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THE ECONOMIC, FISCAL, AND EMISSIONS IMPACTS OF A REVENUE-NEUTRAL CARBON TAX

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Table of Contents

Executive Summary

Alliance for Market Solutions ("AMS") engaged FTI Consulting, Inc. ("FTI") to examine the impact of a revenue-neutral carbon tax on the U.S. economy at the federal, state, and industry levels. This report considers the impact of a carbon tax on the federal budget, U.S. and state economies, carbon dioxide emissions, and major industries from 2019 through 2028 (the "study period") in two cases: (1) a status quo Base Case, and (2) a Carbon Tax Case.

The carbon tax and tax reform policies considered in this report have the following features:

- A tax of $20 per metric ton of carbon dioxide starting in 2019 at the point of extraction or import ("upstream") and increasing five percent per year in real terms, allowing costs to be passed down to end-use customers;
- Adjustments for energy-intensive, trade-exposed ("EITE") industries, mostly in manufacturing;
- Tax reform measures, including the extension of certain individual and family tax provisions in the Tax Cuts and Jobs Act of 2017 ("TCJA") from 2026 through 2028;
- The extension of numerous other expiring federal tax provisions through 2028; and,
- Delaying the implementation of certain tax increases under the Patient Protection and Affordable Care Act of 2010 ("ACA") through 2028.

The carbon tax and associated tax reform measures would result in both positive and negative changes to the economy and energy sector. For instance, under the Carbon Tax Case, higher fossil fuel prices would incentivize investments in renewable power while negatively affecting the coal and petroleum industries and their supply chains.

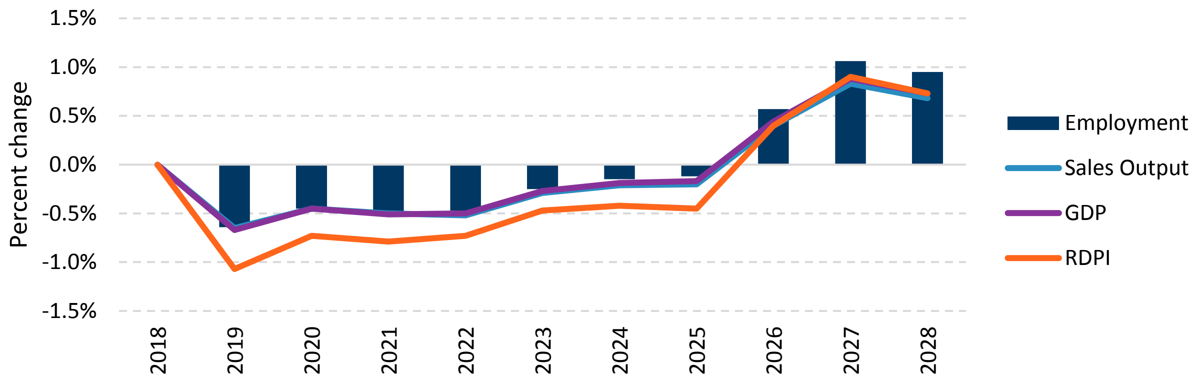
FTI used the combination of the PLEXOS electricity model, the Carbon Tax Assessment Model ("CTAM"), and the Regional Economic Models, Inc. ("REMI") macroeconomic model in this analysis. First, FTI employed PLEXOS to model the electricity sector. FTI utilized CTAM to calculate the emissions, federal tax revenues, and the change in various fossil energy prices for residential, commercial, industrial, and transportation consumers. Finally, FTI used the results from PLEXOS and CTAM as inputs into the REMI model to simulate the economic impact of the carbon tax and tax reforms, including EITE rebates, capital investments in the power generation sector, and demand for fossil fuel inputs. ES Figure 1 below shows the fiscal impact of the carbon tax by comparing the results from the Base and Carbon Tax Cases.

ES Figure 1: Fiscal Impact of Carbon Tax and Tax Reform Measures (2016 $ billions)

CATEGORY	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2019-2028
Carbon tax revenue	$93	$94	$96	$98	$100	$103	$104	$106	$109	$111	$1,013
EITE credits	($9)	($9)	($9)	($9)	($10)	($10)	($10)	($10)	($11)	($11)	($98)
Net revenues	$85	$85	$87	$88	$90	$93	$94	$95	$98	$100	$915
Extend TCJA tax cuts	-	-	-	-	-	-	-	($95)	($155)	($159)	($410)
Extend expiring provisions	($12)	($12)	($13)	($13)	($14)	($14)	($15)	($15)	($15)	($15)	($137)
Delay ACA taxes	($15)	($31)	($32)	($33)	($43)	($46)	($50)	($42)	($42)	($42)	($378)
Tax reform total	($27)	($43)	($45)	($46)	($57)	($61)	($64)	($152)	($212)	($217)	($924)
Net fiscal impact	$57	$42	$42	$42	$33	$32	$29	($57)	($114)	($116)	($9)

Designed to be revenue-neutral, the carbon tax would generate $1 trillion in federal revenue during the study period. After accounting for $98 billion in EITE rebates and $924 billion to fund tax reform, the Carbon Tax Case would add $9 billion to the federal deficit, or less than 0.1 percent of federal revenue, during the study period. The timing of the tax measures (i.e., the years in which the revenue from the carbon tax is used to fund the TCJA and other extensions) would strongly influence the chronology of the Carbon Tax Case's economic impact, shown in ES Figure 2 below.

ES Figure 2: Economic Impact of Revenue-Neutral Carbon Tax (Carbon Tax Case vs. Base Case)



For the first seven years of the study period (i.e., 2019 to 2025), the impact of the carbon tax on the U.S. economy would be slightly negative because the policy would extract net revenues from the economy (i.e., decrease the federal deficit) and higher fossil energy prices would negatively affect energy consumers. By 2026, once the carbon tax begins to fund the TCJA and other extensions, the economic impact of the carbon tax would become positive because it would return after-tax income to households, increasing real disposable personal income ("RDPI"). According to employment, sales output, gross domestic product ("GDP"), and RDPI, the impact of the Carbon Tax Case would be small compared to the total size and scale of the U.S. economy. Most notably, the impact for each of these macroeconomic indicators would be within 1.1 and -1.1 percent, though usually within 0.5 percent, in either direction from the Base Case.

The carbon tax would raise the cost of fossil fuel as an input, which would change the power generation mixture in the short term, the types of plants built and retired in the long term, and electricity prices for utility customers. The power sector would be the most responsive to the carbon tax, followed by industrial sector consumers, while the residential, commercial, and transportation sectors would be relatively inelastic. Our analysis shows the Carbon Tax Case would reduce emissions by 13 percent during the study period compared to Base Case levels, shown below in ES Figure 3.

ES Figure 3: Reduction of Emissions from Carbon Tax (millions of metric tons)

RESULT	REDUCTION	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2019-2028
Total	**Absolute**	257	414	511	620	701	769	912	999	1,052	1,136	7,371
Total	**Percentage**	5%	8%	10%	12%	14%	15%	18%	20%	21%	23%	13%
Non-Power	**Absolute**	38	72	111	153	198	248	302	359	421	487	2,389
Non-Power	**Percentage**	1%	2%	3%	4%	6%	7%	9%	11%	12%	14%	6%
Power	**Absolute**	219	342	400	467	503	521	610	640	631	649	4,982
Power	**Percentage**	13%	21%	25%	29%	32%	33%	39%	41%	41%	43%	28%

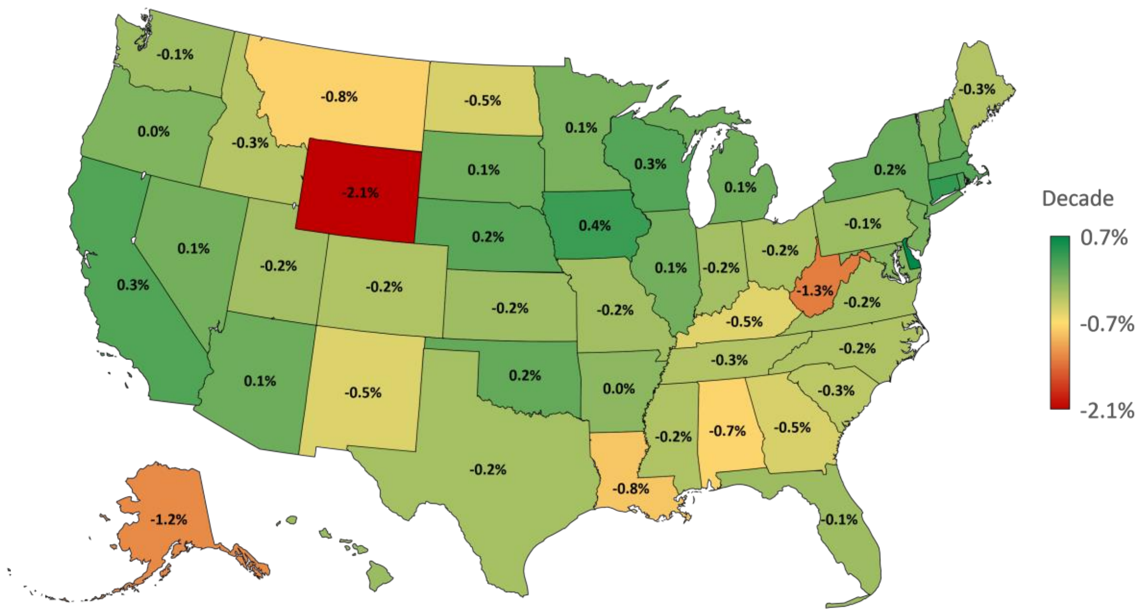
In addition to the emissions in ES Figure 3, FTI's PLEXOS model reported power plant additions, retirements, and electricity prices. Under the Carbon Tax Case, the U.S. power sector would shift more toward wind, solar, and new natural gas plants and away from coal, fuel oil, and older gas plants. Our analysis shows the U.S. power sector would add 94 gigawatts ("GW") of wind and solar capacity, add 55 GW of new gas capacity, and retire 56 GW of coal, fuel oil, and older gas plants in the Carbon Tax Case compared to the Base Case.

Electricity prices would increase under the Carbon Tax Case because plant owners and operators would pay more for fossil fuel and pass higher fuel costs down to customers, though the magnitude of this effect would vary regionally. For example, in 2028, retail residential electricity prices on the West Coast and throughout the Great Plains would rise only a few percent due to substantial hydroelectric and wind resources in those regions. However, in 2028, retail residential prices for the Ohio

Valley, Southeast, and Southern Rockies would rise by as much as 10 to 15 percent due to low renewable resource penetration and higher regional reliance on coal and natural gas plants.

Different resource endowments across the U.S. (such as states' wind, solar, gas, and coal resources; the energy intensity of different states' industries; and the average amount and type of federal taxes paid by households) would help determine each state's relative sensitivities to the carbon tax and associated tax reform. ES Figure 4 below shows the aggregate net effect of the Carbon Tax Case on state GDP during the study period.

ES Figure 4: Impact to State GDP (Aggregate, 2019-2028)



CT	0.5%
DC	0.0%
DE	0.7%
HI	-0.1%
MA	0.3%
MD	0.0%
NH	0.2%
NJ	0.0%
RI	0.3%
VT	0.0%

States with significant wind resources, such as Iowa and Oklahoma, and states with households paying an above average amount of federal taxes on a per capita basis, such as states on the East Coast and California, would experience a higher state GDP under the Carbon Tax Case. While Texas maintains both substantial wind resources and high-tax households, it would experience a negative impact on state GDP due to its midstream and downstream petroleum activities. In addition, states paying less in federal taxes on a per capita basis, such as New Mexico, as well as states with a large fossil fuel presence, such as Wyoming, West Virginia, and Alaska, would experience an adverse effect on GDP.

ES Figure 5 shows the largest positive and negative GDP impacts by industry. Many of the tax reform measures would directly or indirectly lower the cost of insurance and healthcare, which would increase demand and lower costs for these industries and aid states such as Delaware and Iowa. While a fossil fuel, the gas industry would benefit under the Carbon Tax Case due to the net increase in gas capacity. Thus, the construction sector would benefit from increased capital expenditures in power generation for new plants, including renewable resources, and supporting infrastructure.

ES Figure 5: Impact to GDP Contribution by Industry (Aggregate, 2019-2028, 2016 $ billions)

Largest Increase in Aggregate GDP

1. $263 billion – Finance and Insurance
2. $14 billion – Healthcare and Social Assistance
3. $10 billion – Oil and Natural Gas Extraction
4. $9 billion – Construction

Largest Decrease in Aggregate GDP

1. -$84 billion – Utilities
2. -$83 billion – Mining (including Coal)
3. -$43 billion – State and Local Government
4. -$35 billion – Retail

In conclusion, the fiscal impact of the Carbon Tax Case would be revenue-neutral and have a negligible impact on the U.S. economy. Most of the economic benefits of the revenue-neutral carbon tax policy align with the extension of the TCJA tax cuts, which do not expire until 2025, and coincide with positive impacts in 2026, 2027, and 2028. Emissions under the Carbon Tax Case would decline sizably, mostly because of a shift toward renewables and new gas facilities and away from coal and older gas plants in the power sector. The distribution of economic changes resulting from the Carbon Tax Case would not be equal across the U.S., because there are disproportionate impacts for certain states and industries.

