



# AN ASSESSMENT OF THE ENERGY INNOVATION AND CARBON DIVIDEND ACT

BY NOAH KAUFMAN, JOHN LARSEN, PETER MARSTERS,  
HANNAH KOLUS, AND SHASHANK MOHAN

OCTOBER 2019

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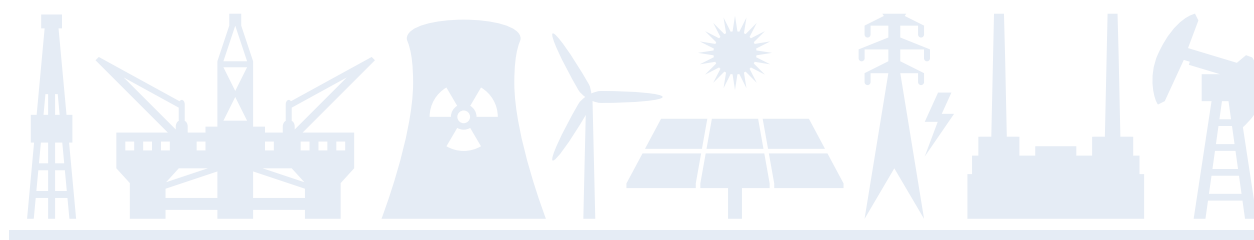
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# FOREWORD

The Center on Global Energy Policy (CGEP) at Columbia University's School of International and Public Affairs launched a Carbon Tax Research Initiative in 2018 with the goal of enabling the design and thoughtful consideration of federal carbon tax policy in the United States. The initiative is a collaboration among scholars at CGEP, the broader Columbia University faculty, and independent external experts. This paper is a collaboration between CGEP and Rhodium Group, an independent research provider.



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tools. He joined Rhodium in 2008 as a research analyst, and has since worked across Rhodium's practice areas to analyze the impact of policy proposals and structural developments on specific markets and broader economic trends. Shashank has extensive experience building and leveraging a wide variety of economic and energy system modeling, including computable general equilibrium models, econometric growth models, the National Energy Modeling System, and input-output analysis, to inform market and policy-relevant energy, economic, and environmental analysis. Prior to joining Rhodium, Shashank was a software engineer at Microsoft. He holds a master's degree from the School of International and Public Affairs at Columbia University and is a mathematics and computer science graduate of the Indian Institute of Technology (IIT), Kharagpur.



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# EXECUTIVE SUMMARY

Growing public concern about the social, economic, and environmental impacts of climate change, along with pressure for lawmakers to introduce policy proposals that reduce emissions, have brought carbon taxes to the center of policy discussions on Capitol Hill. Thus far in 2019, seven different carbon tax legislative proposals have been introduced in Congress. The proposal with the most cosponsors, totaling 64 Democrats and 1 Republican as of the end of September 2019, is the Energy Innovation and Carbon Dividend Act (EICDA), introduced in February 2019 by lead sponsor Ted Deutch (D-FL). This study assesses the potential impacts of EICDA on the US energy system, environment, and economy.

EICDA establishes a fee on each ton of greenhouse gas (GHG) emissions. It covers over 80 percent of gross national emissions. The fee starts at \$15 per metric ton and increases by \$10 or \$15 each year, depending on future emissions levels. Revenue raised by the carbon fee is used for “carbon dividends,” a rebate to every eligible US citizen or lawful resident. The bill also includes measures to protect US competitiveness and to reduce the risk that companies will relocate their operations to a different country with laxer climate laws. Through the carbon fee and additional regulations if necessary, EICDA targets 90 percent emissions reductions by 2050 compared to 2016 levels.

This study is part of a joint effort by Columbia University’s Center on Global Energy Policy (CGEP) and Rhodium Group to help policymakers, journalists, and other stakeholders understand the important decisions associated with the design of carbon tax policies and the implications of these decisions. This analysis uses a version of the National Energy Modeling System maintained by the Rhodium Group (RHG-NEMS) to quantify the energy and environmental implications of EICDA, focusing on outcomes through 2030. Supplemental analyses provide insights on how EICDA would affect households, the economy, and government budgets.

The following are key results:

- **GHG emissions decline substantially.** *Compared to 2005 levels, implementing EICDA as a stand-alone policy leads to economy-wide net GHG emissions reductions of 32–33 percent by 2025 and 36–38 percent by 2030.* These emissions reductions exceed the targets in the EICDA proposal through 2030 and exceed the US commitments to the Paris Agreement over this period. Most of the near-term emission reductions occur in the power sector, where emissions fall 82–84 percent by 2030.
- **Air pollution also declines.** *EICDA reduces local air pollution from power plants.* Sulfur dioxide (SO<sub>2</sub>) and mercury emissions from the power sector decline by more than 95 percent and emissions of oxides of nitrogen (NO<sub>x</sub>) decline by about 75 percent by 2030 relative to a current policy scenario.
- **Electricity generation shifts to cleaner sources.** *The price on carbon causes the US economy to shift from carbon-intensive energy sources to low- and zero-carbon energy*



*sources.* Coal is nearly eliminated from the power sector by 2030, with solar, wind, nuclear, and natural gas with carbon capture and storage all providing significantly larger generation shares compared to a current policy scenario.

- **Energy prices rise but do not skyrocket.** *The price on carbon causes energy prices to increase for all carbon-emitting fuels, which leads to significantly higher overall energy expenditures, though within the range of recent historical variation.* Taking two prominent examples, results show EICDA causing national average gasoline prices to increase by about 12 cents per gallon in 2020 and 90 cents per gallon in 2030 and causing national average electricity prices to increase by about 1 and 3 cents per kilowatt hour in 2020 and 2030, respectively. EICDA causes per capita energy expenditures to increase by \$200-\$210 in 2020 and \$1,160-\$1,170 in 2030 compared to a current policy scenario. In all years, annual per capita energy expenditures remain below the recent historical peak during the commodities crisis in 2008.
- **The carbon dividend cushions energy price impacts.** *EICDA generates substantial revenue that is distributed in the form of equal dividend payments.* EICDA generates \$72-\$75 billion in carbon tax revenues in 2020 and \$403-\$422 billion in 2030. This translates into an annual dividend for eligible adults of \$250-\$260 in 2020 and \$1,410-\$1,470 in 2030, with half those amounts also paid to eligible children. On average, the carbon dividend payments are comparable to the changes in energy expenditures caused by EICDA. Because higher-income households purchase far more carbon-intensive goods and services, distributing dividends equally implies that average low- and middle-income households receive more in dividends than they pay in increased economy-wide prices for goods and services resulting from the carbon tax.
- **Net government revenue declines slightly, at least initially.** *Carbon tax-and-dividend policies are often described as “revenue neutral,” but the impacts of EICDA on government revenue are uncertain and likely negative in the near term.* We estimate that the net government revenues under EICDA decline by roughly 10 percent of the annual carbon tax revenue in the early years of the policy. This estimate considers government revenue gains from taxing emissions and dividends, dividend payouts, and government revenue losses from reduced income and payroll taxes from those who pay the carbon tax. However, the proposal will also affect government revenue in other ways that are beyond the scope of our analysis, so the overall impacts on net government revenue is uncertain.



# INTRODUCTION

This paper analyzes the Energy Innovation and Carbon Dividend Act (EICDA) of 2019 proposed by Congressman Ted Deutch (D-FL) and cosponsored by 65 members of the House of Representatives as of the end of September 2019, including 1 Republican. It presents estimates of the impacts of EICDA on emissions, energy markets, households, and government revenues. It also compares EICDA to other recent proposals for federal carbon pricing policies and highlights relevant results from the literature.

EICDA establishes a fee on emissions of greenhouse gases (GHGs) that starts at a rate of \$15 per metric ton and increases by \$10 per year plus the rate of inflation, contingent on meeting annual emission targets stipulated in the legislation. If emissions from covered fuels fail to meet a target in a given year, the tax rate increases by \$15 the following year. EICDA also covers fluorinated gases at a rate of 10 percent of the carbon fee, so it grows from \$1.50 per ton of CO<sub>2</sub> equivalence (CO<sub>2</sub>e) in 2020 to \$11.50 by 2030. The GHG emissions covered by EICDA account for the majority (over 80 percent) of gross national emissions. Outside the scope of the bill are emissions from and related to agriculture, land use, certain industrial processes, and any emissions from the armed forces.

Revenue raised by the carbon fee (after minor administrative expenses) is used for “carbon dividends,” a rebate to every eligible US citizen or lawful resident. Eligible adults would receive a full portion and children would receive half. In addition, the bill proposes a border carbon adjustment that would tax carbon-intensive imports and refund taxes to carbon-intensive exports.

