 4. Changes in Value of Shipments Under CPP/Carbon Price Scenario

Source: EIA Annual Energy Outlook 2016.

The industrial sector, too, experiences large losses in the value of shipments under EIA's carbon tax scenario, with an average decline of 1.9% ($186 billion) per year. This amounts to nearly 4.3 trillion in cumulative losses. Not unexpectedly, energy–intensive manufacturing takes the hardest relative hit. This sector's shipments would be expected to be 4.2% lower on average each year with a total drop in shipments of $2.0 trillion.

Conclusion

EIA's side case forecast runs provide insightful perspectives on the how the economy, particularly the energy economy, will react to particular policy choices.

Given all of the EIA-generated data detailed above, it is hard to conclude other than that a climate policy that includes CPP in combination with a hefty price on carbon will lead to trillions of dollars less economic growth, hundreds of thousands fewer jobs, much higher energy prices and expenditures, trillions of dollars less disposable income, and trillions of dollars less industrial output. As sobering as it to consider these results, it should be pointed out that the suite of policies examined here does not even come close to the Obama Administration's lofty mid-century emissions goal of an 80% reduction from 2005 levels. These impacts, therefore, should be considered a partial down payment only.

Indeed, should the policies similar to those in EIA's Industrial Efficiency High Incentive scenario be implemented, it is very likely that many of the problems we know see in Europe related to high energy prices will manifest themselves here.

Keep in mind that these policies would be put in place at a time when the United States has a tremendous energy advantage over our competitors. America's energy revolution has given U.S. businesses a critical leg up in today's intensely competitive global economy. American industry pays two to four times less for natural gas, coal, and electricity than many of its global competitors, a difference that is helping to drive a U.S. manufacturing revival.

Contrast that with Europe, where regulatory structures—including the Emissions Trading System, taxes, user fees, large subsidies, and mandates—all conspire to make the continent's electricity prices among the highest in the world. Exorbitant energy prices are harming its energy-intensive industries. More and more, we are seeing European companies closing up shop and fleeing to other countries, including the United States, with lower energy costs. If U.S. energy is similarly taxed, the same thing can happen here.

An argument can be made that the United States is a rich country and can afford these costs, which in the case of GDP amount to a fraction of a percentage point difference in growth. But these small margins lead to huge losses. We noted above how lowering the *rate* of economic growth over the 2018 to 2040 period by just 2% translates into a cumulative loss in GDP of $5.3 trillion.

Are we that wealthy that we can afford to throw $5.3 trillion away? The federal government takes roughly 20% of GDP in revenue, which means that over the 23 year period examined here it would be sacrificing nearly $1 trillion under a climate policy consistent with EIA's side case examined here—this at a time when the U.S. government has unfunded liabilities in the tens of trillion of dollars and budget deficits in the hundreds of billions of dollars.

One point that has little to do with climate change but says a great deal about the new post-recession economy created by the Obama Administration: Typically, the deeper the recession, the more robust the recovery. But the economy under President Obama has been anything but typical, with regulations smothering incentives to invest and grow, and the most sluggish economic recovery ever.

The *New York Times* recently reported that, "The Obama administration in its first seven years finalized 560 major regulations—those classified by the Congressional Budget Office as having particularly significant economic or social impacts [*e.g.*, like CPP]. That was nearly 50 percent more than the George W. Bush administration during the comparable period . . ."[xxiv] Is it any wonder the economy continues to expand at an anemic rate?

Back in 2007, before the Great Recession, EIA's *AEO2007* forecast had an annual GDP growth rate of 2.9% in its reference base case. That is a faster rate of growth than the 2.8% annual rate EIA used in its *AEO2016* "High Economic Growth" scenario. So what was thought a few years ago to be ordinary economic growth is now considered extraordinary.

Small differences in growth rates can lead to vastly different economic outcomes. Consider that EIA's *AEO2016* No CPP Reference case has an annual GDP growth rate of 2.2% and its High Economic Growth Case has a rate of 2.8%. The difference in cumulative GDP between the two out to 2040 is greater than $60 trillion.

We have said all along that at its most fundamental level, reducing GHG emissions is a technology challenge. Instead of raising the costs of traditional sources of energy, we would be better served by working to lower the cost of alternate technologies. Unless and until that happens, traditional fuels will continue to capture the lion's share of global energy demand. The shale revolution should serve as an example of a simple truth: When business finds a new technology that works better than an existing technology, it will use it.

Innovation, however, ultimately depends on a robust economy. As the results of EIA's *AEO2016* demonstrate, we cannot tax and regulate our way to lower emissions and expect higher growth, more jobs, and lower energy prices.

Endnotes

[i] Includes biofuels.