Introduction

This report examines the impact of a nationwide, revenue-neutral carbon tax. It considers the impact of the tax on federal revenue, the economy, carbon dioxide emissions, and the power sector at the national, state, and industry levels – including the District of Columbia ("DC") – from 2019 to 2028. To maintain revenue neutrality, this study uses the revenues generated from the carbon tax to fund the extension of various tax cuts, primarily under the TCJA;[1] delay the expiration of other federal tax provisions; and postpone the implementation certain tax increases under the ACA.[2]

While some carbon tax studies consider implementing a fee on emissions "downstream" near the point of combustion, this analysis applies the carbon tax upstream at the point of extraction or import. This carbon tax policy would increase the cost of fossil fuels, which would encourage consumers to reduce the carbon-intensive consumption of these fuels and make renewable energy more competitive in power generation and end-use consumption.[3]

On December 19, 2017, Congress passed the TCJA, which changed the federal tax code for individuals and corporations.[4] The TCJA lowered tax rates for individuals and families in every bracket and doubled the standard deduction. In addition, the TCJA lowered corporate income taxes, dropping the top marginal rate from 35 percent to 21 percent, and shifted the U.S. to using more of a territorial tax system for income earned by U.S. corporations overseas.[5]

Since passing the TCJA, President Donald Trump and others, such as Congressman Kevin Brady (R-TX), chairman of the House Committee on Ways & Means, have called for "Phase 2" of the legislation to minimize its effect on the federal deficit and to resolve expiring provisions, particularly for individual and family taxpayers.[6] While speculative, this reform could include making the individual tax cuts permanent, because these provisions currently expire at the end of 2025; lowering the capital gains tax rate; and/or other measures to offset lost revenues from the TCJA tax cuts.[7]

One possibility for new revenues, described in this report, would be to use the revenues from a carbon tax to extend the tax cuts under the TCJA for individuals and families, delay the expiration of other provisions, and fund the delay in various tax increases passed under the ACA that have not yet become effective.

To consider the impact of a carbon tax, FTI integrated the capabilities of the following three energy and macroeconomic forecasting tools, which analyze the effects of policy changes on the economy.

1. **PLEXOS**[8] – *a capacity-expansion model of the North American electrical grid, including all power plants and describing the constraints of the power grid, such as additions, retirements, and reserve margins*

[1] "H.R. 1, the Tax Cuts and Jobs Act," *Congressional Budget Office*, 13 November 2017, https://www.cbo.gov/publication/53312
[2] "Affordable Care Act," *Congressional Budget Office*, https://www.cbo.gov/topics/health-care/affordable-care-act
[3] "What is a carbon tax," *Carbon Tax Center*, https://www.carbontax.org/whats-a-carbon-tax/
[4] Siobhan Hughes, "Sweeping Tax Bill Heads to Trump But Uncertain When He Will Sign," 20 December 2017, *Wall Street Journal*, https://www.wsj.com/articles/sweeping-tax-bill-heads-to-trump-for-his-signature-1513792578
[5] "Preliminary Details and Analysis of the Tax Cuts and Jobs Act," *Tax Foundation*, 18 December 2017, https://taxfoundation.org/final-tax-cuts-and-jobs-act-details-analysis/
[6] Naomi Jagoda, "GOP pushes for 'phase two' of tax cuts," *The Hill*, 18 March 2018, http://thehill.com/policy/finance/378861-gop-pushes-for-phase-two-of-tax-cuts
[7] Bob Bryan, "Here's how the newly passed GOP tax bill will impact the economy, businesses, the deficit, and your wallet," *Business Insider*, 20 December 2017, http://www.businessinsider.com/trump-gop-tax-reform-bill-impact-economy-business-debt-income-2017-12
[8] "PLEXOS Integrated Energy Model," *Energy Exemplar*, https://energyexemplar.com/software/plexos-desktop-edition/

2. **CTAM**[9] – *a model that describes emissions from non-power sources, such as motor gasoline and heating fuels, with data from the Annual Energy Outlook ("AEO")*[10] *and consumer responses to higher fossil energy prices*
3. **REMI**[11] – *a detailed model of the U.S. economy and 51 regions (the 50 states plus DC) with 70 economic sectors, their households, demographics, and their reactions to exogenous policy shocks*

Using these three models in tandem allowed FTI to capture the multifaceted nexus between the U.S. economy and energy sector. Specifically, FTI used these models to study the impacts of a carbon tax from 2019 to 2028 under two cases: (1) a Base Case, which represents the status quo without a carbon tax and includes all current laws and regulations, and (2) a Carbon Tax Case, which reflects the implementation of a carbon tax and uses the tax's revenue to offset the cost of extending the tax cuts described above and delaying the implementation of certain tax increases through 2028.

Policy Design

Carbon Tax

For this study, we considered the impact of a tax starting in 2019 at $20 per metric ton of carbon dioxide on the implied CO_2 content of extracted fossil fuels increasing by five percent each year in real terms.[12] By 2028, the carbon tax would reach $37.93 in nominal dollars (or $29.62 in 2016 dollars). The implementation of the tax would be at extraction or import, which allows for the most straightforward tracking of taxes owed and engages the fewest legal entities.[13]

Applying the tax at the point of extraction or import would allow fuel suppliers to pass the cost of the tax down directly to consumers. For example, a coal mine would pass the cost on to a coal plant, which would eventually pass its higher costs down to end-use electricity consumers. The utility would face higher wholesale prices and, thus, raise retail rates borne by its customers. In these ways, the upstream tax eventually becomes a part of the regular basket of energy prices faced by residential, commercial, industrial, and transportation consumers throughout the economy.

The U.S. government would receive the proceeds from the carbon tax as a source of federal revenue. For this study, we considered a revenue-neutral tax where the federal government would then use these proceeds to offset the extension of expiring individual provisions under the TCJA, to extend the sunsetting of several expiring provisions through 2028,[14] and to delay the implementation of certain ACA tax increases. Prior to distributing carbon tax revenues for tax purposes, the policy design would remit some of the proceeds to EITE industries as tax credits, rebates, or direct payments to protect these industries' competitiveness and mitigate leakages, further described below.

Adjustments for Energy-Intensive, Trade-Exposed Industries

Applying the tax at the point of extraction or import would raise fossil fuel prices downstream, and this policy design would provide tax rebates and credits for EITE industries.[15] The purpose of providing rebates to these industries is twofold: (1) it would help U.S. industry, particularly heavy and bulk manufacturers, maintain cost competitiveness; and (2) it would help discourage the relocation of emissions-intensive industries overseas.

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[9] "Carbon Tax Assessment Model (CTAM)," *Washington Department of Commerce (WA DOC)*, http://www.commerce.wa.gov/growing-the-economy/energy/washington-state-energy-office/carbon-tax/

[10] "Annual Energy Outlook 2018," *U.S. Energy Information Administration*, 6 February 2018, https://www.eia.gov/outlooks/aeo/

[11] "Model Equations," *Regional Economic Models, Inc.*, http://www.remi.com/wp-content/uploads/2017/10/Model-Equations-v2_1.pdf

[12] PLEXOS, CTAM, and REMI all rely on 2016 dollars. Thus, for modeling purposes, we began the tax at $19.10 per metric ton (in 2016 dollars) in 2019 based on the REMI projection of the consumer price index. For instance, $19.10 in 2016 dollars is equivalent to $20 in 2019 dollars.

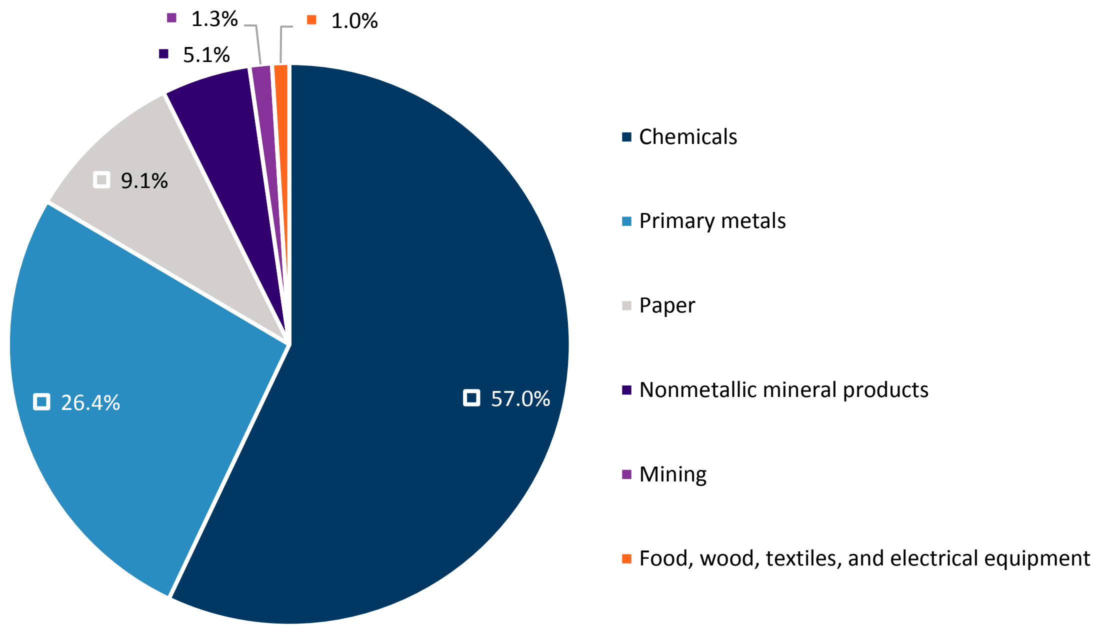
[13] John Horowitz, Julie-Anne Cronin, Hannah Hawkins, Laura Konda, and Alex Yuskavage, "Methodology for Analyzing a Carbon Tax," *U.S. Department of the Treasury – Office of Tax Analysis*, January 2017, https://www.treasury.gov/resource-center/tax-policy/tax-analysis/Documents/WP-115.pdf

[14] The ACA included several tax increases, such as a tax on medical deficits, health insurance providers, and investment returns. Congress has "patched," or delayed, the actual implementation of many of these taxes several times. The policy considered herein would extend many of these delays through 2028.

[15] "Energy-Intensive, Trade-Exposed Industries," *American Council for an Energy Efficient Economy*, https://aceee.org/topics/energy-intensive-trade-exposed-industries

For this study, we defined EITE industries using federal standards and allocated rebates proportionally based on industry size and emissions levels.[16] Figure 1 below shows the distribution of adjustments nationally and by the major industries. The manufacturers of bulk products, such as chemical manufacturers, primary metal manufacturers,[17] paper manufacturers, and nonmetallic mineral products, would receive the majority of the EITE tax rebates. Our analysis shows chemical manufacturers would claim 57 percent of the EITE rebates, followed by 26.4 percent for primary metal manufacturers, 9.1 percent for paper manufacturers, and the remaining 7.5 percent for all other EITE sectors.

Figure 1: Percentage of EITE Tax Rebates by Major Manufacturing Sector



Extension of certain expiring TCJA provisions

The TCJA allows most U.S. families to pay less in taxes,[18] though most of its provisions for individual taxpayers and families expire at the end of 2025.[19] Congress set these provisions to expire in 2025 to comply with procedural rules under the reconciliation process regarding the maximum allowable amount of money added to the federal deficit. Sunsetting the individual provisions after 2025 allowed the TCJA to comply with these requirements.[20]

As mentioned above, the policy design considered in this study would extend the TCJA's individual provisions through 2028 using revenue from the carbon tax. Table 11-1 from the "Federal Receipts" chapter of a Government Accountability Office report provides the fiscal cost of funding these extensions, which we used as inputs into our analysis.[21] We also considered

[16] "The Effects of H.R. 2454 on International Competitiveness and Emissions Leakage in Energy-Intensive Trade-Exposed Industries: An Interagency Report Responding to a Request from Senators Bayh, Specter, Stabenow, McCaskill, and Brown," *U.S. Environmental Protection Agency*, 2 December 2009, https://www.epa.gov/sites/production/files/2016-07/documents/interagencyreport_competitiveness-emissionleakage.pdf
[17] Including steel, aluminum, and copper
[18] Adam Pearce, Quoctrung Bui, Ben Casselman, and Blacki Migliozzi, "Tax Bill Calculator: Will Your Taxes Go Up or Down," *New York Times*, 17 December 2017, https://www.nytimes.com/interactive/2017/12/17/upshot/tax-calculator.html
[19] Heather Long, "The final GOP tax bill is complete, here's what is in it," *Washington Post*, 15 December 2017, https://www.washingtonpost.com/news/wonk/wp/2017/12/15/the-final-gop-tax-bill-is-complete-heres-what-is-in-it/?utm_term=.f9cc3d8a733e
[20] Bob Bryan, "Here's why Senate Republicans are making tax cuts for average Americans temporary," *Business Insider*, 15 November 2017, http://www.businessinsider.com/trump-gop-tax-plan-senate-bill-why-individual-tax-cuts-temporary-2017-11
[21] "Federal Receipts," *Government Accountability Office*, https://www.whitehouse.gov/wp-content/uploads/2018/02/ap_11_receipts-fy2019.pdf

the carbon tax and associated tax reforms during the study period (i.e., 2019 to 2028), which is the same timeframe used by the Congressional Budget Office ("CBO") for its fiscal and economic impact analyses.