Finally, EICDA proposes to temporarily suspend Environmental Protection Agency (EPA) authority to regulate emissions from stationary sources of CO<sub>2</sub> that are also covered by the carbon fee. Regulatory authority over mobile emissions sources and emissions not covered by the carbon fee are unchanged. If emissions goals are not met after 10 years, regulatory authority is restored to accompany the increasing carbon fee, and the federal government is required to put regulations in place to achieve the targets described in the bill, which chart a pathway to 90 percent emissions reductions by 2050 compared to 2016 levels.



# ANALYTICAL APPROACH

To assess the energy and environmental implications of the EICDA proposal, we modeled a range of scenarios in a version of the National Energy Modeling System constructed by the Energy Information Agency and maintained by the Rhodium Group (RHG-NEMS). RHG-NEMS can produce economy-wide projections of the US energy system as well as projections of all major GHG emissions.<sup>1</sup>

Energy technology and market assumptions for all scenarios match Rhodium Group's *Taking Stock 2018* scenarios.<sup>2</sup> Specifically we consider high-, central-, and low-energy cost scenarios that vary the assumed costs of renewable energy and battery technologies as well as the price of natural gas. More details can be found in the *Taking Stock 2018* technical appendix.<sup>3</sup> In the low-energy cost scenario only, we also assume the availability of additional low-carbon technologies beyond what's included in *Taking Stock 2018*, such as carbon capture and storage for industrial facilities and renewable natural gas.<sup>4</sup> These additions are intended to represent additional technological innovation that may occur in the US in connection with the implementation of an economy-wide carbon price.

Historical GHG data used in this analysis is sourced from the EPA's GHG inventory published in 2018 with data through 2016. Consistent with the EPA inventory, we use 100-year global warming potentials and upstream methane emission rates for fossil fuel production and distribution from the Intergovernmental Panel on Climate Change Fourth Assessment Report.

Throughout this report, we primarily discuss results out to 2030, due to uncertainties about the evolution of the US energy system and economy further into the future.

## Modeling the EICDA Proposal

As a starting point, we construct a current policy scenario that reflects all federal and state policies in place through May 2018. This scenario assumes US carbon sequestration from land use, land use change, and forestry follows the optimistic pathway considered in Rhodium Group's 2018 *Taking Stock* report.<sup>5</sup> We assume climate policy in the rest of the world remains unchanged across all of our scenarios.

Our EICDA scenario builds on the current policy scenario, adding all provisions contained in the EICDA proposal unless otherwise noted below. We assume all state and federal policies not revoked or revised by the proposal remain in place.

We assume all measures take effect in 2020 and continue throughout the projection period. For CO<sub>2</sub> emissions from fossil fuel use, we apply the tax in RHG-NEMS to all covered fuels, and the model solves for the least-cost pathway to provide energy services throughout the US economy.

The carbon tax applies to imported fossil fuels but not exports. Under EICDA, a border tax adjustment would be applied to the export and import of certain energy- and trade-intensive products. To reflect this provision of the bill, we fixed relative international prices for fuels



and commodities so that international trade is not affected by a change in US prices due to a carbon tax. Tax credits are available for nonemissive uses of taxed fuels and for the capture and permanent sequestration of CO<sub>2</sub> emissions from taxed fuels. Modeling the impact of the fee on F-gases is outside the scope of our analysis.

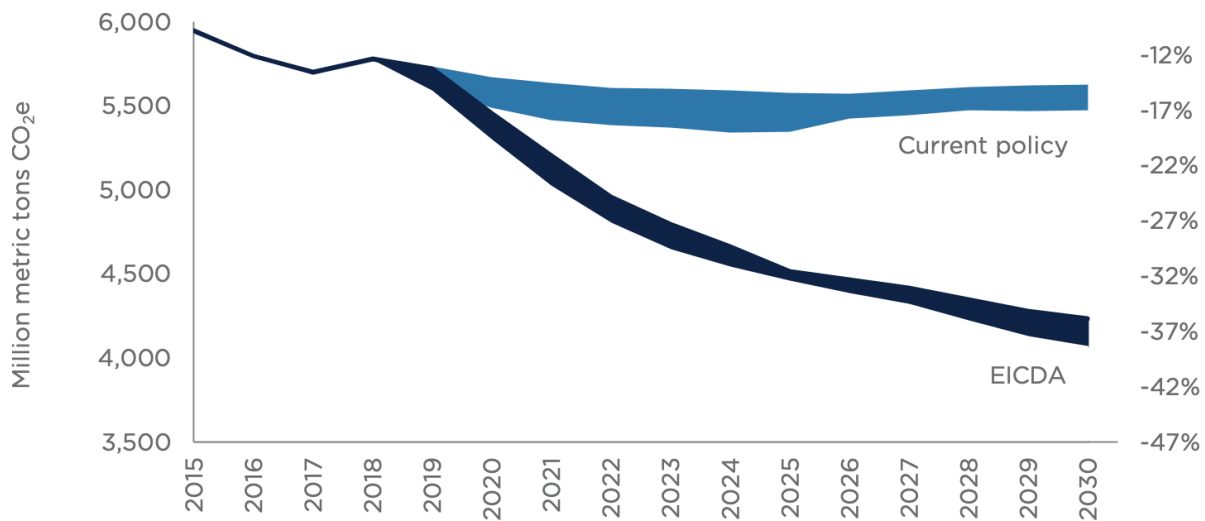
In line with the language in the proposal, we assume the carbon fee does not apply to upstream GHG emissions from fossil fuel production due to the administrative difficulties of doing so, but an alternative plausible reading of the proposal is that it covers these emissions.



# GHG EMISSIONS IMPLICATIONS

We find that the EICDA proposal could drive US economy-wide net GHG emissions down 32–33 percent from 2005 levels by 2025 and down 36–38 percent from 2005 levels by 2030 (figure 1). The range reflects the three energy cost scenarios discussed above. The bill represents a departure from current policy, under which emissions are projected to be between 15–19 percent below 2005 levels in 2025 and 15–17 percent below 2005 levels by 2030.

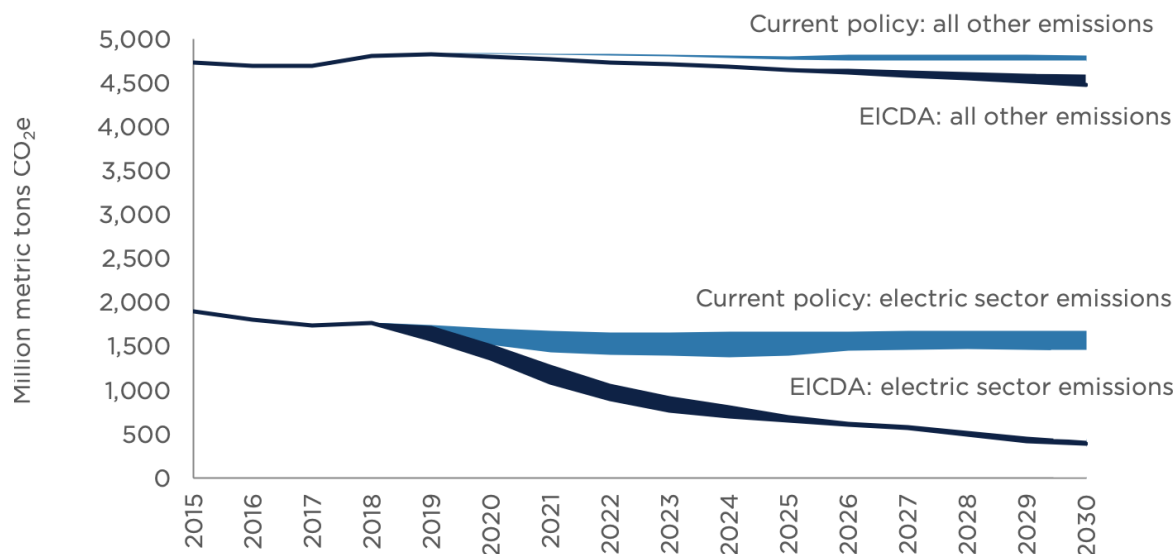
**Figure 1:** US economy-wide net GHG emissions, 2015-2030



Source: Rhodium Group analysis

More than two-thirds of the emissions reductions achieved relative to 2005 and roughly 85 percent of the emission reductions achieved relative to current policy occur in the electric power sector. Indeed, power sector emissions decline rapidly once the tax is in place and fall 82–84 percent below 2005 levels by 2030 (figure 2). These reductions are greater than the 30–39 percent reductions from 2005 by 2030 that occur in the current policy scenario. Driving these reductions are the presence of competitive markets and readily available abatement opportunities, such as shifting dispatch from carbon-intensive coal generators to lower-carbon natural gas generators, as well as developing new low- and zero-emitting capacity, such as wind, solar, and natural gas with carbon capture and storage.<sup>6</sup>