[ii] Intended Nationally Determined Contribution of the United States of America. Available at: http://www4.unfccc.int/submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf.

[iii] See for example:
- Institute for 21st Century Energy. 2015. "Mind the Gap: The Obama Administration's International Climate Pledge Doesn't Add Up." Available at: http://www.energyxxi.org/mind-gap-obama-administrations-international-climate-pledge-doesnt-add.
- D. Bookbinder. 2015 *Testimony of David Bookbinder before the Senate Environment and Public Works Committee*. Available at: http://www.epw.senate.gov/public/_cache/files/96e1aded-05af-485a-9e23-544f82e0f4bc/bookbinder.pdf.

[iv] This letter of association is available at: http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/unitedstatescphaccord_app.1.pdf.

[v] *Second Biennial Report of the United States of America Under the United Nations Framework Convention on Climate Change*. 2016. U.S. Department of State. Available at:

http://unfccc.int/files/national_reports/biennial_reports_and_iar/submitted_biennial_reports/application/pdf/2016_second_biennial_report_of_the_united_states_.pdf.

vi Energy Information Administration. 2016. *Annual Energy Outlook 2016*. Available at: http://www.eia.gov/forecasts/aeo/.

vii A gigaton equals 1 billion metric tons.

viii These figures do not include emissions from industrial processes.

ix From about 2020 on, natural gas used in other sectors of the economy remains down about 4% compared to the No CPP Reference case, which explains why total natural gas demand does not fluctuate as much as demand in the power sector vis-à-vis the Reference case.

x The difference between these two GDP growth figures to three decimal places is -0.047 percentage points.

xi The cumulative cost to 2025, the administration's Paris pledge year, is $1.9 trillion, an annual average of $240 billion.

xii Even the sign of the SCC could change depending on the assumptions used. See for example: Dayaratna, K. *et al.* 2016. "Empirically-Constrained Climate Sensitivity and the Social Cost of Carbon". *Social Science Research Network*. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2759505.

xiii Interagency Working Group on Social Cost of Carbon, United States Government. 2015. *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*. [May 2013, Revised July 2015]. Available at: https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf.

xiv The Working Group also generated a range of estimates using discount rates of 2.5%, and 5%.

xv Interagency Working Group on Social Cost of Carbon, United States Government. 2010. *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*. Available at: https://www3.epa.gov/otaq/climate/regulations/scc-tsd.pdf.

xvi Available at: http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx.

xvii EPA. 2015. *Regulatory Impact Analysis for the Clean Power Plan Final Rule*. Available at: https://www.epa.gov/sites/production/files/2015-08/documents/cpp-final-rule-ria.pdf.

xviii These results use the administration's central SCC estimate at the 3% discount rate and EPA's midrange estimate of ancillary benefits estimates also using a 3% discount rate. As noted earlier, the Interagency Working Group on the SCC developed other SCC estimates using different discount rates and that EPA had low and high estimates of co-benefits at the 3% discount rate. We combined these (both Global and Domestic) with the low, mid, and high co-benefit estimates developed by EPA. The only cases where benefits exceed costs in when the wildly high worst case 3%/95th percentile Global SCC estimates were used.

xix Labor productivity also improves at a slightly lower rate in the Industrial Efficiency High Incentive case versus the No CPP Reference case.

xx *EPA Clean Power Plan: EIA's Forecast Shows Benefits Fall Well Short of Costs...Again*. 2016. U.S. Chamber of Commerce Institute for 21st Century Energy. Available at: http://www.energyxxi.org/epa-clean-power-plan-eia%E2%80%99s-forecast-shows-benefits-fall-well-short-costsagain.

xxi The nine Census regional divisions are defined as:
- New England: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.
- Middle Atlantic: New Jersey, New York, and Pennsylvania.
- East North Central: Illinois, Indiana, Michigan, Ohio, and Wisconsin.
- West North Central: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota.
- South Atlantic: Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia.
- East South Central: Alabama, Kentucky, Mississippi, and Tennessee.
- West South Central: Arkansas, Louisiana, Oklahoma, and Texas.
- Mountain: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming.
- Pacific: Alaska, California, Hawaii, Oregon, and Washington.

xxii EIA's expenditure figures do include biofuels.

xxiii Note that this figure and the electricity expenditure figure cited earlier cannot be added together because of some significant overlap.

[xxiv] B. Applebaum and N.D. Shear. 2016. "Once Skeptical of Executive Power, Obama Has Come to Embrace It." *New York Times*. Available at: http://www.nytimes.com/2016/08/14/us/politics/obama-era-legacy-regulation.html?hp&action=click&pgtype=Homepage&clickSource=story-heading&module=first-column-region&region=top-news&WT.nav=top-news&_r=0.