Expiring provisions extended through 2028

Congress routinely delays the sunsetting of a few dozen "expiring provisions" each year, which represent tax reductions or certain tax credits that would expire without Congressional action. These provisions are diverse, ranging from tax credits for education and the hiring of disadvantaged minorities, to tax credits for consumer debt, modified depreciation on specific types of capital investments, energy-related tax credits, and delays on implementing certain excise and import taxes. The Joint Committee on Taxation ("JCT") releases a full list of the expiring tax provisions each year.[22]

The policy design would use revenues to further extend some of these expiring provisions. Table 1 lists the provisions funded by the carbon tax in this study using the abbreviations and numbers taken from the JCT report entitled *Estimated Budget Effects of the Revenue Provisions Contained in the Bipartisan Budget Act of 2018*.[23] Table 1 shows the reference letter and number from JCT, and the accompanying footnotes show the full names of the expiring provisions.

Table 1: Expiring Provisions (2019-2028) Included

CATEGORY	PROVISIONS
Extension of expiring provisions	A1 – A3,[24] B1 – B12,[25] C1 – C17,[26] D1[27]
Miscellaneous provisions	1[28]

Delaying certain ACA tax increases

To fund the ACA, which became effective in 2014, the legislation included tax increases. Many of the increases have not been implemented because of recurrent postponements by Congress. Three of these taxes include:

1. The "Cadillac tax"[29] on low-deductible, high-cost health insurance plans, which currently has a delay through the end of 2022 but would otherwise take effect in 2023.
2. The "medical device tax" on manufacturers and importers of certain medical equipment. This tax has a marginal rate of 2.3 percent and would currently take effect in 2020 without Congressional action.

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[22] "JCX-1-18," *Joint Committee on Taxation*, 9 January 2018, https://www.jct.gov/publications.html?func=startdown&id=5057
[23] "JCX-4-18," *Joint Committee on Taxation*, 8 February 2018, https://www.jct.gov/publications.html?func=startdown&id=5061
[24] "Extension of exclusion from gross income of discharge of indebtedness on qualified principal residence indebtedness; Extension of mortgage insurance premiums treated as qualified residence interest; Extension of above-the-line deduction for qualified tuition and related expenses"
[25] "Extension of Indian employment tax credit; Extension of railroad track maintenance credit; Extension of mine rescue team training credit; Extension of classification of certain race horses as 3-year property; Extension of 7-year recovery period for motorsports entertainment complexes; Extension of accelerated depreciation for business property on an Indian reservation; Extension of election to expense mine safety equipment; Extension of special expensing rules for certain film, television, and live theatrical productions; Extension of deduction allowable with respect to income attributable to domestic production activities in Puerto Rico; Extension of special rate for certain timber gain; Extension of empowerment zone tax incentives; Extension of American Samoa economic development credit"
[26] "Extension of credit for section 25C nonbusiness energy property; Extension and modification of credit for residential energy efficient property; Extension of alternative motor vehicle credit for qualified fuel cell motor vehicles; Extension of credit for alternative fuel vehicle refueling property; Extension of credit for two-wheeled plug-in electric vehicles; Extension of second generation biofuel producer credit; Extension of biodiesel and renewable diesel incentives - extend present-law income tax credits, excise tax credit, and outlay payments; Extension of production credit for Indian coal facilities; Extension of beginning-of-construction date for non-wind renewable power facilities eligible to claim the electricity production credit or investment credit in lieu of the production credit; Extension of credit for construction of energy-efficient new homes; Extension and phaseout of the section 48 energy investment tax credit; Five-year cost recovery for certain energy property; Extension of special depreciation allowance for second generation biofuel plant property; Extension of energy efficient commercial buildings deduction; Extension of special rule for sales or dispositions to implement Federal Energy Regulatory Commission ("FERC") or State electric restructuring policy for qualified electric utilities; Extension of excise tax credits and outlay payments for alternative fuel, and excise tax credits for alternative fuel mixtures; Extension of Oil Spill Liability Trust Fund financing rate"
[27] "Modifications of credit for production from DOE & advanced nuclear power facilities"
[28] "Extension of temporary increase in limit on cover over of rum excise tax revenues (from $10.50 to $13.25 per proof gallon) to Puerto Rico and the Virgin Islands"
[29] "Cadillac Tax," *Cigna*, https://www.cigna.com/health-care-reform/cadillac-tax

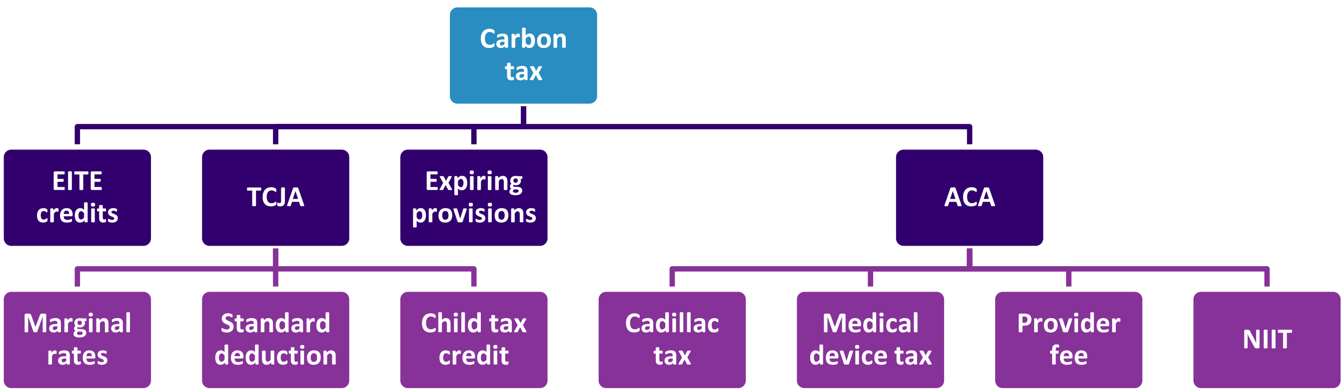
3. An annual fee for health insurance providers (also referred to as the "provider fee"), which is delayed through 2019 and would otherwise begin in 2020 under current law.

Other ACA revenue measures have gone into effect since the legislation's enactment, such as the net investment income tax ("NIIT"). The NIIT became effective on January 1, 2013, and affects individuals, estates, and trusts. The NIIT now collects a 3.8 percent tax on certain net investment income for groups with incomes above statutory amounts.[30]

In addition to extending the TCJA and other expiring provisions, the policy design studied under the Carbon Tax Case would defer the implementation of the Cadillac tax, medical device tax, and provider fee through 2028, and reverse the NIIT through from 2019 through 2028. The JCT studied the impact these measures when Congress considered the repeal or modification of the ACA in 2017 and early 2018, and we used the JCT's revenue estimates as inputs into our analysis.[31]

Figure 2 below depicts the policy design, which includes the carbon tax (including the EITE adjustments), extending the TCJA individual provisions, extending other expiring provisions, and delaying the ACA tax increases.

Figure 2: Carbon Tax and Tax Reform Measures



By design, revenue from the carbon tax (as shown at the top of Figure *2* above in light blue) would almost completely offset the cost of the EITE rebates and various tax reform measures (in the second two rows).

Methodology and Approach

Major Assumptions and Inputs

As inputs into the PLEXOS-CTAM-REMI linked models, FTI relied on the following assumptions and sources.

- **Existing law/no other changes** – While modeling the carbon tax and fiscal reform, we assumed no other policy changes in the U.S. at the state or federal level, such as a state modifying its renewable portfolio standard ("RPS") or federal changes in the Corporate Average Fleet Economy regulations.
- **AB32 and RGGI auction prices** – We assumed the carbon tax causes the auction prices in California under AB32 and in the Northeast and Mid-Atlantic for RGGI to fall to their price floors from 2019 forward.
- **JCT scores** – We used JCT estimates of the fiscal value of the tax measures discussed above, such as extending the delay on the Cadillac tax through 2028, to calculate the fiscal impact of the carbon tax.

[30] "Questions and Answers on the Net Investment Income Tax," *Internal Revenue Service (IRS)*, https://www.irs.gov/newsroom/net-investment-income-tax-faqs
[31] "JCX-27-17," *Joint Committee on Taxation*, 24 May 2017, https://www.jct.gov/publications.html?func=startdown&id=5000

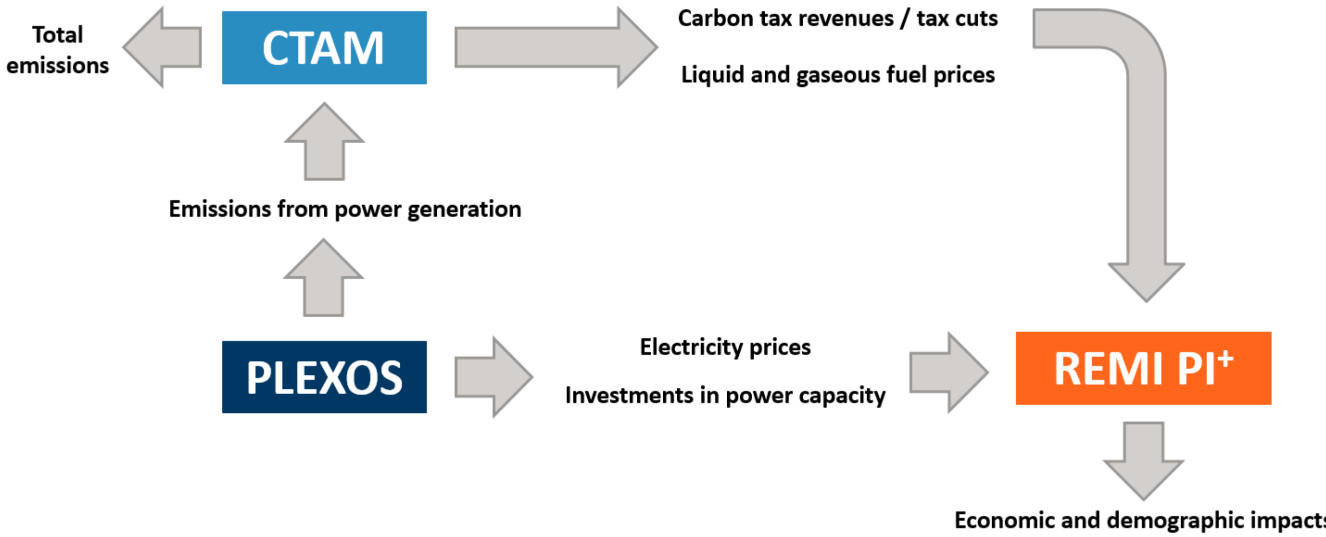
- **REMI Standard National Control and Standard Regional Controls –** For regional economic data, we used REMI control forecasts. REMI derives its calibration data[32] from public sources, such as the Bureau of Economic Analysis, Bureau of Labor Statistics, state demographers, and the U.S. Census Bureau.
- **REMI Price Index Data** – All inputs and results are in 2016 dollars. Where necessary, we converted inputs and results to 2016 dollars using price index data from the REMI Standard National Control.
- **REMI Elasticities** – REMI has default price elasticities,[33] which we also used in CTAM for consistency to calculate the effect that higher energy prices would have on demand for energy from fossil fuels.
- **REMI CGE Settings** – We did not modify any of the REMI computable general equilibrium ("CGE") model settings.
- **Distributional analysis** – We examined the distribution between states and industries but not income strata.
- **AEO 2018 Reference Case** – Produced by the Energy Information Administration ("EIA"), the AEO 2018 Reference Case provided long-term projections of energy consumption and prices for CTAM and natural gas prices for PLEXOS. We constructed our Base Case using data from the AEO 2018 Reference Case.
- **Electric vehicles** – We assumed the carbon tax would not substantially accelerate the AEO 2018 Reference Case's projection for electric vehicle adoption, which is seven percent of new sales in 2025,[34] enough to significantly influence gasoline demand or electricity load through 2028 and the end of our study period.
- **Regional and state emissions** – We used regional energy consumption data from the AEO 2018 Reference Case to produce state level data in combination with data from the EIA's State Energy Data System ("SEDS").[35] We used the SEDS data to map EIA regional forecasts down to the state level.
- **Emissions factors** – The Environmental Protection Agency ("EPA") provides the carbon emissions factors for various sources, including stationary (e.g., power plants) and mobile (e.g., cars and trucks) sources, which we used as inputs in CTAM to convert energy demand into carbon dioxide emissions.[36]
- **ABB's Ventyx Velocity Suite[37]** – We obtained information on electrical power generators and load through Ventyx.
- **Capital costs** – We used the EIA report entitled *Capital Cost Estimates for Utility Scale Electricity Generating Plants* from November 2016 to inform the capital cost of new plants as an input in PLEXOS.[38]

Modeling Platforms

To assess the economic impact of a carbon tax on federal revenues, economic growth, job creation, carbon dioxide emissions, and the power sector at the national and state levels, we used a combination of three energy market and economic models (namely PLEXOS, CTAM, and REMI). Their various linkages are in Figure 3 below.