**Figure 2:** US electric power sector and all other GHG emissions, 2015-2030

Source: Rhodium Group analysis

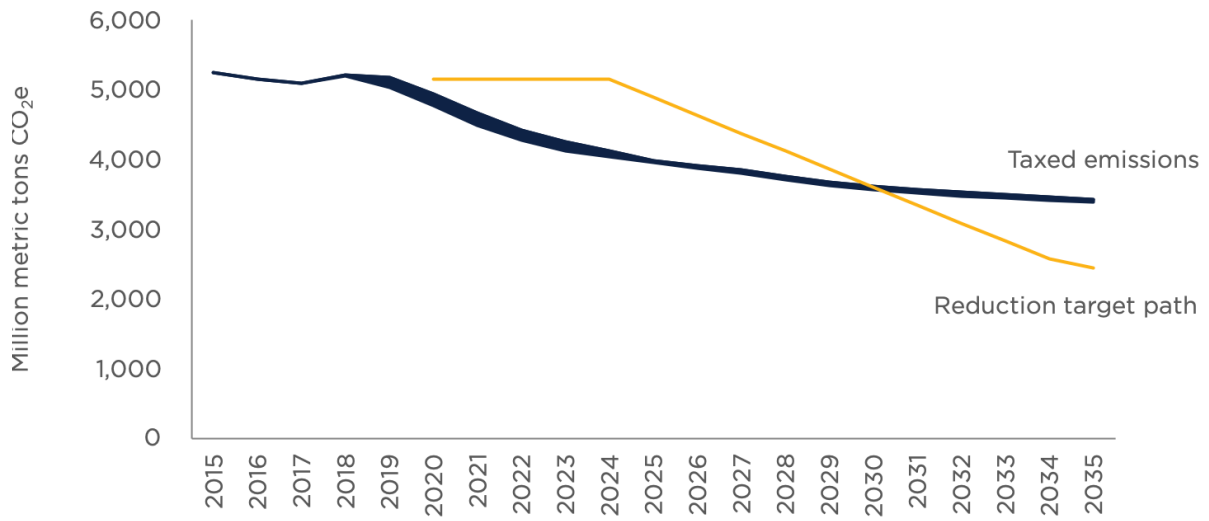
Emissions from other sectors also decline under the EICDA proposal, but not to the same degree as in the electric power sector. Some sectors, such as buildings and transportation, are slower to respond to a carbon tax because of relatively small changes in consumer prices, slow stock turnover, and other nonprice barriers such as principal-agent problems.<sup>7</sup> Some emissions sources, such as in the agriculture and waste sectors, are not subject to the carbon tax and in turn are little changed compared to current policy.<sup>8</sup> Taken together, we find that emissions from the rest of the US economy outside the electric power sector decline slowly under the EICDA proposal to 6–9 percent below 2005 levels by 2030. Still, emissions reductions are three times greater under EICDA than the 2–3 percent reduction from 2005 levels under current policy in that year.

As mentioned above, EICDA includes emissions targets and a provision that accelerates the annual carbon tax rate increases if taxed emissions from covered fuels are above these targets. Through 2030, we find that the provision in the proposal that adjusts the tax rate to meet emission-reduction targets for taxed emissions is not triggered in our scenarios (figure 3).

This analysis focuses on outcomes through 2030 due to the limitations of projecting energy systems over multiple decades. Looking at the results beyond 2030, the RHG-NEMS model shows that reductions in taxed emissions slow substantially and exceed the EICDA's emission-reduction targets in the early 2030s (figure 3). If this comes to pass, the tax rate in the proposal would increase at \$15/ton per year instead of the default \$10/ton per year until covered emissions are reduced to a point where they meet or exceed the targets. However, if we are underestimating the technological progress of clean energy or the behavioral responses to the carbon tax,<sup>9</sup> or if other policies are adopted that enable more rapid emissions reductions, the emissions targets could be achieved through early 2030 and beyond.



**Figure 3:** EICDA taxed emissions and emissions reduction targets, 2015-2035



Source: Rhodium Group analysis





# ENERGY IMPLICATIONS

The price on carbon contained in the EICDA proposal causes the US economy to shift from carbon-intensive energy sources to low- and zero-carbon energy sources. This shift underlies the emissions reductions discussed above. If their products are competitive in global markets, US fossil fuel producers can seek external markets, since exports are not taxed, and our analysis does not assume that comparable policies are put in place by US trading partners. Meanwhile, energy prices for all consumers rise to reflect the carbon tax. In turn, energy expenditures increase relative to current policy.

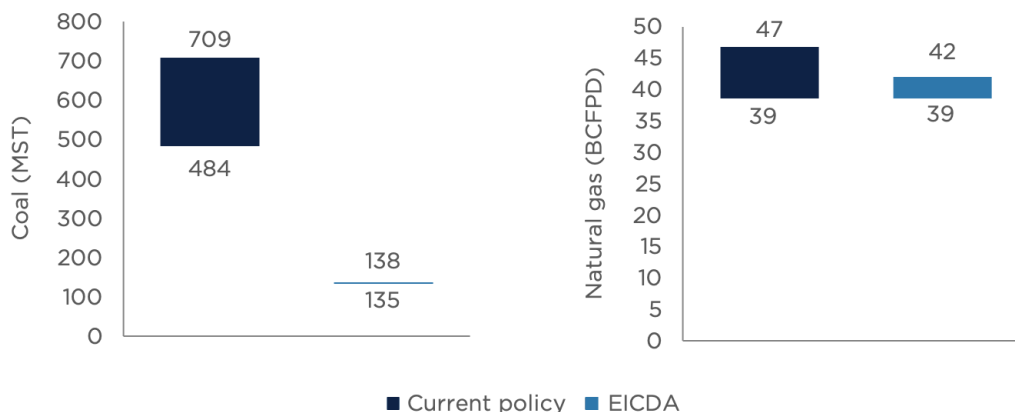
## Energy Production Implications

Looking across all US fossil fuel production, we find that the carbon tax has the largest impact on coal, because it is the most carbon-intensive fuel. In 2030, coal production is 135–138 million short tons under EICDA, which is a 72–81 percent reduction relative to current policy (figure 4), with remaining coal production predominantly serving consumers in the industrial sector.<sup>10</sup> We find that coal exports are roughly the same under EICDA as they are under a current policy scenario.

US oil production is essentially unchanged under EICDA compared to a current policy scenario. Fuel demand is lower under the carbon tax, but this translates into a reduction in net petroleum imports rather than a change in production.

Natural gas production in 2030 is projected to be similar under EICDA and under current policies in the high-energy cost scenario. In the low-energy cost scenario, projected natural gas production in 2030 is five billion cubic feet per day lower under EICDA due to deployment of renewable natural gas. This low-carbon alternative captures market share from fossil natural gas in response to the carbon tax.

**Figure 4:** US fossil fuel production, 2030



Source: Rhodium Group analysis

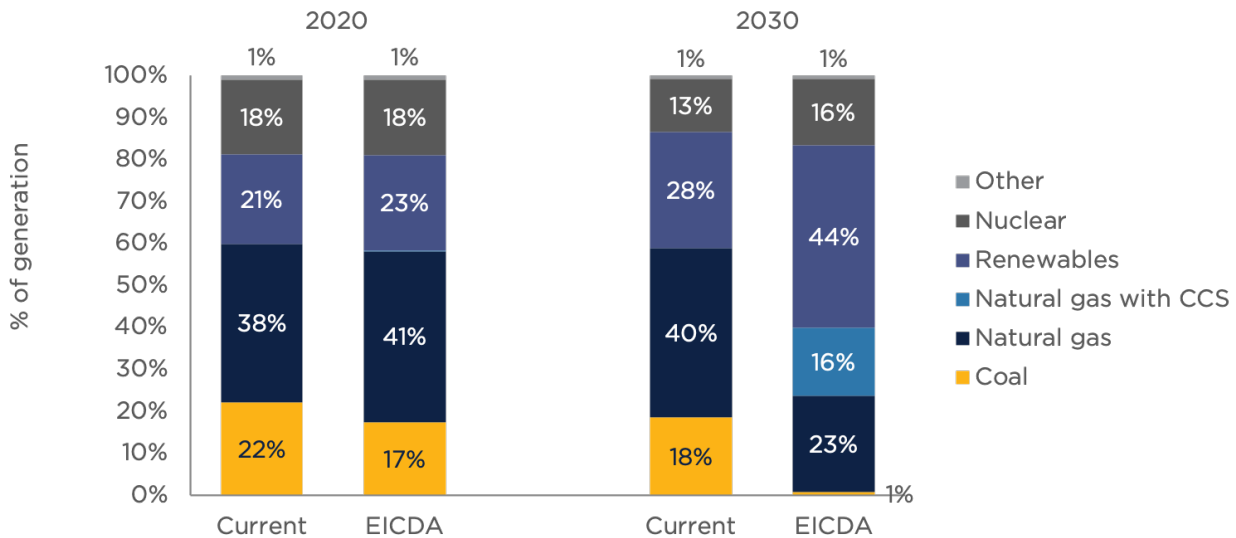


Electricity generation from zero- and low-CO<sub>2</sub>-emitting sources increases under EICDA compared to a current policy scenario. Figure 5 displays the results from our central-energy cost scenario. In 2020, the first year of the tax, we find that conventional natural gas and renewable generation both increase relative to a current policy scenario, displacing coal.

By 2030, the US electric system looks quite different under EICDA. Coal generation falls from 18 percent of generation under current policies to 1 percent of generation under EICDA in response to the carbon tax, and generation from natural gas without carbon capture and storage (CCS) declines by a similar amount. They are replaced in large part by renewables (primarily wind and solar), which increase to 44 percent of generation under EICDA; average annual deployment in the 2020s of solar and wind capacity are 20–24 gigawatts (GW) and 9–10 GW, respectively. Also replacing uncontrolled fossil generation are new natural gas-fired power plants equipped with CCS, which provides 16 percent of total generation in 2030.

Finally, EICDA causes nuclear generation to retain more of its current market share. While some retirements of nuclear plants will occur regardless of the carbon tax, under EICDA, the remaining nuclear plants are more competitive compared to uncontrolled fossil fuel generators. Depending on cost assumptions, between 4 and 30 GW of nuclear energy capacity retirements are avoided by 2030 due to EICDA, and nuclear energy provides about 16 percent of total generation under EICDA in each of the cost scenarios.<sup>11</sup>

**Figure 5:** US electric generation mix, 2020 and 2030



Source: Rhodium Group analysis. Note: Only central-energy cost results are shown.



## Energy Price Implications

The price on carbon in the EICDA proposal increases the cost of fuels and electricity for all consumers across the economy. We focus on prices for two key energy commodities: gasoline and electricity.

The carbon tax increases the price of transportation fuels in relation to their carbon intensity. Meanwhile, as consumers respond to price increases, travel demand declines; over time, some drivers choose electric vehicles over internal-combustion vehicles to reduce costs. This reduced demand for gasoline slightly dampens the overall impact of the carbon tax on gasoline prices. In 2020, we find that national average gasoline prices under EICDA are \$3.12–\$3.14 per gallon, compared to roughly \$3.00 per gallon under current policy (figure 6). As the tax rate escalates, gasoline prices increase. In 2030, gasoline costs \$4.33–\$4.41 per gallon under EICDA, which is roughly 90 cents more per gallon than under current policy in the same year.

**Figure 6:** US average gasoline prices, 2020 and 2030

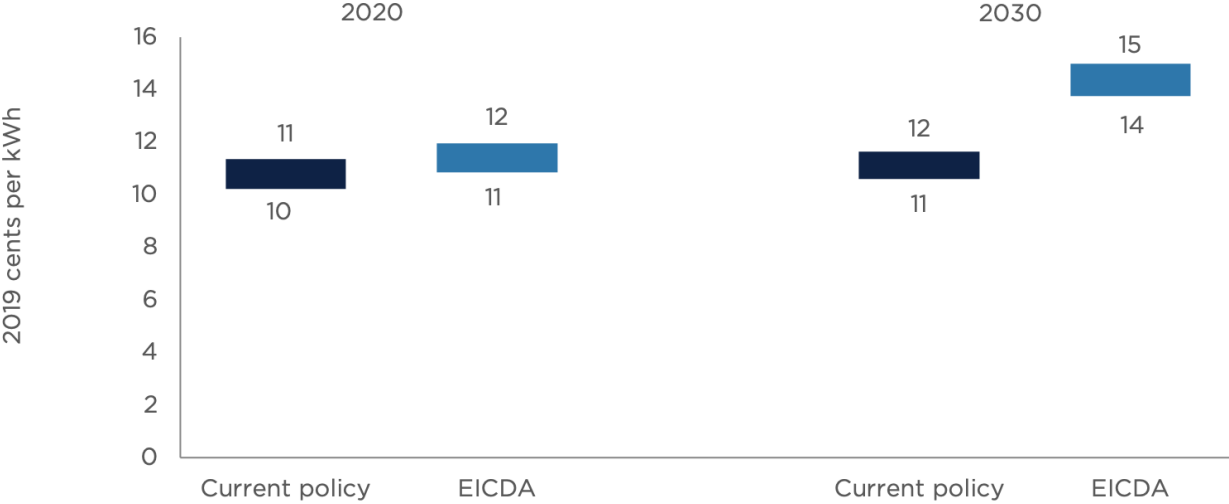


Source: Rhodium Group analysis

In the current policy scenario, national average electric prices rise from a range of 10–11 cents per kilowatt-hour (kWh) in 2020 to 11–12 cents per kWh in 2030 (figure 7). Under the EICDA proposal, wholesale electric prices increase as EICDA causes the cost of generation from fossil fuel-fired power plants to rise, leading electric markets to shift away from carbon-intensive resources. These higher costs flow through to retail rates. In 2020, average retail prices are 11–12 cents per kWh, or 9–10 percent higher than the current policy scenario; in 2030, prices are 14–15 cents per kWh, 25–27 percent higher than the current policy scenario. Consumers respond to higher prices by reducing demand, so the impacts on national average electric bills are smaller. In 2020, average bills are roughly 4–5 percent higher under EICDA than under current policy, and in 2030, bills are 22–24 percent higher.



**Figure 7:** National average electric prices, 2020 and 2030



Source: Rhodium Group analysis

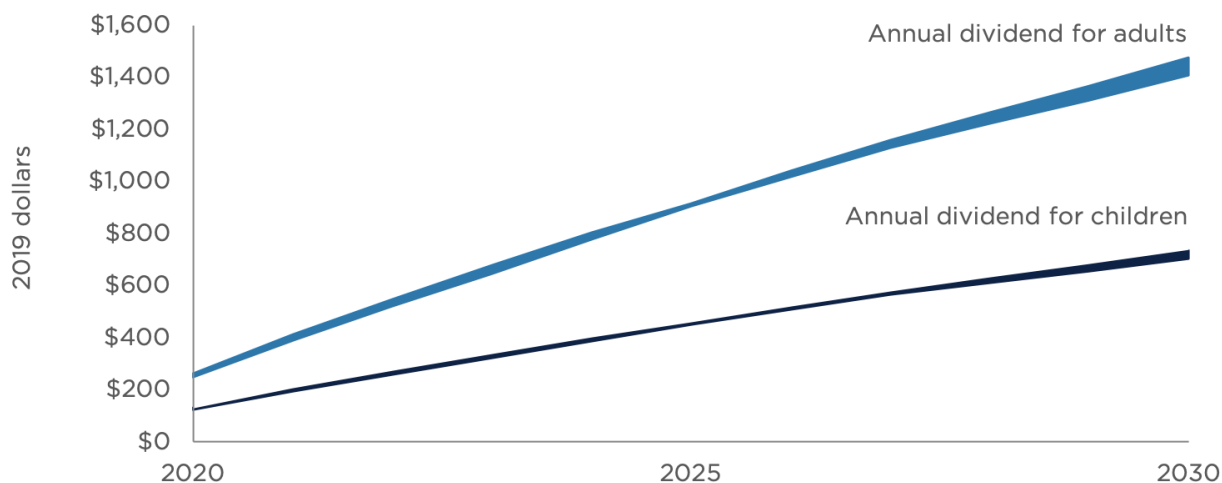


## REVENUE AND CARBON DIVIDEND

The tax generates substantial new revenue for the federal government. We estimate carbon tax gross revenue of \$72–\$75 billion in 2020. Because of the increasing tax rate, annual carbon tax gross revenue increases throughout the decade and reaches \$403–\$422 billion in 2030.

Carbon tax revenue is distributed in the form of a monthly dividend payment to anyone with a Social Security number or a tax identification number. An exception is for administrative expenses, which we assume account for 1 percent of carbon tax revenue each year.<sup>12</sup> Eligible individuals 19 years and older (adults) receive a full dividend, while those 18 years and younger (children) receive a half dividend. Figure 8 shows our estimates of the annual dividends, which are about \$250–\$260 for each adult and \$125–\$130 per child in 2020, rising steadily to \$1,410–\$1,470 for each adult and \$705–\$735 per child in 2030. Appendix A provides the details of these calculations.