[32] "Data Sources and Estimation Procedures," *Regional Economic Models, Inc.*, http://www.remi.com/wp-content/uploads/2017/10/Data-Sources-and-Estimation-Procedures-v2_1.pdf
[33] "Consumption Equation Estimation PI+ v. 1.7," *Regional Economic Models, Inc.*, July 2014, http://www.remi.com/wp-content/uploads/2017/10/Consumption_Equation_Estimation_v1.7.pdf
[34] "Annual Energy Outlook 2018 with projections to 2050," *Energy Information Administration*, 6 February 2018, https://www.eia.gov/outlooks/aeo/pdf/AEO2018.pdf
[35] "About SEDS," *U.S. Energy Information Administration*, https://www.eia.gov/state/seds/
[36] "Emissions Factors for Greenhouse Gas Inventories," *U.S. Environmental Protection Agency*, 4 April 2014, https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf
[37] "ABB Ability Velocity Suite," *ABB*, http://new.abb.com/enterprise-software/energy-portfolio-management/market-intelligence-services/velocity-suite
[38] "Capital Cost Estimates for Utility Scale Electricity Generating Plants," *U.S. Energy Information Administration (EIA)*, https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capcost_assumption.pdf

Figure 3: PLEXOS, CTAM, and REMI Integration



Using these linked models, FTI produced two cases: (1) the Base Case, which assumes current policy holds with no carbon tax or changes to TCJA, the expiring provisions, or the ACA taxes; and (2) the Carbon Tax Case, which incorporates the revenue-neutral carbon tax and associated tax reform measures. To describe the process:

1. **PLEXOS** represents every electrical generating unit in North America plus regional transmission constraints and incorporates gas prices from the AEO 2018 Reference Case. PLEXOS reflects the status quo for the electricity sector with plants, transmission lines, and federal and state policies, such as RPS requirements. In the short run, PLEXOS changes how power plants bid because of higher coal, gas, and oil fuel input costs. In the long run, PLEXOS adds and retires plants. For this analysis, we used PLEXOS results to replace the default electricity sector in CTAM; provide capacity changes by technology nationally, regionally, and by state; model demand for coal, gas, and oil fuel inputs for generation; and modeled wholesale electricity prices. We converted the PLEXOS-generated wholesale electricity prices to retail electricity prices using historical relationships between the same.[39]
    a. For the **Base Case**, we used PLEXOS generation data, load forecasts, and fuel prices from publicly available sources, in addition to other inputs, to solve for the least-cost solution to meet electricity needs. This least-cost case included any planned plant additions or retirements.
    b. For the **Carbon Tax Case**, we used the same information as the Base Case but also incorporated revised energy prices, which included the carbon tax, from CTAM. These prices informed the input costs for power plants, which influenced wholesale prices, dispatch competition, and capital expenditures. We then used PLEXOS to solve for the least-cost solution.
2. **CTAM** calculates emissions based on AEO energy demand and EPA emissions factors for the Base Case. For the Carbon Tax Case, FTI incorporated the new energy prices reflecting the carbon tax and REMI price elasticities to see how demand changes once price rise. This new demand creates a new forecast of emissions for gaseous and liquid fuels, mostly in residential, commercial, industrial, and transportation sectors, and determines revenues from the

[39] "Table 5.6.A. Average Price of Electricity to Ultimate Customers by End-Use Sector," *U.S. Energy Information Administration*, 23 March 2018,https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a

carbon tax. The default CTAM model is for the state of Washington;[40] FTI updated and expanded CTAM to include all states and fuels for both the Base and Carbon Tax Cases.

3. **REMI** is a dynamic, CGE model of the U.S. economy and its regions, in this case states.[41] Regions in the REMI model are endogenous concepts and all have their own unique industries, consumption patterns, spatial relationships with their neighbors, and energy sectors. For example, a state such as Kansas, with so much of its population and economy on the Missouri border, responds differently to labor market shocks compared to Utah, which has no major metropolitan areas on its borders. The REMI model includes state and regional labor markets, product markets, demographics, and industry competitiveness nationally and internationally.
    a. From PLEXOS, REMI takes data on plant openings, retirements, fuel demand, and electricity prices.
    b. From CTAM, REMI utilizes data on changing prices for non-electric fossil energy and EITE credits.
    c. We used REMI to model the impact of the tax cuts for individuals, institutions, and businesses.
    d. REMI then shows the economic impacts, by state and industry, to employment, sales output, GDP, and RDPI, along with other supporting economic and demographic metrics.

Summary of Results

This section presents results for the Base and Carbon Tax Cases. As mentioned, the Base Case forecasts the economy, emissions, and power sector from 2019 to 2028 based on the status quo (i.e., no carbon tax) while the Carbon Tax Case considers the tax revenues, U.S. economy, emissions, and power sector under the carbon tax and tax reform measures. We adjusted monetary outputs to reflect 2016 dollars to remove any inflation considerations.[42]

Fiscal Impacts

Figure 4 below shows how the carbon tax would increase by five percent in real terms each year and how associated revenue generated by the tax would also increase during the study period. As shown, revenue from the carbon tax would begin in 2019 at $93 billion and increase to $111 billion in 2028 as the tax rate increases.

[40] "Carbon Tax Assessment Model (CTAM)," *Washington Department of Commerce (WA DOC)*, http://www.commerce.wa.gov/growing-the-economy/energy/washington-state-energy-office/carbon-tax/

[41] George Treyz, Dan Rickman, and Gang Shao, "The REMI Economic-Demographic Forecasting and Simulation Model," *International Regional Science Review*, 1 December 1991, http://journals.sagepub.com/doi/abs/10.1177/016001769201400301

[42] State-by-state impact analysis available upon request

Figure 4: Annual Carbon Tax Rate and Carbon Tax Revenues

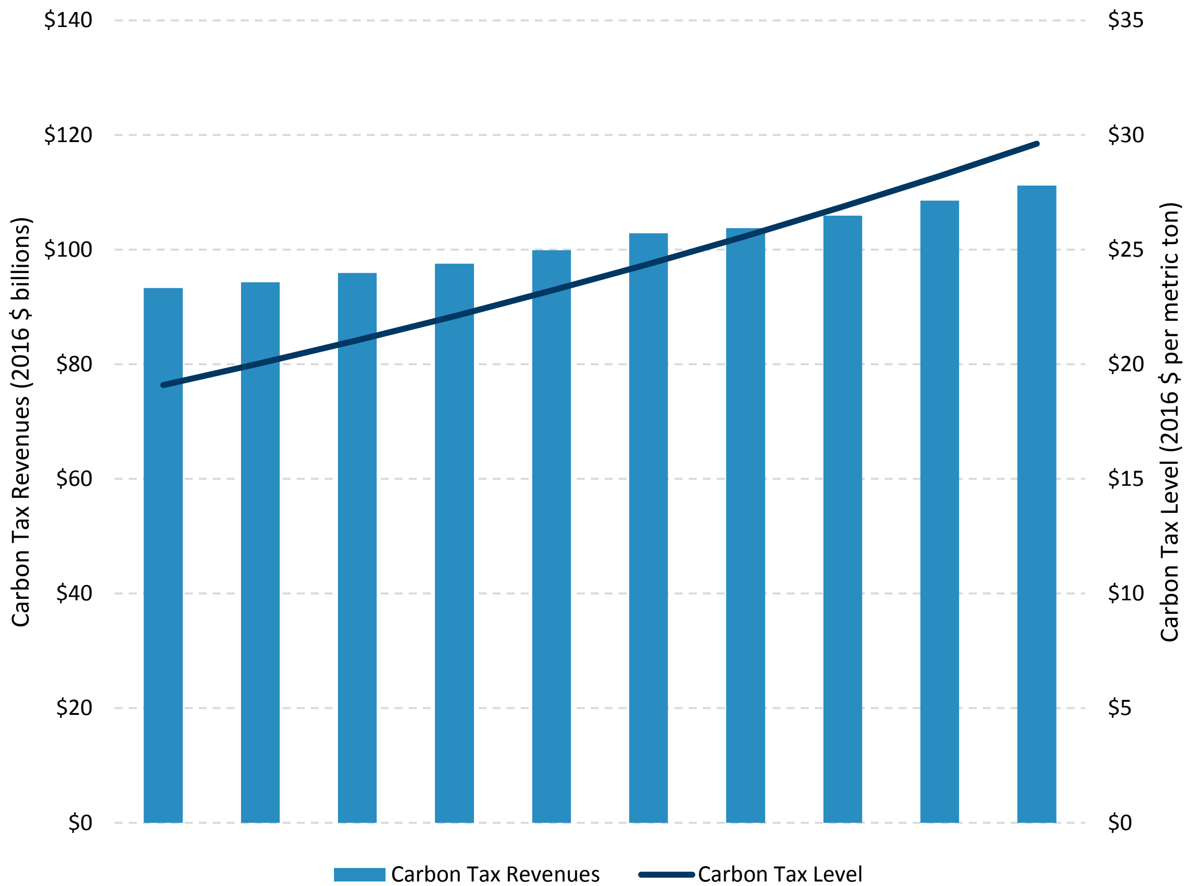


Table 2 below shows the overall tabulation of carbon tax revenues (i.e., the numbers as in Figure 4), adjustments for EITE industries, and the tax reform measures funded by carbon tax revenue related to TCJA and ACA. In line with CBO and JCT conventions, positive numbers indicate increased federal revenue (which *reduces* the federal deficit) and negative numbers indicate a liability against the federal budget (which *increases* the federal deficit). The bottom row shows the net impact of the carbon tax and use of its revenues to fund tax reform, which would have an aggregate net effect of a $9 billion liability (or increase in the federal deficit) during the study period, explained below.

Table 2: Fiscal Impact of Carbon Tax and Tax Reform Measures (2016 $ billions)

CATEGORY[43]	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2019-2028
Carbon tax revenue	$93	$94	$96	$98	$100	$103	$104	$106	$109	$111	$1,013
EITE credits[44]	($9)	($9)	($9)	($9)	($10)	($10)	($10)	($10)	($11)	($11)	($98)
Net revenues	$85	$85	$87	$88	$90	$93	$94	$95	$98	$100	$915
Extend TCJA tax cuts[45]	-	-	-	-	-	-	-	($95)	($155)	($159)	($410)
Extend expiring provisions[46]	($12)	($12)	($13)	($13)	($14)	($14)	($15)	($15)	($15)	($15)	($137)
Delay ACA taxes[47]	($15)	($31)	($32)	($33)	($43)	($46)	($50)	($42)	($42)	($42)	($378)
Tax reform total	($27)	($43)	($45)	($46)	($57)	($61)	($64)	($152)	($212)	($217)	($924)
Net fiscal impact	$57	$42	$42	$42	$33	$32	$29	($57)	($114)	($116)	($9)

Funding for extending expiring tax provisions and delaying the implementation of ACA taxes would remain stable during the study period. Extending TCJA individual provisions would have the largest effect on net revenue, which would begin in 2026 after the provisions expire, and they would have a substantial impact in 2027 and 2028.

The final row in Table 2 shows the fiscal impact of the carbon tax and tax reform in terms of their effect on the federal deficit in that year. The Carbon Tax Case would generate net revenue (i.e., decrease the federal deficit) from 2019 through 2025, but would have the opposite effect (i.e., increase the federal deficit) between 2026 and 2028. This occurs because of the timing (i.e., after 2025) and size of extending the TCJA individual provisions through 2028. Thus, the impact on the federal budget would be effectively neutral. Specifically, the Carbon Tax Case's aggregate fiscal impact during the study period would be a $9 billion increase in the federal debt, which would be less than 0.1 percent of 2017 GDP or approximately 0.1 percent of the over $1 trillion in total revenue generated by the carbon tax during the study period.

Economic Impacts

This section describes and compares the impact of the carbon tax on the U.S. economy, including employment, GDP, RDPI,[48] and sales output in the Base and Carbon Tax Cases. The impact of the Carbon Tax Case when compared to the Base Case would be negative from 2019 to 2025 because the policy "banks" (i.e., creates a federal surplus) revenue while the economy adjusts to higher fossil energy prices. Once the carbon tax revenue begins to fund the TCJA extensions, however, the impact of the Carbon Tax Case would become positive from 2026 to 2028. Thus, the positive economic impacts associated with this revenue-neutral carbon tax would align closely with the timing of the extension of the TCJA tax cuts.

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[43] All numbers are in 2016 dollars converted used the REMI consumer price index. Where JCT data ran out before 2028, we assumed constants in real terms from last data year.
[44] "The Effects of H.R. 2454 on International Competitiveness and Emissions Leakage in Energy-Intensive Trade-Exposed Industries: An Interagency Report Responding to a Request from Senators Bayh, Specter, Stabenow, McCaskill, and Brown," *U.S. Environmental Protection Agency*, 2 December 2009, https://www.epa.gov/sites/production/files/2016-07/documents/interagencyreport_competitiveness-emissionleakage.pdf
[45] "Federal Receipts," *Government Accountability Office (GAO)*, https://www.whitehouse.gov/wp-content/uploads/2018/02/ap_11_receipts-fy2019.pdf
[46] "JCX-4-18," *Joint Committee on Taxation*, 8 February 2018, https://www.jct.gov/publications.html?func=startdown&id=5061
[47] "JCX-27-17," *Joint Committee on Taxation*, 24 May 2017, https://www.jct.gov/publications.html?func=startdown&id=5000
[48] In REMI, RDPI equals net household income, including income from all sources, the cash-equivalent value of benefits, minus taxes, and adjusted for changing consumer prices.