**Figure 8:** EICDA estimated annual dividend payments, 2020-2030

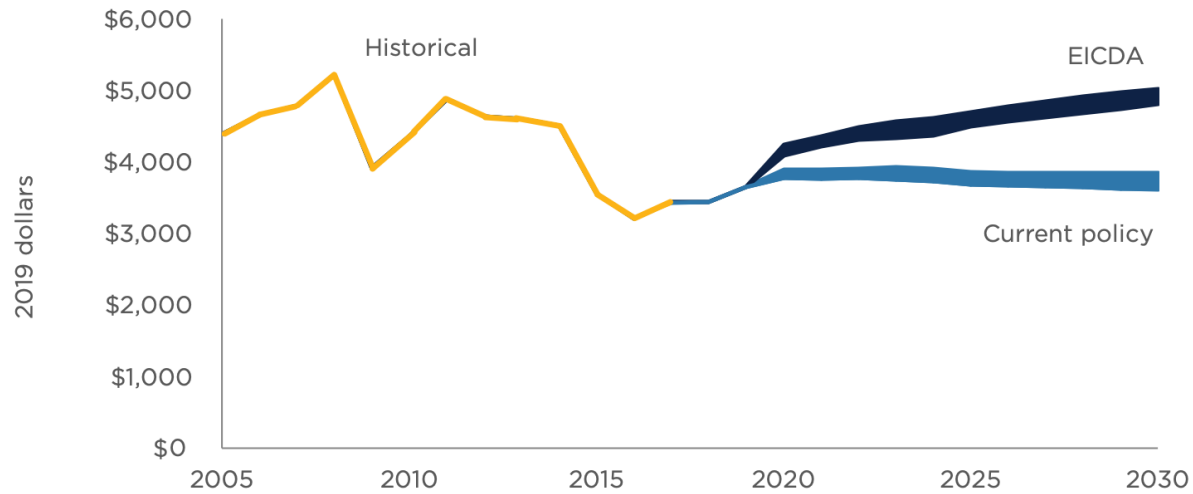


Source: CGEP and Rhodium Group analysis

A natural question is how the dividend payments compare to the impacts on consumers of increased energy prices. This is a difficult question to answer, but to inform it, we compare the dividend payments to the increases in per capita energy expenditures, defined as economy-wide expenditures divided by total population.

Figure 9 shows that the carbon tax increases per capita energy expenditures steadily through the 2020s, to \$5,035 per person in 2030 in the central-energy cost scenario. This is \$1,171 more than the comparable value under current policies. Even with a carbon tax rate of over \$100 per ton in 2030, per capita energy expenditures do not exceed the recent historical peak of \$5,214 during the commodities crisis in 2008.



**Figure 9:** US per capita energy expenditures, 2005-2030

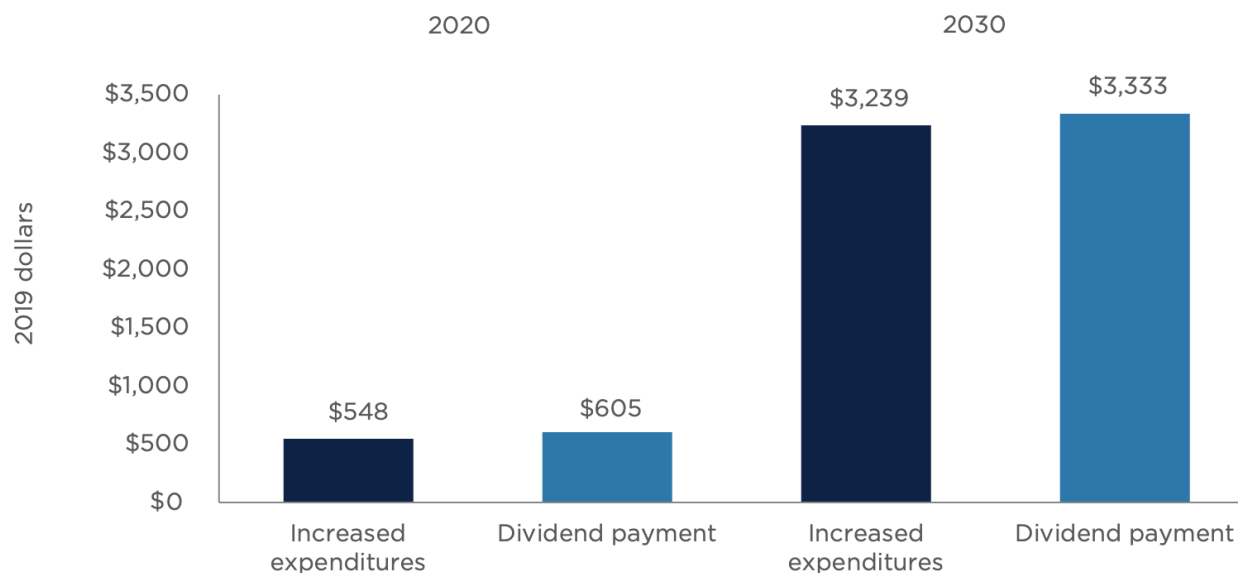
Source: Rhodium Group analysis

Figure 10 compares the annual dividend payments to the economy-wide increases in energy expenditures caused by EICDA for an average household in 2020 and 2030. It shows that the dividend payments are roughly equal to the increased expenditures, with the dividend payments slightly higher both years for the average household.

This is a coarse comparison for numerous reasons: the expenditure figures include energy price changes that are incurred in part by commercial services providers, industrial good providers, and transportation providers, which are likely to be passed on to households to some degree through increases in the cost of goods and services; the tax implications for both the dividend and the expenditures are ignored; and, of course, there will be significant differences in per capita expenditures across regions of the country and income levels. Still, it provides a high-level perspective on how dividends compare to increases in consumer energy costs.



**Figure 10:** Average household dividend payments and changes in household energy expenditures, 2020 and 2030



Source: CGEP and Rhodium Group analysis. Note: Household energy expenditures represent economy-wide energy expenditure increases averaged over all households. Dividends are calculated by taking total revenues of the tax less administrative fees and distributing them evenly among households.

## Impacts on Federal Government Revenue

The two largest changes in federal government revenue and expenditures caused by EICDA are the payments of the carbon tax and the payments of the carbon dividends. We estimate the gross revenue raised by the carbon tax is \$72–\$75 billion in 2020, rising to \$403–\$422 billion in 2030.

Since virtually all revenues are used to fund carbon dividends, carbon tax-and-dividend proposals are commonly described as “revenue neutral.” However, the actual effect on government revenue is more complicated due to numerous additional policy impacts.

First, under EICDA, the dividend payments are taxable income. We estimate that by taxing dividends, the federal government will collect an additional 10–12 percent of the carbon tax revenue each year. This is a progressive tax because the proportion of the tax payments from higher-income individuals is higher than the proportion of the population that is higher-income individuals. However, roughly half of the dividend tax payments come from individuals or households in the 10 or 12 percent marginal tax bracket (see appendix for details on these calculations).

Second, like any excise tax, the payments of a carbon tax leave individuals and businesses with less income and thus lower tax payments derived from that income. This is referred to

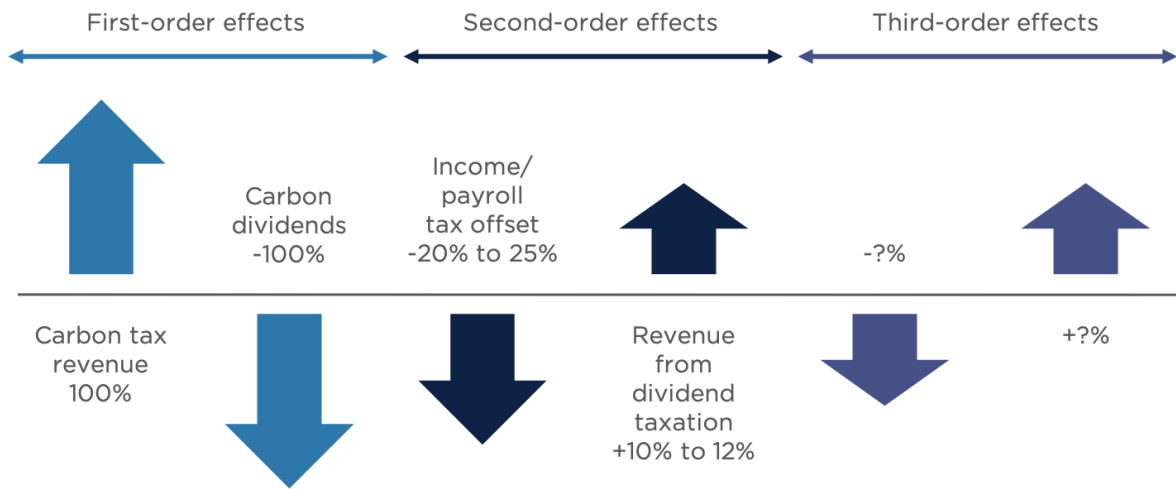


by the Joint Committee on Taxation and the Congressional Budget Office as the “Income and Payroll Tax Offset,”<sup>13,14</sup> and it implies lower government revenues. Recent analysis of separate carbon tax proposals in 2018 indicate that this offset could reduce government revenue by about 23 percent of the annual carbon tax revenue.<sup>15</sup>

Finally, there will be other effects that we have not quantified. Consumers will spend the carbon dividend, creating additional taxable income; to some extent, payments of the carbon tax will come in lieu of payments for other goods and services, which means less taxable income; perhaps most importantly, the carbon tax will lead to shifts in economic activity (and thus tax revenue) across the economy.