Figure 5 shows the impact of the carbon tax and associated tax reform on U.S. employment, sales output, GDP, and RDPI by comparing the Carbon Tax Case to the Base Case. All metrics would initially decline due to the timing of the reform measures, as described above, and then surge in the last three years with the TCJA extensions online. As a CGE model, the REMI model aims to balance an economy through adjustments and changing prices in labor and product markets over time. Thus, the U.S. economy improves slowly after the initial shock that the carbon tax has on fossil fuel prices in 2019.

The impact of the carbon tax is small in comparison to the U.S. economy. In fact, the typical impact would be between 0.5 percent and -0.5 percent for most metrics in most years, and never more than 1.1 percent in either direction.

Figure 5: Economic Impact in Percentage Terms (Carbon Tax Case vs. Base Case)

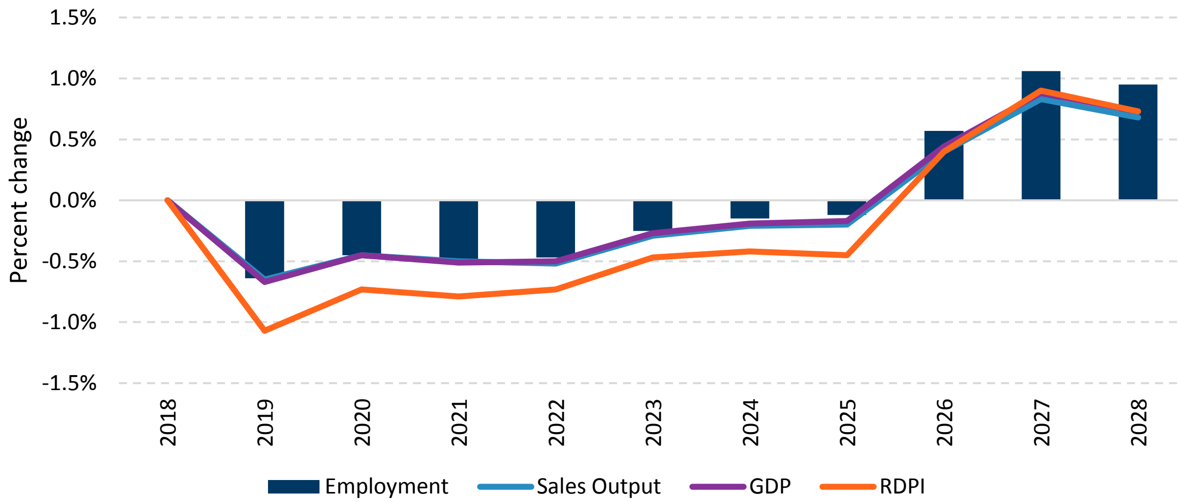


Table 3 below shows the average impact that the Carbon Tax Case would have on jobs[49] during the study period and the aggregate impact (i.e., the sum from 2019 through 2028) on sales output, GDP, and RDPI compared to the Base Case. The difference in impact between the Base and Carbon Tax Cases is small; for example, U.S. aggregate GDP would change by less than one-quarter of one-quarter percent between the two cases below.

Table 3: Economic Impact during the Study Period (Total Jobs or 2016 $ trillions, 2019-2028)

RESULT	CALCULATION	BASE CASE	CARBON TAX CASE	DIFFERENCE	PERCENTAGE
Employment	Average	200.09 million	200.10 million	+10,000	<0.01%
Sales Output	Aggregate	$371.404	$371.158	-$0.246	-0.07%
GDP	Aggregate	$215.525	$215.424	-$0.100	-0.05%
RDPI	Aggregate	$165.511	$165.122	-$0.389	-0.23%

Figure 6 illustrates the similarity in GDP between the two cases. As shown by the proximity of the two lines, the effect of the revenue-neutral carbon tax on U.S. aggregate GDP during the study period is -0.05 percent. This quantity is equivalent to two days' economic output during the 3,652 days making up the whole of the study period.

[49] Jobs are not cumulative across years in the REMI model, which makes the annual average (i.e., the number of jobs held in the economy) the easiest comparison to make

Figure 6: Projected U.S. GDP in the Base Case and Carbon Tax Case

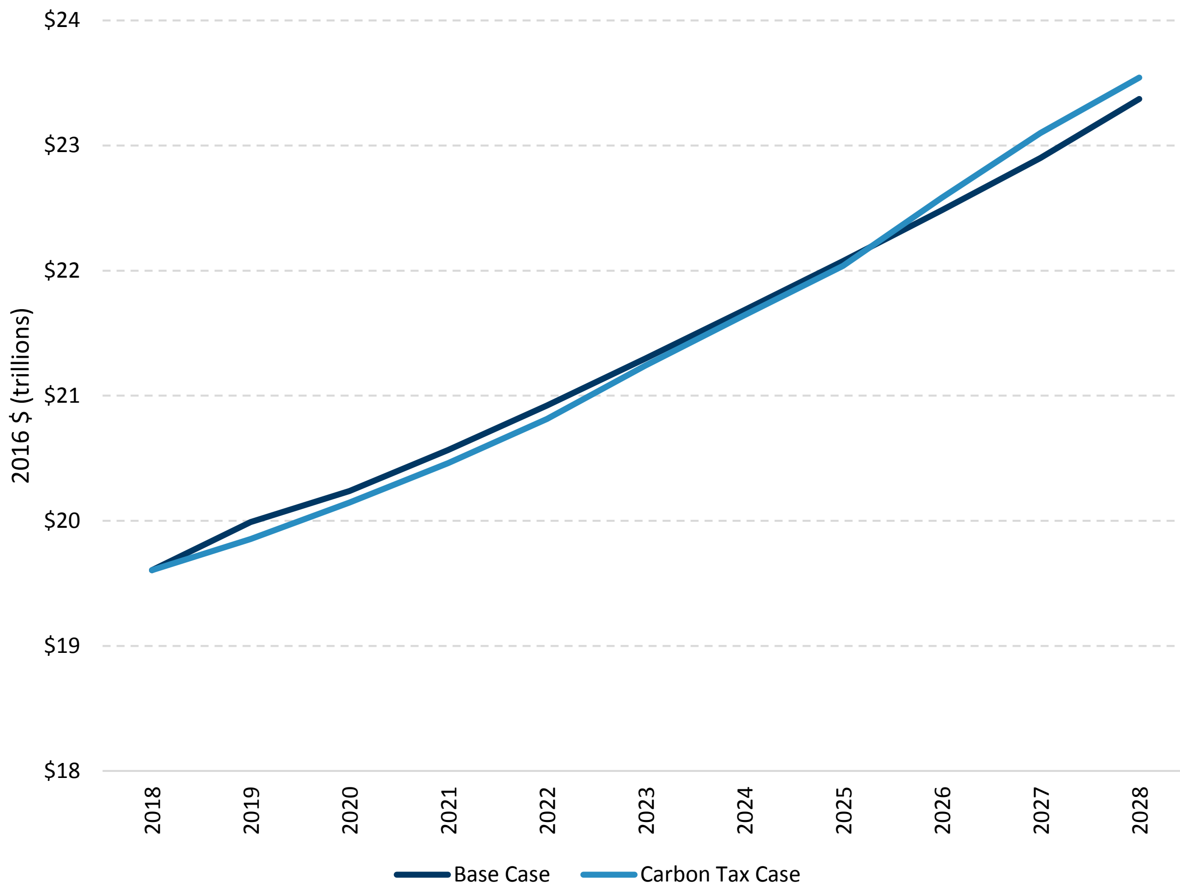


Table 4 shows the impact of the Carbon Tax Case compared to the Base Case in terms of employment, sales output, GDP, and RDPI in 2028. The overall economic impact of the revenue-neutral carbon tax in 2028 is positive.

Table 4: Economic Impacts in 2028

METRIC	IMPACT	UNIT	PERCENTAGE
Employment	1.9 million	Jobs	0.95%
Sales Output	$276.8 billion	2016 $	0.68%
GDP	$170.9 billion	2016 $	0.73%
RDPI	$130.8 billion	2016 $	0.73%

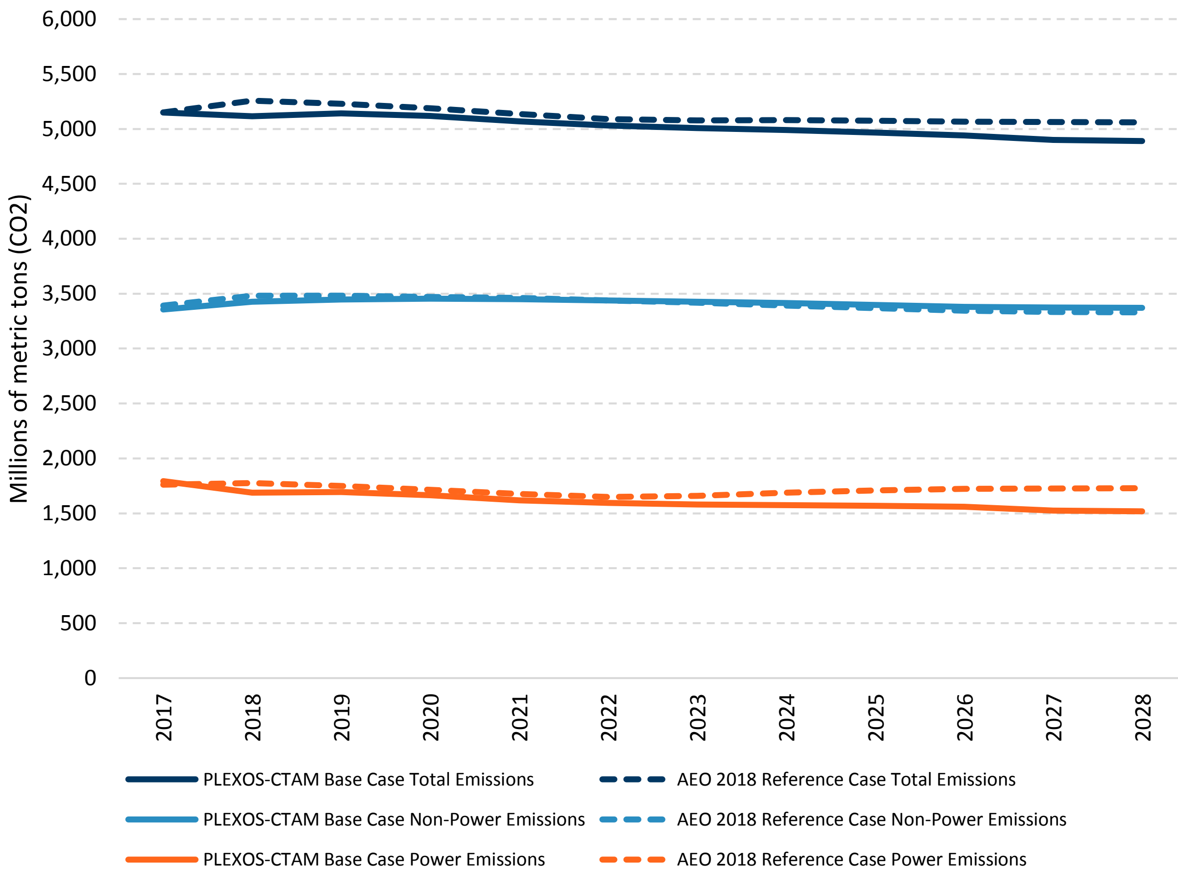
The amassed economic impact of the carbon tax and tax reform measures on the U.S. economy would be relatively neutral, though positive in the last few years of analysis, as shown above in Table 4. As explained below, the U.S. experiences a larger impact in terms of carbon dioxide emissions, conversely, under the Carbon Tax Case.

Emissions Impacts

Implementing the carbon tax would yield a sizable reduction in carbon dioxide emissions, especially from power generation. This would be true in both the absolute and proportional sense – it does not include the implied "co-benefits" of reduced conventional air pollution, such as nitrous oxides and sulfur dioxide, associated with cars, trucks, and power plants. These emissions reductions would occur because fossil fuel plants would generate less or retire. While a carbon tax would reduce emissions, it would degrade the market position of some fossil plants, particularly coal plants.

To ensure the reasonableness of our models, we compared the projected carbon dioxide emissions from the Base Case to the same from the AEO 2018 Reference Case. The findings are in Figure 7 below.

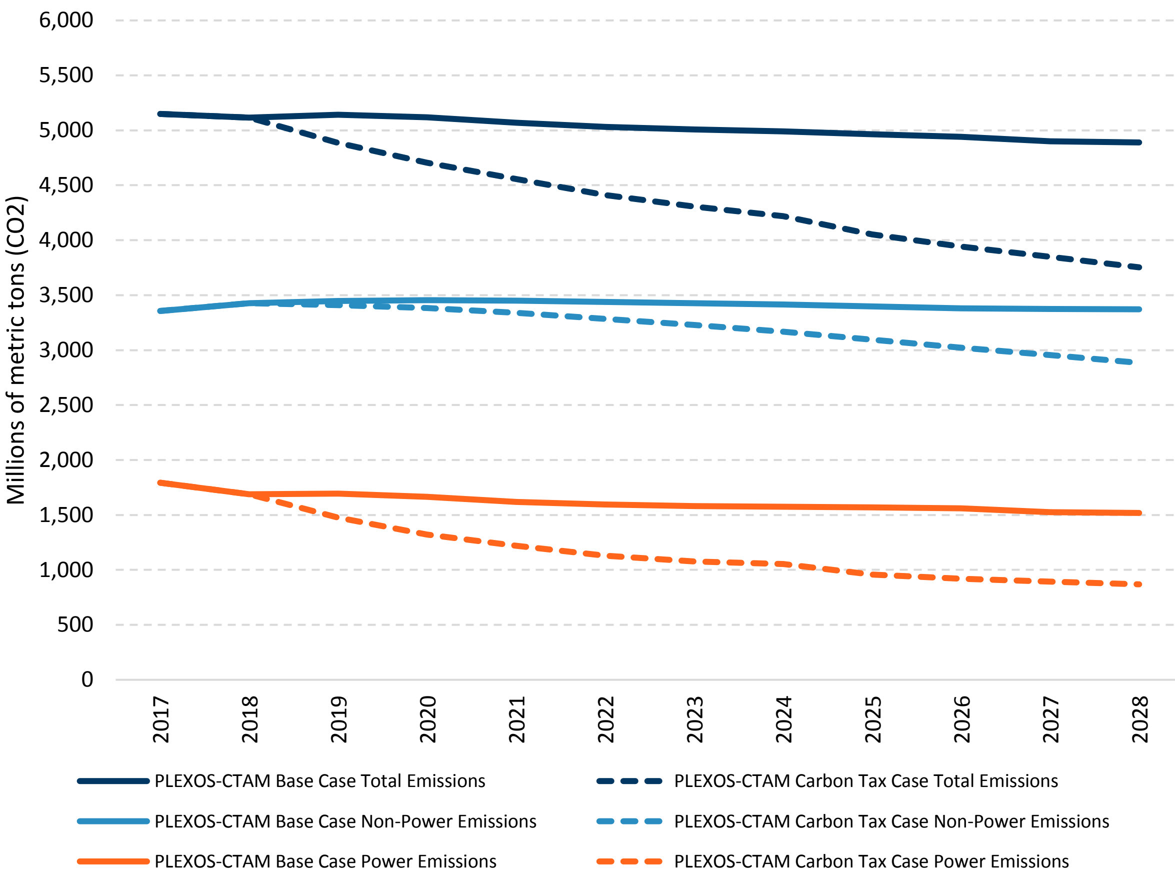
Figure 7: Base Case Carbon Dioxide Emissions Compared to AEO 2018 Reference Case



As shown above, both power and non-power emissions from the Base Case closely match the emissions in the AEO 2018 Reference Case through 2023. The emissions between the two cases diverge moderately in the later 2020s, mostly because of added renewable generation capacity in the PLEXOS electricity model used in the Base Case compared to the AEO 2018 Reference Case. Even so, carbon dioxide emissions fall only modestly by 2028 without a carbon tax from a projected 5.2 billion metric tons to 4.9 billion metric tons (a decline of five percent), closely mirroring the AEO 2018 Reference Case's results. This confirms that our Base Case analysis of carbon dioxide emissions is reasonable.

We compared the emissions results of the Base and Carbon Tax Cases in terms of power sector and non-power emissions, as presented in Figure 8. By 2028, U.S. carbon dioxide emissions would be 23 percent less under the Carbon Tax Case than Base Case. Most of this reduction occurs in the power sector, as power sector emissions under the Carbon Tax Case would fall by 43 percent in 2028, while non-power sector emissions would fall by 14 percent in 2028. In aggregate, the Carbon Tax Case would reduce carbon dioxide emissions by an estimated 7.4 billion metric tons (around 18 months of U.S. emissions at current levels) from 2019 to 2028, a 13 percent reduction from Base Case emissions over this period. Reduced emissions from the power sector represent approximately five billion metric tons of this aggregate reduction.

Figure 8: Carbon Dioxide Emissions in the Base Case and the Carbon Tax Case Emissions



The implementation of the tax would have a greater impact on carbon dioxide emissions from the power sector compared to the residential, commercial, industrial, and transportation sectors. The carbon intensity of electricity can decline over time because electricity can utilize a range of different technologies. Specifically, low or zero emission power generation from natural gas, solar, wind, or other renewables can substitute for more carbon-intensive generation.

In the short term, the Carbon Tax Case would change the relative competitiveness of natural gas plants and coal plants by increasing input costs based on feedstock carbon intensity. In the long term, capacity additions and retirements would occur, reflecting incremental investment in renewable plants and infrastructure and more efficient fossil plants, particularly gas-fired ones, and the retirement of older natural gas-fired plants, fuel oil plants, and coal plants.

The non-power sector maintains fewer ready substitutes than the non-power sector; here, fossil fuel consumption often occurs through nondurable items or capital assets, such as vehicles, which can take years or even decades before they need replacement. While waiting for these assets to depreciate, the consumer response to higher heating and vehicle fuel prices tends to be inelastic.[50] For instance, the average age of a vehicle on U.S. roads is 11.5 years, which implies that it could take twice as long for the entire U.S. the vehicular fleet to turnover.[51] For housing and structures, the timeline would be even longer; the median owner-occupied home in the U.S. is currently 35 years old.[52]

[50] The REMI elasticity for inelastic fuels is moderately inelastic at -0.66

[51] Nathan Bomey, "Average of cars on U.S. roads breaks record," USA Today, 29 July 2015, https://www.usatoday.com/story/money/2015/07/29/new-car-sales-soaring-but-cars-getting-older-too/30821191/

[52] Josh Miller, "The Age of the Housing Stock by State," *National Association of Home Builders*, 5 February 2014, http://eyeonhousing.org/2014/02/the-age-of-the-housing-stock-by-state/

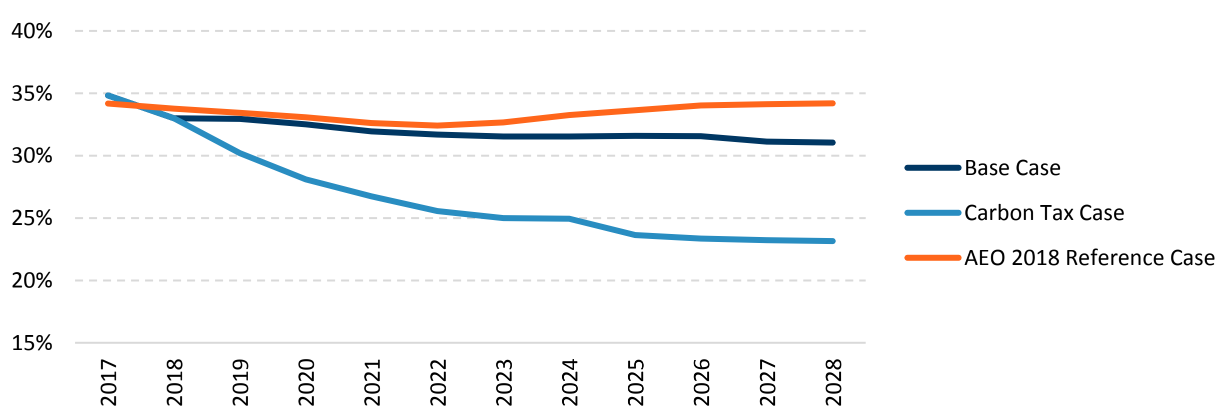
Therefore, the impact of the Carbon Tax Case on emissions from the non-power sector would be lower. This may provide some protection for natural gas distributors and petroleum suppliers in the early years of the Carbon Tax Case because motor gasoline consumption, for example, would not change dramatically in the short run. Table 5 below illustrates the difference in responsiveness between the power and non-power sectors in the Base and Carbon Tax Cases, showing how power sector emissions under the Carbon Tax Case would be greater than those of the non-power sector.

Table 5: Emissions in the Base and Carbon Cases (millions of metric tons)

RESULT	CASE	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2019-2028
Total	**Base**	5,142	5,119	5,069	5,032	5,007	4,990	4,966	4,941	4,899	4,890	55,168
Total	**Carbon Tax**	4,886	4,705	4,558	4,412	4,305	4,220	4,054	3,942	3,848	3,753	47,809
Total	**Difference**	-257	-414	-511	-620	-701	-769	-912	-999	-1,052	-1,136	-7,371
Total	**Percentage**	-5%	-8%	-10%	-12%	-14%	-15%	-18%	-20%	-21%	-23%	-13%
Non-Power	**Base**	3,448	3,454	3,450	3,437	3,427	3,415	3,398	3,381	3,375	3,372	37,584
Non-Power	**Carbon Tax**	3,410	3,383	3,339	3,284	3,229	3,167	3,096	3,022	2,954	2,884	35,198
Non-Power	**Difference**	-38	-72	-111	-153	-198	-248	-302	-359	-421	-487	-2,389
Non-Power	**Percentage**	-1%	-2%	-3%	-4%	-6%	-7%	-9%	-11%	-12%	-14%	-6%
Power	**Base**	1,694	1,665	1,619	1,595	1,579	1,574	1,568	1,560	1,524	1,518	17,584
Power	**Carbon Tax**	1,475	1,322	1,219	1,128	1,076	1,053	958	920	894	869	12,612
Power	**Difference**	-219	-342	-400	-467	-503	-521	-610	-640	-631	-649	-4,982
Power	**Percentage**	-13%	-21%	-25%	-29%	-32%	-33%	-39%	-41%	-41%	-43%	-28%

As shown above, as well as in Figure 9, the power sector would respond more quickly to price signals. Emissions from power would decline 13 percent in the first year and 29 percent by 2022, compared to one percent and four percent, respectively, for the non-power sector. Even so, the impact of the carbon tax would increase during the study period, as annual emissions reductions for the power sector would surpass 40 percent beginning in 2026 and emissions reductions for the non-power sector would increase to 14 percent by 2028. Such response to the carbon tax would continue through the 2020s and 2030s because households and businesses would invest in more efficient durable goods and capital investments such as furnaces, windows, insulation, and vehicles as energy prices increase with the carbon tax.

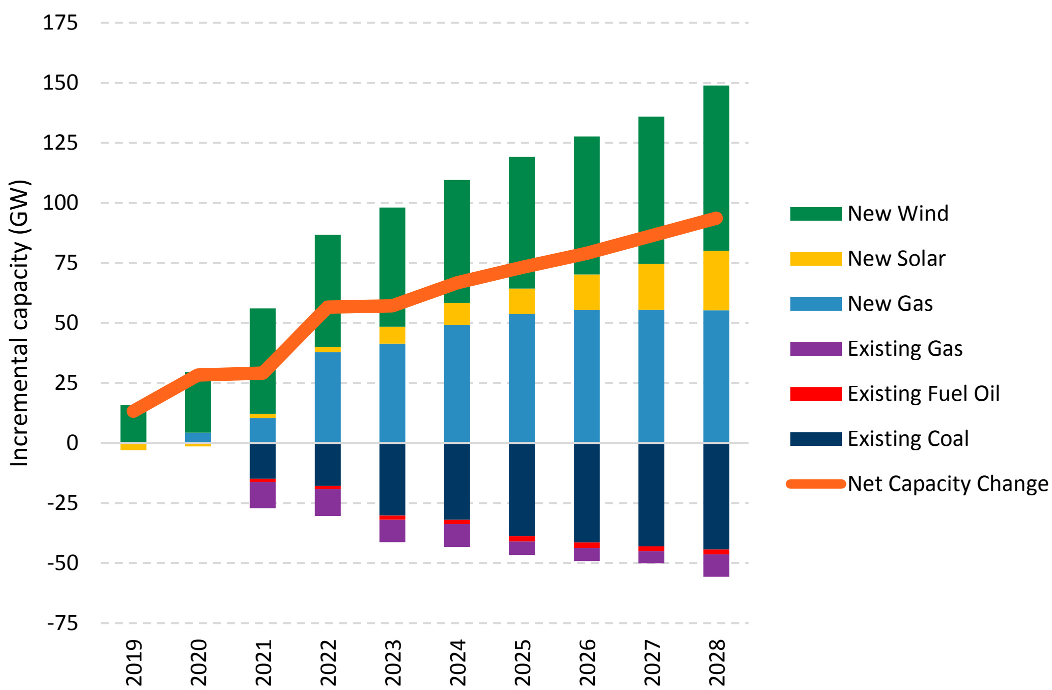
Figure 9: Percentage of U.S. Emissions from Power Sector



Power Sector Impacts

Implementing a carbon tax would substantially alter the U.S. generation fleet, which featured almost 1,200 GW of capacity at the close of 2017.[53] By 2028, the incremental change between the Base Case and the Carbon Tax Case, which shows the effect of the carbon tax on markets, would be 94 GW of additional wind and solar resources and the retirement of 56 GW of more carbon-intensive capacity (i.e., coal, fuel oil, and older natural gas plants). Natural gas-fired capacity, which emits carbon dioxide at a lower intensity per unit of output compared to coal and fuel oil, would still add a net of 46 GW because newer, more efficient gas-fired plants would come online to replace retired natural gas plants. Therefore, the natural gas industry would benefit from increased capital expenditures and fuel purchases even accounting for the retirement of older gas-fired plants under the Carbon Tax Case. In contrast, coal and fuel oil plants would see their positions degrade, because the carbon tax would adversely impact the entire industry's cost competitiveness. Figure 10 below illustrates this phenomenon, showing changes to cumulative capacity and by resource type during the study period.