Figure 11 summarizes the effects on federal government revenue. Based on the impacts we can reasonably estimate, EICDA would be expected to cause a small decrease in federal government revenue in the early years of the policy. However, the effects we have not quantified could be large, particularly in the long run, making the net effects on federal government revenue unknown.<sup>16</sup>

**Figure 11:** Changes to government revenue from EICDA



Source: CGEP analysis





## How EICDA Compares to Other Proposals

In addition to EICDA, several legislative proposals that would put a price on carbon across the US energy system have been put forward in or about the last year.

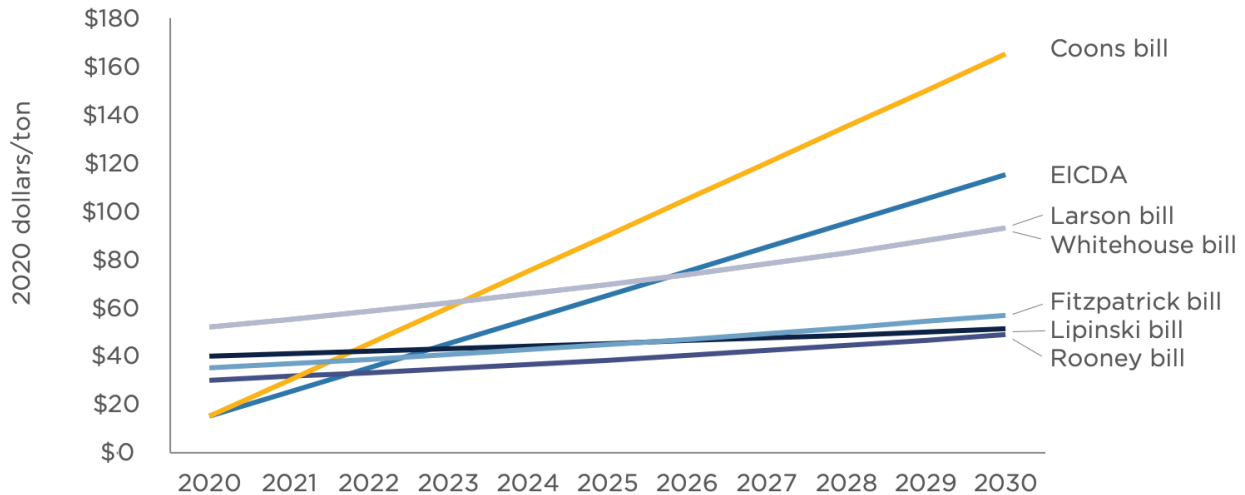
- The MARKET CHOICE Act proposed by Congressman Brian Fitzpatrick (R-PA) in September 2019 (“Fitzpatrick Bill”)
- The American Opportunity Carbon Fee Act proposed by Senator Sheldon Whitehouse (D-RI) in April 2019 (“Whitehouse Bill”)
- The Stemming Warming and Augmenting Pay Act proposed by Congressman Francis Rooney (R-FL) in July 2019 (“Rooney Bill”)
- The Climate Action Rebate Act proposed by Senator Chris Coons (D-DE) in July 2019 (“Coons Bill”)
- The Raise Wages, Cut Carbon Act proposed by Congressman Dan Lipinski (D-IL) in July 2019 (“Lipinski Bill”)
- The America Wins Act proposed by Congressman John Larson (D-CT) in August 2019 (“Larson Bill”)

In addition, in March 2019, Senator Chris Van Hollen (D-MD) and Congressman Don Beyer (D-VA) introduced legislation that would auction a limited number of carbon dioxide emissions permits and distribute the proceeds as an equal dividend (“Van Hollen Bill”).

EICDA and each of these proposals are more similar than different. Each of the policies puts a price on carbon across the energy system, with only minor differences in the emissions sources covered. Each includes a border carbon adjustment intended to protect the competitiveness of US firms, prevent emissions leakage, and encourage other countries to implement their own carbon prices. Each includes measures to protect low-income households from energy price increases they cannot afford.

Figure 12 shows the tax rates in each of the carbon tax proposals. EICDA carbon tax rates start lower than the other bills but increase at a rapid annual pace, making it a higher tax rate by the mid-2020s than every other bill except the Coons proposal. Not reflected in figure 12 are mechanisms in many of the proposals (EICDA, Coons, Fitzpatrick, and Rooney) to accelerate the tax rate increase if emissions targets are missed.



**Figure 12:** Comparing carbon tax rates across proposals, 2020-2030

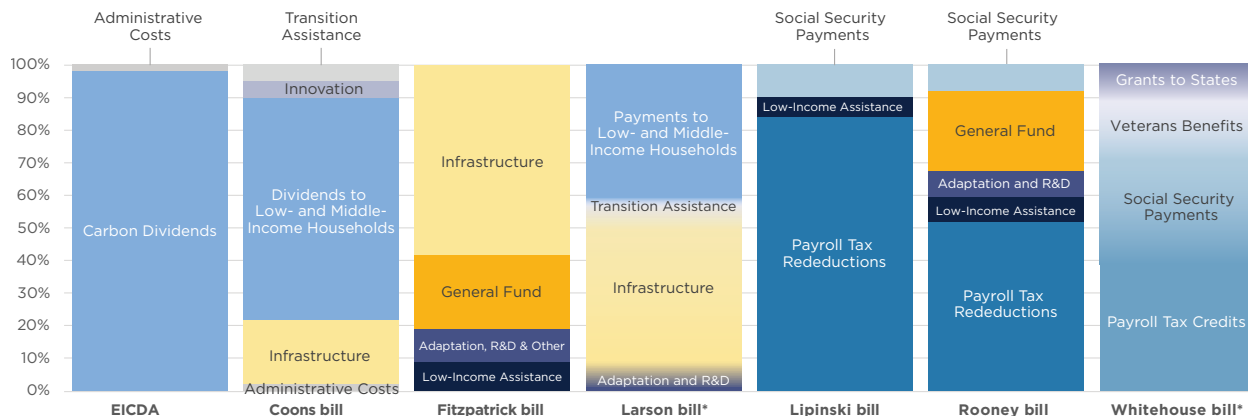
Source: CGEP analysis

All else equal, higher carbon tax rates drive deeper emissions reductions. However, in the near term, because large emissions reductions are available at a relatively low cost, there is generally diminishing additional emissions reductions for higher carbon tax rates (i.e., doubling the rates is unlikely to produce double the emissions reductions).

The other major difference among these carbon pricing proposals is the use of the revenue, displayed in figure 13. EICDA uses the revenue for equal carbon dividends. Other proposals use most revenues for infrastructure or to fund reductions in payroll taxes, and some use a small portion to invest in workers and communities dependent on the fossil fuel industry. All of the proposals set aside at least a portion of revenues for the protection of vulnerable households and communities.



**Figure 13:** Use of carbon tax revenues



Source: CGEP analysis

\*Larson and Whitehouse bills' revenue divisions are estimated; exact values will vary by year.

Finally, much has been made of the potential to swap a carbon tax for the elimination of regulations on the theory that such a trade would be appealing to the industry and certain regulations will become fully or partially redundant upon implementation of a price on carbon.<sup>17</sup> However, as shown in table 1, the differences across proposals in this regard are relatively minor thus far. The Coons, Larson, Van Hollen, and Whitehouse proposals do not change any existing regulations or authorities. Along with the Lipinski and Rooney proposals, EICDA suspends EPA authority to regulate CO<sub>2</sub> emissions from stationary sources; such regulations may be redundant to a policy such as EICDA.<sup>18</sup> The Fitzpatrick proposal suspends the same EPA regulations and repeals the federal fuel excise taxes.

**Table 1:** Policy modifications

EICDA, Lipinski, and Rooney bills	Fitzpatrick bill	Coons, Larson, and Whitehouse bills
Suspends EPA regulations of stationary-source CO <sub>2</sub> emissions covered by the carbon tax	<ul style="list-style-type: none"> <li>Suspends EPA regulations of stationary-source CO<sub>2</sub> emissions sources covered by the carbon tax;</li> <li>Repeals fuel excise taxes</li> </ul>	None



# IMPACTS NOT DIRECTLY MODELED

Our analysis focuses on the impacts of EICDA on emissions, energy markets, and revenues. The broader literature on carbon tax impacts provides certain robust findings that are likely to apply to EICDA as well. The following sections describe the literature’s findings on a few key issues beyond the scope of our analysis.