Figure 10: Change in Power Capacity Between Cases (>0 = Additions, <0 = Retirements)



As discussed in the Emissions Impacts section, the power generation sector would respond to price signals, including the price of carbon where applicable, in both the short run (day-to-day power dispatch) and long run (changes in capacity through additions and retirements). Implementing the carbon tax would sharply increase the cost of generating electricity from carbon-intensive plants from 2019 onwards, hastening economically determined capacity retirements and encouraging more investment in wind and solar resources and newer natural gas plants.

Natural gas-fired capacity would remain comparatively stable because dispatchable generation capacity (i.e., capacity that can turn on or off as necessary and can generate a reliable, predictable amount of power) must comprise a substantial portion of the generation fleet for reliability purposes. The intermittency of renewable technologies (without utility-scale storage) preclude renewables from supplying intermediate or base load. Therefore, in the near term, the retirement of coal, fuel oil, and older natural gas plants would correspond with the addition of new gas-fired capacity.

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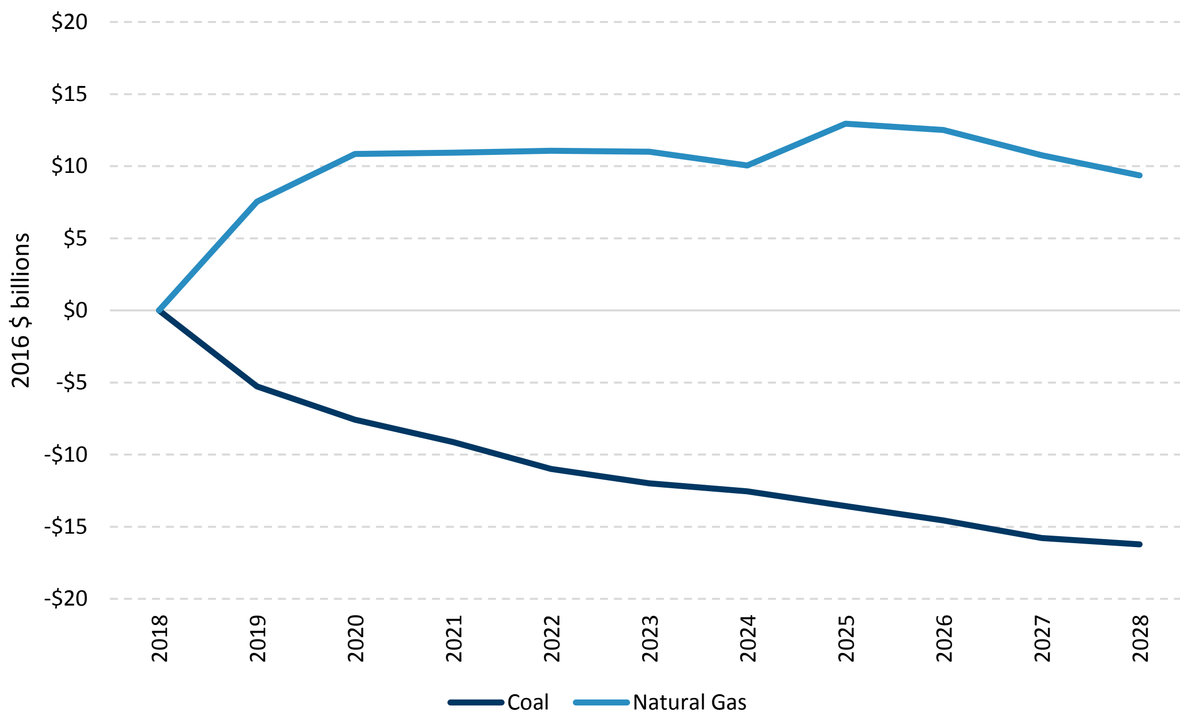
[53] "Industry Data," *Edison Electric Institute*, http://www.eei.org/resourcesandmedia/industrydataanalysis/industrydata/Pages/default.aspx

Combined-cycle gas turbine ("CCGT") plants would comprise all new natural gas-fired capacity, as opposed to open cycle technology, which has a higher short-term marginal cost of generation and, hence, tends to only operate in the summer and other periods of peak demand. CCGT plants would continue to replace coal and fuel oil as the capacity for meeting base load (i.e., around the clock) and for balancing renewable resource intermittency.

Compared to the Base Case, expenditures on coal (minus the embedded value of the carbon tax) for use in power generation would decline under the Carbon Tax Case following the imposition of the tax in 2019. Conversely, expenditures on gas (minus the value of the tax) would increase with rising natural gas dispatch and capacity.

Figure 11: Change in Fuel Demand for Power Generation



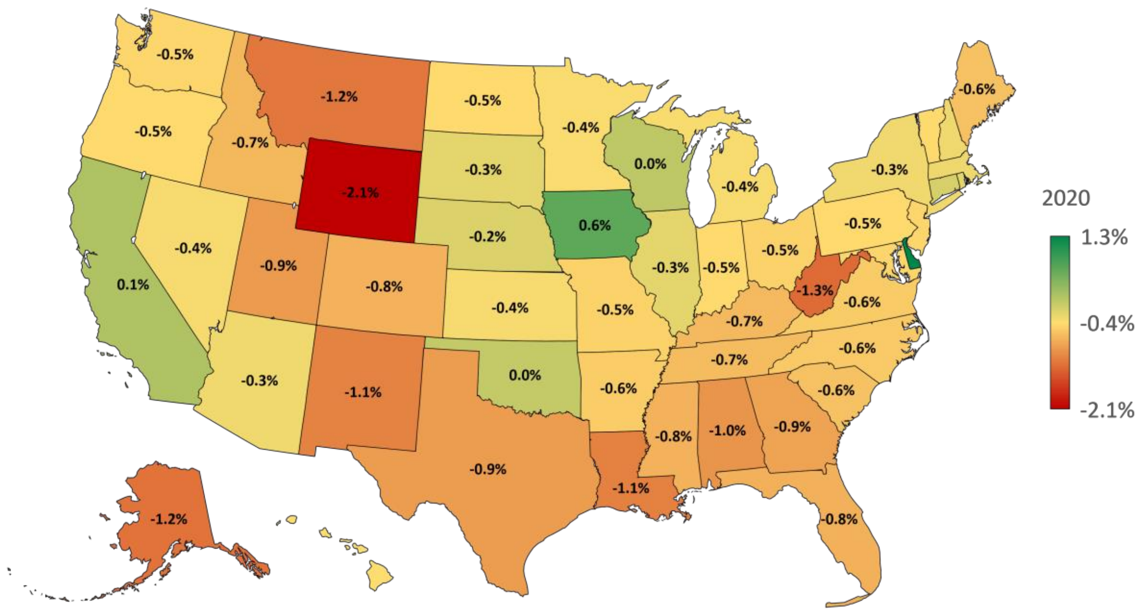
Overall, the carbon tax would benefit the wind and solar industries (as well as their associated states) due to capacity investments. The carbon tax would have a generally positive impact on power generation related to gas, though the owners/operators of incrementally new plants would benefit at the expense of older plants. The coal and petroleum industries would experience hardships in the Carbon Tax Case because higher fossil fuel prices, reflective of the carbon tax, would reduce demand for coal and fuel oil inputs. Because coal and fuel oil plants dispatch less or shut down, demand for coal and petroleum would fall for the states most associated with their production.

State Impacts

This section describes the impact of the carbon tax on state GDP during the study period, specifically examining the percent difference between the Base and Carbon Tax Cases in 2020 and 2028 as benchmark years.

In 2020, shown in Figure 12, capital investments for power plants and changing fuel demand would have the largest influence on state GDP in the Carbon Tax Case. Tax reform, which would concentrate on insurance and healthcare in 2020, also benefit states such as California, Connecticut, Delaware, and Iowa. In the Carbon Tax Case, the carbon tax would negatively impact states with large coal and oil sectors, such as Montana, West Virginia, and Wyoming, because many of these plants would shut down. Conversely, other states, such as Iowa and its neighbors in the Midwest, would benefit from investments in solar and especially wind. While the difference in GDP between the Base and Carbon Tax Cases would be generally negative in 2020, it would typically differ by less than one percent in all but a handful of states.

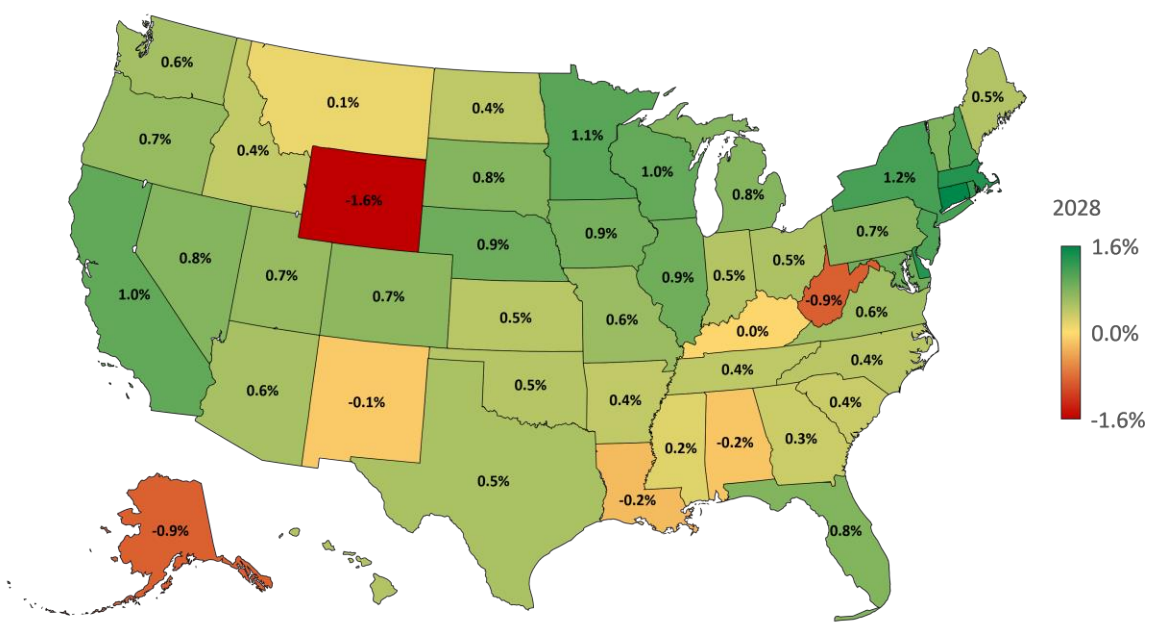
Figure 12: Percentage Change in State GDP Between the Base Case and Carbon Tax Case (2020)



CT	-0.2%
DC	-0.3%
DE	1.3%
HI	-0.4%
MA	-0.3%
MD	-0.5%
NH	-0.3%
NJ	-0.5%
RI	-0.3%
VT	-0.5%

State GDP mostly recovers by 2028 in Figure 13 below, because only seven states would experience a negative impact to GDP in proportional terms. The impact in four of these states would be close to negligible, less than -0.25 percent, though the impact in Alaska, West Virginia, and Wyoming would be greater because of significant (and adversely impacted) coal industries. Most states would experience an increase in GDP under the Carbon Tax Case relative to the Base Case in 2028 due to the benefits of extending the TCJA individual provisions. These benefits would ensue in all states, boosting consumer income and spending and, hence, the U.S. economy. States with larger populations that pay a large quantity of federal income taxes on a per capita basis, such as California and in the Northeast, would especially benefit.

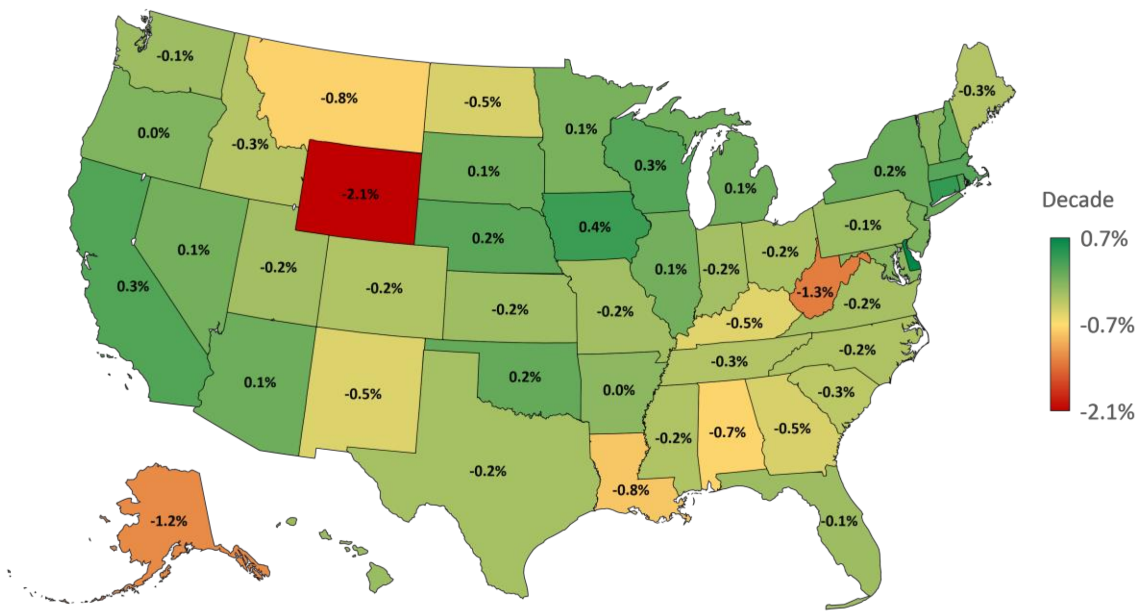
Figure 13: Percentage Change in State GDP Between the Base Case and Carbon Tax Case (2028)



CT	1.6%
DC	0.6%
DE	1.4%
HI	0.5%
MA	1.4%
MD	0.9%
NH	1.1%
NJ	1.1%
RI	1.3%
VT	0.8%

Figure 14 shows the change in aggregate GDP by state during the study period. Over half (30) of states would experience an impact between ±0.25 percent of GDP, and only three states (Alaska, West Virginia, and Wyoming) would experience an impact of less than -1 percent because of reduced demand for coal and petroleum products. In contrast, states across the Northeast, Great Plains, and West Coast would experience a neutral to positive impact on GDP due to increased renewable resource development and the benefit of the TCJA extensions for American households.

Figure 14: Percentage Change in State GDP Between the Base Case and Carbon Tax Case (Aggregate, 2019-2028)



CT	0.5%
DC	0.0%
DE	0.7%
HI	-0.1%
MA	0.3%
MD	0.0%
NH	0.2%
NJ	0.0%
RI	0.3%
VT	0.0%

Industry Impacts

Table 6 shows the change in employment across 24 sectors. The trend in most industry employment tracks the timing of the tax reform measures, as the change in employment between the Base and Carbon Tax Cases would be negative from 2019 to 2025 before turning positive in 2026. The largest exception to this trend is in the finance and insurance sector. A large portion of the tax reforms either reduce excise taxes on insurance products (i.e., the Cadillac tax), taxes on the objects ultimately consumed through those insurance products (i.e., the medical device tax), or the fees on health insurers (i.e., the provider fee). Commercial and professional sectors are generally less carbon-intensive than industrial and manufacturing sectors. The oil and natural gas extraction sector would see a net benefit, mostly through the increasing role of natural gas in the power generation sector since the carbon tax would reduce demand for petroleum products.

Table 6: Impact to Employment by Industry (thousands)

SECTOR	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2019-2028 AVERAGE
Finance and Insurance	-66	65	63	67	175	202	225	231	280	260	150
Construction	-188	-192	-189	-170	-80	-13	18	230	427	407	25
Health Care and Social Assistance	-128	-84	-92	-85	-51	-41	-44	164	288	262	19
Oil and Gas Extraction	2	9	8	8	8	6	11	14	13	9	9
Real Estate and Rental/Leasing	-67	-48	-52	-42	-18	-9	-7	63	106	97	2
Educational Services	-32	-22	-24	-22	-14	-11	-12	33	60	55	1
Farming and Ranching	0	0	0	0	0	0	0	0	0	0	0
Federal Civilian	0	0	0	0	0	0	0	0	0	0	0
Federal Military	0	0	0	0	0	0	0	0	0	0	0
Arts, Entertainment, and Recreation	-37	-25	-28	-26	-17	-14	-15	32	59	52	-2
Forestry, Fishing, and Related	-4	-4	-4	-4	-3	-3	-3	1	3	2	-2
Information	-19	-13	-15	-15	-10	-9	-9	13	27	23	-3
Administrative and Waste Management Services	-78	-54	-60	-58	-33	-24	-23	60	116	101	-5
Other Services	-108	-73	-80	-73	-47	-39	-43	93	169	147	-5
Management of Companies	-14	-11	-13	-14	-11	-10	-10	4	14	10	-6
Manufacturing	-22	-9	-15	-39	-36	-30	-33	25	66	35	-6
Accommodation and Food Services	-85	-61	-65	-60	-39	-32	-34	53	105	93	-13
State and Local Government	-30	-38	-45	-47	-37	-28	-23	10	48	60	-13
Utilities	-19	-18	-18	-16	-14	-13	-14	-11	-8	-9	-14
Wholesale	-46	-36	-40	-41	-32	-29	-30	21	52	43	-14
Transportation and Warehousing	-51	-42	-45	-46	-36	-31	-32	15	44	36	-19
Mining (including Coal)	-11	-15	-18	-21	-22	-22	-23	-22	-22	-23	-20
Professional, Scientific, and Technical	-70	-58	-66	-68	-48	-40	-39	29	81	70	-21
Retail	-202	-155	-164	-154	-115	-102	-104	92	212	186	-51

The impact of the carbon tax on each industry's contribution to U.S. GDP is akin to trends in industry employment. Both would fluctuate over time with the year-to-year fiscal impact of the revenue-neutral carbon tax.

As shown in Table 7, changes in GDP contributions by industry would be negative from 2019 to 2025 but become positive in 2026. Construction and manufacturing would experience short-term boosts in 2019 and 2020 due to an increase in demand for labor and equipment to construct new wind, solar, and natural gas plants. The mining sector, which includes the coal sector, would see a large decrease in its GDP contribution because of reduced fuel demand.

Table 7: Impact to GDP Contribution by Industry (2016 $ billions)

SECTOR	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2019-2028 AGGREGATE
Finance and Insurance	-$10	$11	$11	$12	$30	$35	$39	$40	$49	$46	$263
Health Care and Social Assistance	-$8	-$6	-$6	-$6	-$4	-$3	-$4	$11	$21	$19	$14
Oil and Gas Extraction	$0	$1	$1	$1	$1	$1	$1	$2	$2	$0	$10
Construction	-$14	-$15	-$15	-$14	-$8	-$3	-$1	$16	$32	$31	$9
Arts, Entertainment, and Recreation	-$2	-$1	-$1	-$1	-$1	-$1	-$1	$2	$3	$3	$0
Farming and Ranching	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Federal Civilian	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Forestry, Fishing, and Related	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Other Services	-$4	-$3	-$3	-$3	-$2	-$2	-$2	$4	$8	$7	$0
Educational Services	-$1	-$1	-$1	-$1	-$1	-$1	-$1	$1	$2	$2	-$2
Real Estate and Rental/Leasing	-$21	-$16	-$18	-$15	-$8	-$5	-$5	$19	$35	$31	-$3
Administrative and Waste Management Services	-$4	-$3	-$3	-$3	-$2	-$2	-$2	$3	$6	$5	-$5
Accommodation and Food Services	-$3	-$2	-$3	-$3	-$2	-$2	-$2	$2	$4	$4	-$7
Federal Military	$0	$0	$0	-$1	-$1	-$1	-$1	-$1	-$1	-$1	-$7
Information	-$6	-$4	-$5	-$5	-$4	-$3	-$4	$5	$10	$8	-$8
Management of Companies	-$2	-$2	-$2	-$2	-$2	-$2	-$2	$1	$2	$2	-$9
Professional, Scientific, and Technical	-$7	-$6	-$7	-$8	-$6	-$5	-$5	$3	$9	$8	-$24
Wholesale	-$8	-$6	-$7	-$8	-$6	-$6	-$6	$4	$10	$8	-$25
Manufacturing	-$6	-$3	-$4	-$8	-$7	-$7	-$9	$2	$10	$1	-$31
Transportation and Warehousing	-$5	-$4	-$5	-$5	-$5	-$4	-$5	-$1	$2	$1	-$31
Retail	-$13	-$10	-$11	-$11	-$8	-$8	-$8	$6	$15	$13	-$35
State and Local Government	-$6	-$6	-$7	-$7	-$6	-$6	-$5	-$3	$1	$2	-$43
Mining (including Coal)	-$4	-$6	-$7	-$8	-$9	-$9	-$10	-$10	-$10	-$10	-$83
Utilities	-$10	-$10	-$10	-$10	-$8	-$8	-$9	-$7	-$6	-$6	-$84

Table 6 and Table 7 include only the results for the U.S., though the models generated such results for all states and DC, as well as similar detailed outputs for the electric power sector.

Conclusion

This study explores the net impact of a revenue-neutral carbon tax and associated federal tax reforms on the U.S. economy, carbon dioxide emissions, and the power sector at the federal, state, and industry levels.

FTI considered a tax on carbon dioxide emissions of $20 per metric ton, increasing annually by five percent in real terms, applied at the point of extraction or import. Applying the tax upstream is simpler and enables the extractors of fossil fuels to embed the carbon tax into their prices, which incentivizes power plants and customers downstream to change their consumption or behavior. This study also provides a rebate to EITE industries – mostly heavy manufacturers – to help maintain their competitiveness and prevent the export of emissions overseas.

After subtracting EITE revenues from total carbon tax revenues, FTI used the net revenues to fund three types of tax reform on a revenue-neutral basis: (1) extending TCJA individual provisions from the end of 2025 to the end of 2028, (2) extending various other expiring federal tax provisions through 2028, and (3) delaying the implementation of taxes associated with the ACA. The deferred ACA taxes include the Cadillac tax on high-end health insurance, the excise tax on medical devices, the insurance provider fee, and respite from the NIIT. The net effect of the carbon tax and these tax reform measures would be negligible according to our calculations herein and JCT's cost estimates.

To quantify the impact of the carbon tax and associated tax reform measures, FTI relied on several leading third-party data sources and models (PLEXOS, CTAM, and REMI). We then combined these models together to develop a Base Case, which represented the status quo, and a Carbon Tax Case, which reflected changes to the U.S. economy and energy sector under the revenue-neutral carbon tax and associated tax reform measures.

Table 8 below illustrates the aggregate difference between the two cases during the study period:

Table 8: Impact of Carbon Tax and Tax Reform on U.S. Federal Budget, Economy, and Emissions (2019-2028)

RESULT	DIFFERENCE	PERCENTAGE
Increase to federal deficit	$9 billion	*Negligible* (<0.0001%)
Average impact to U.S. employment	+10,000	<0.01%
Reduced aggregate U.S. GDP	$100 billion	0.05%
Reduced aggregate U.S. RDPI	$389 billion	0.23%
Reduced U.S. emissions	7.4 billion metric tons	13%
Reduced U.S. power sector emissions	5.0 billion metric tons	28%

As shown above, by 2028, the carbon tax and reforms would have a small effect – less than 0.25 percent – on aggregate GDP and RDPI, and virtually no effect on the deficit. This occurs largely because, while consumers would face higher energy prices for fossil fuels under the tax regime, their taxes would also fall by an equal amount because carbon tax revenue is used to fund the tax reforms. According to the macroeconomic indicators, consumers and households would not be substantially worse or better off under the revenue-neutral carbon tax and associated tax reform.

Simultaneously, the carbon tax would incite reductions in carbon dioxide emissions. In the Carbon Tax Case, the carbon tax would reduce aggregate emissions by 7.4 billion metric tons, or 13 percent, from the Base Case during the study period. Most of these reductions (i.e., 68 percent) come from the power sector. In the Carbon Tax Case, the power sector would retire 56 GW of coal, oil, and gas plants and add 94 GW of wind, solar, and new gas plants because of the incentives created by the carbon tax regime. Here, the renewable and gas industries would benefit, while the coal and petroleum industries would experience negative impacts. These operating and capital expenditure decisions inform state level macroeconomic effects, which would fluctuate due to the carbon tax, the tax reforms, and changes in the power sector.

While the national effect of the carbon tax is negligible, certain states would outperform or underperform their neighbors. Delaware, Connecticut, and Iowa would have positive impact to state GDP because of their association with the insurance industry and/or increasing investment in renewable resources. In contrast, Wyoming, Alaska, and West Virginia, which extract and process significant coal and oil resources, would experience the most negative GDP impacts.

At the industry level, the sectors that would benefit the most from the carbon tax and tax reform in terms of employment are the finance and insurance and healthcare sectors. A large portion of carbon tax revenues would be used to reduce excise taxes on health insurance or fees on insurance providers. Because these industries would enjoy a lower tax burden on their businesses and products under the carbon tax, their employment and GDP contribution would expand. In contrast, the retail and professional services sector would experience the largest decline in employment, mostly due to their labor intensity and sensitivity to macroeconomic fluctuations. The mining industry, which includes coal mining but not gas, would experience a significant decline in GDP contribution and employment as 44 GW of coal plants retire.

In summary, the carbon tax and tax reform measures would generate over $1 trillion in new federal revenues during the study period under the Carbon Tax Case. Because of the EITE adjustments and associated tax reform measures, however, the net fiscal impact under the Carbon Tax Case is a deficit of $9 billion, or 0.9 percent of the carbon tax revenue. This would be an insignificant sum compared to annual federal revenue or the budget during the study period. At the same time, the carbon tax would incentivize a 13 percent decline in cumulative emissions between the cases, mostly from the power sector, and a 23 percent reduction in U.S. emissions in 2028. While the carbon tax would incentivize more development in wind and solar, benefiting states endowed with renewable resources, states with coal and petroleum industries would face adversity. Natural gas, while a fossil fuel, would experience a net increase in gas-fired power capacity and an increase in demand for gas in power generation. The final effect would be a neutral impact nationally, though with noteworthy impacts between states and industries, with a significant reduction in carbon dioxide emissions.