## Macroeconomic Impacts

A large-scale shift from high-carbon to low-carbon energy sources will have a wide-ranging effect on the US economy. A price on carbon is a uniquely cost-effective policy tool because it incentivizes emissions reductions wherever and however they can be achieved at the lowest cost. That is why economists almost universally support putting a price on carbon.<sup>19</sup>

For years, economists have been studying the potential economic impacts of carbon pricing policies. Model projections suggest small and typically negative impacts of a carbon tax on near-term macroeconomic outcomes like gross domestic product (GDP) compared to a current policy scenario. These studies are highly imperfect—they nearly always exclude the economic benefits of avoided regulations and reduced emissions, as well as any changes in technological progress stimulated by the tax.

Economic studies of carbon prices may be most useful in highlighting the trade-offs among policy design choices. Among carbon pricing policies, how the carbon tax revenue is used is the major differentiating factor in macroeconomic outcomes. Economic studies show that macroeconomic outcomes are best when carbon tax revenues are used in ways that correct preexisting inefficiencies in the US economy. For example, using revenue to reduce payroll taxes or income taxes would not only return the revenues to taxpayers but also provide financial incentives for increased work.

In contrast, using revenues for carbon dividends, as contemplated by EICDA, returns the carbon tax payments to eligible recipients without correcting existing distortions in the economy, so economic studies typically show slightly worse macroeconomic outcomes for carbon tax policies that use revenues for carbon dividends. According to recent empirical estimates, differing revenue uses could lead to differences in GDP in the range of 0 to 0.5 percent after 10 years of policy implementation.<sup>20</sup>

## Impacts on Low- and Middle-Income Households

The impacts on individual households of a price on carbon vary based on the characteristics of the household. Of particular concern are the consequences of rising energy prices for low- and middle-income households. One study estimated that in 2015, nearly one-third of US households had trouble either paying energy bills or maintaining adequate heating or cooling service.<sup>21</sup>

Many low-income households (particularly retirees) receive support from Social Security and other government assistance programs in which payments are tied to price levels (i.e., they increase with inflation); when the carbon tax increases energy prices, support from



these government programs will also increase. But this only partially shields households from higher prices.

Carbon tax revenue can be used in ways that offset these adverse impacts. EICDA's use of revenues for equal carbon dividends creates a highly progressive policy: on average, low- and middle-income households receive more in rebates than they pay out in increased prices of carbon-emitting services and products, while richer households pay more in carbon taxes than they receive in carbon dividends.<sup>22</sup> In addition, EICDA proposes an "advanced carbon dividend" paid to individuals before the first collection of the tax, which should avoid concerns associated with the limited liquidity of low-income households (i.e., the potential difficulties of paying the higher energy prices before receiving the carbon dividends).

Carbon tax proposals that do not use revenues for carbon dividends typically compensate low-income households in other ways, for example, by earmarking a portion of the carbon tax revenue for monetary transfers to low-income households.

Finally, as lower-income and minority households suffer disproportionately from the impacts of criteria air pollutants, such as SO<sub>2</sub>, mercury, particulate matter, and ozone, they are likely to benefit disproportionately from pollution mitigation. While this paper does not explicitly model cobenefits, studies have shown that reducing air pollutants can significantly reduce morbidity and mortality.<sup>23</sup> Coal power is a key source of these pollutants. Under EICDA, our modeling finds that in the power sector, sulfur dioxide and mercury emissions would be reduced by over 95 percent and emissions of nitrogen oxides would be reduced by about 75 percent in 2030 compared to current policy.

## Regional Impacts

Nationwide results mask significant subnational variation in the impacts of a carbon tax. A region's carbon intensity, the availability of cheap low-carbon substitutes, and the characteristics of household energy expenditures across different geographic locations will all influence the impacts of the carbon tax.

Shifting behavior and economic incentives will impact industries differently. The most acute impact of this shift will be felt within communities focused on mining and burning coal for power production, because our analysis of EICDA shows that the use of coal in the US power sector is virtually eliminated by 2030. The coal industry is relatively small in the United States: roughly 161,000 workers were employed in the coal mining, coal transport, and coal-fired electric-generation sectors in 2018.<sup>24</sup> But coal production is highly geographically concentrated. Towns and counties across Appalachia and the Western United States are dependent on the coal industry for jobs and tax revenues. In the absence of a large-scale effort to support these regions, any serious climate-mitigation policy would have significant adverse consequences on the coal industry and thus on coal-dependent regions.<sup>25</sup>

Carbon tax revenues can be used in ways to compensate adversely affected regions of the country. Proposals commonly include grants to states to assist vulnerable households and regions. Additionally, billions of dollars in annual investments to revitalize coal communities could be funded with a very small portion of carbon pricing revenue. Using all revenue for carbon dividends will sacrifice such opportunities, although such programs could potentially be funded with accompanying legislation.



# APPENDIX A: METHODOLOGY FOR ESTIMATING THE CARBON DIVIDEND AND ITS TAXATION

This appendix provides a step-by-step description of the methodology used to estimate the annual carbon dividends and the government revenue from taxing the carbon dividends as income.

The starting point is the estimates from the RHG-NEMS model of the annual payments of the carbon tax under EICDA. The EICDA proposal generates roughly \$72-\$75 billion in gross revenue in 2020. Because of the increasing tax rate, annual carbon tax revenue increases \$422 billion in 2030 in the central-energy cost scenario. EICDA sets aside a small portion of the carbon tax revenues for administrative expense; we assume 1 percent of the total annual revenues is used for administrative expenses.

The remainder of the revenue is allocated for equal carbon dividends, with eligible adults (19 years and older) receiving a full share and eligible children receiving a half share. We use data from the RHG-NEMS model and the US Census to estimate the total US population by age.<sup>26,27</sup>

Individuals are eligible for the carbon dividend if they have a Social Security or taxpayer identification number. As a proxy for the portion of the total population that is ineligible for the carbon dividend, we use data on the unauthorized immigrant population in the United States from the Pew Research Center.<sup>28</sup>

We estimate a 2018 population of eligible adults of 241 million and eligible children of 77 million. We assume the population grows between 0.7 and 0.8 percent per year using data from RHG-NEMS. The annual carbon dividends for adults and children are then calculated using the annual estimates of the total revenue (after administrative expenses) and eligible adults and children.

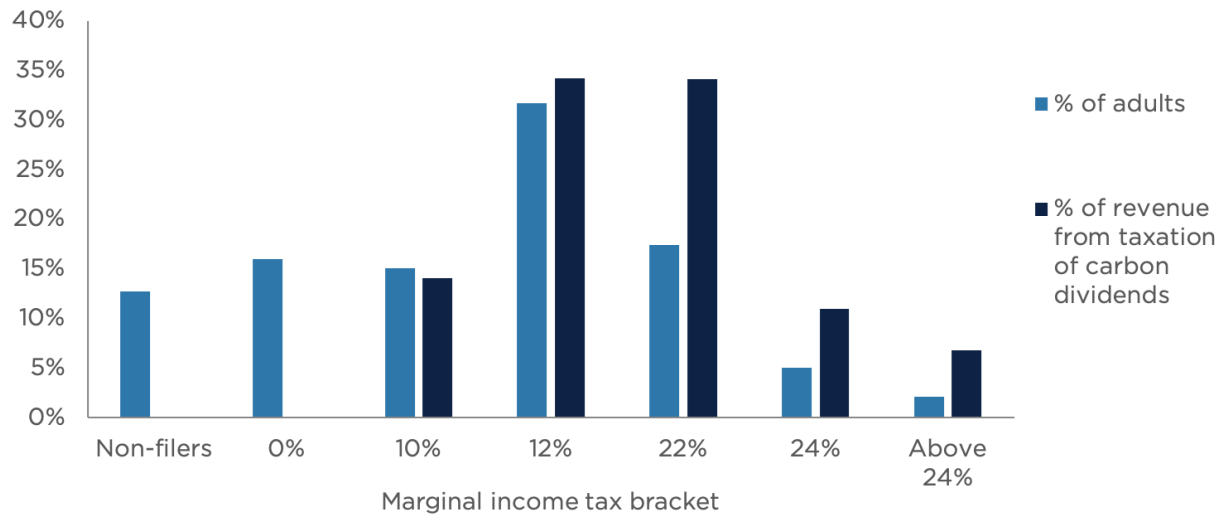
The Tax Policy Center<sup>29,30</sup> provides the data of distribution of tax units by marginal tax bracket, presence of children, and marital status as of December 2018. Using these data and our estimates of the total population of adults and children, we estimated the number of adults and children within each marginal tax bracket.

Finally, we estimate the total carbon dividend payments to individuals within each marginal tax bracket and then apply the marginal tax rate to estimate the government revenue from the taxation of dividends. Total government revenues from the taxation of dividends divided by the total carbon tax payments (i.e., gross revenues from the carbon tax) is roughly 10-12 percent in each year.

Figure A1 displays the distribution of eligible adults and the taxation of carbon dividends by marginal tax bracket. These distributions show that like the income tax in the United States, the taxation of the carbon dividends is progressive, with higher-income households paying more than proportionately. However, the majority of income comes from households in the 12 and 22 percent tax brackets.



**Figure A1:** Distribution of eligible adults and carbon dividend taxation revenue



Source: CGEP analysis



# NOTES

1. For more information on RHG-NEMS, see <https://rhg.com/impact/us-climate-service/>.
2. John Larsen, Kate Larsen, Whitney Herndon, Peter Marsters, Hannah Pitt, and Shashank Mohan, *Taking Stock*, June 28, 2018, <https://rhg.com/research/taking-stock-2018/>.
3. Larsen et al., “Technical Appendix,” *Taking Stock*.
4. For a complete description of all input assumptions and model details, see <https://rhg.com/research/taking-stock-2018/> and <https://rhg.com/research/energy-and-environmental-implications-of-a-carbon-tax-in-the-united-states/>.
5. Larsen et al., *Taking Stock*. This assumption is done to simplify the analysis. If LULUCF (Land Use, Land-Use Change, and Forestry) trends follow the pessimistic pathway, then net GHG results will be higher than reported here.
6. Two-thirds of US electric load is served by competitive wholesale electric power markets where generators directly compete on costs. See Federal Energy Regulatory Commission, *Electric Power Markets: National Overview*, April 10, 2019, <https://www.ferc.gov/market-oversight/mkt-electric/overview.asp>. The remaining electric load is served by integrated utilities and other entities, such as cooperatives and municipal utilities. While this subset of the electric sector does not directly compete on costs, these organizations are still incentivized to provide least-cost service to consumers. A carbon tax will drive operations and investment decisions to shift away from carbon-intensive generation in a similar way to what’s expected in competitive markets.
7. We assume consumers respond to carbon taxes like they respond to other comparable energy price changes. If consumers are more responsive to the more permanent and visible price changes caused by a carbon tax, energy consumption and energy bills will be lower than we project.
8. For a comprehensive discussion of sectoral emissions implications of carbon taxes, see John Larsen, Shashank Mohan, Peter Marsters, and Whitney Herndon, *Energy and Environmental Implications of a Carbon Tax in the United States*, July 17, 2018, <https://rhg.com/research/energy-and-environmental-implications-of-a-carbon-tax-in-the-united-states/>.
9. Indeed, there are reasons to believe that most energy system models, including RHG-NEMS, may underestimate the potential emissions impacts of a carbon tax because, for example, models cannot anticipate the cost and performance of future low-carbon technologies that in many cases have yet to reach commercial scale. They also do not capture the accelerated innovation in low-carbon technologies caused by the carbon tax. See Noah Kaufman, Michael Obeiter, and Eleanor Krause, “Putting a Price on Carbon: Reducing Emissions,” *World Resources Institute Issue Brief*, January 2016, (Washington: World Resources Institute).





10. The broad range of coal production under current policy reflects uncertainty around future natural gas prices and the cost of renewable energy technologies. Both factors can materially change the share of coal generation in the electric power sector by 2030.
11. 2030 nuclear capacity under current policies is projected to be between 58 and 84 GWs, depending on energy costs. Under EICDA, 88 GWs of nuclear capacity is projected to be in operation in 2030 regardless of energy costs.
12. According to our estimates, 1 percent of gross carbon tax revenue would provide an average of \$2.7 billion per year for administrative expenses over the first decade. To help put this in context, \$2.7 billion is about one-third of the sum of 2017 administrative expenses for Social Security payments (\$3.8 billion for the Old Age and Survivors Insurance Trust Fund) and IRS enforcement costs (\$4.7 billion). For details, see the Social Security Administration website at <https://www.ssa.gov/oact/STATS/admin.html> and the IRS website at <https://www.irs.gov/statistics/irs-budget-and-workforce>.
13. Joint Committee on Taxation, *The Income and Payroll Tax Offset to Changes in Excise Tax Revenues (JCX-59-11)*, Dec. 23, 2011, <https://www.jct.gov/publications.html?func=startdown&id=4378>.
14. G. Thomas Woodward, “The Role of the 25 Percent Revenue Offset in Estimating the Budgetary Effects of Legislation,” *Congressional Budget Office Economic and Budget Issue Brief*, Jan. 13, 2009, <https://www.cbo.gov/sites/default/files/cbofiles/ftpdocs/96xx/doc9618/01-13-25percentoffset.pdf>.
15. Note that the assumption traditionally used by the Congressional Budget Office for the income and payroll tax offset is 25 percent, which does not take into account the potential for increased revenue for taxable dividends. See Joseph Rosenberg, Eric Toder, and Chenxi Lu, *Distributional Implications of a Carbon Tax*, July 17, 2018, <https://energypolicy.columbia.edu/research/report/distributional-implications-carbon-tax>.
16. John W. Diamond and George R. Zodrow, *The Effects of Carbon Tax Policies on the US Economy and the Welfare of Households*, July 18, 2018, [https://energypolicy.columbia.edu/sites/default/files/pictures/CGEP\\_Effects\\_of\\_CarbonTaxPolicies\\_US\\_Economy\\_Welfare\\_of\\_Households.pdf](https://energypolicy.columbia.edu/sites/default/files/pictures/CGEP_Effects_of_CarbonTaxPolicies_US_Economy_Welfare_of_Households.pdf).
17. Justin Gundlach, Ron Minsk, and Noah Kaufman, *Interactions between a Federal Carbon Tax and Other Climate Policies*, March 6, 2019, <https://energypolicy.columbia.edu/research/report/interactions-between-federal-carbon-tax-and-other-climate-policies>.
18. Ibid.
19. IGM Forum, *Carbon Taxes II*, Dec. 4, 2012, <http://www.igmchicago.org/surveys/carbon-taxes-ii>.
20. Diamond and Zodrow, *The Effects of Carbon Tax Policies*.
21. Lauren Ross, Ariel Drehobl, and Brian Stickles, “The High Cost of Energy in Rural America: Household Energy Burdens and Opportunities for Energy Efficiency,” *ACEEE*, July, 2018, <https://aceee.org/sites/default/files/publications/researchreports/u1806.pdf>.



22. Diamond and Zodrow, *The Effects of Carbon Tax Policies*.
23. Mercedes Bravo, Keita Ebisu, Francesca Dominici, Yun Wang, Roger Peng, and Michelle Bell, "Airborne Fine Particles and Risk of Hospital Admissions for Understudied Populations: Effects by Urbanicity and Short-Term Cumulative Exposures in 708 US Counties," *Environmental Health Perspectives* 125 (April 2017), 594–601, <https://ehp.niehs.nih.gov/doi/full/10.1289/EHP257>.
24. National Association of State Energy Officials and the Energy Futures Initiative, *2019 US Energy and Employment Report*, March, 2019, <https://www.usenergyjobs.org>.
25. Adele C. Morris, Noah Kaufman, and Siddhi Doshi, *The Risk of Fiscal Collapse in Coal-Reliant Communities*, July 15, 2019, [https://energypolicy.columbia.edu/sites/default/files/file-uploads/RiskofFiscalCollapseinCoalReliantCommunities-CGEP\\_Report\\_080619.pdf](https://energypolicy.columbia.edu/sites/default/files/file-uploads/RiskofFiscalCollapseinCoalReliantCommunities-CGEP_Report_080619.pdf).
26. For total population, see "United States Quickfacts," US Census, July 1, 2018, <https://www.census.gov/quickfacts/fact/table/US/PST045218>.
27. For population by age, see *Estimates of US Population by Age and Sex: April 1, 2010, to July 1, 2017*, US Census, April 19, 2018, <https://www.census.gov/newsroom/press-releases/2018/pop-characteristics.html>.
28. Jeffrey S. Passel and D'Vera Cohn, *Unauthorized Immigrant Population: National and State Trends, 2010*, Feb. 1, 2011, <http://www.pewhispanic.org/2011/02/01/unauthorized-immigrant-population-brnational-and-state-trends-2010/>.
29. Urban-Brookings Tax Policy Center, *Number of Tax Units by Tax Bracket and Presence of Children, 2018*, Dec. 10, 2018, <https://www.taxpolicycenter.org/model-estimates/baseline-distribution-tax-units-tax-bracket-and-presence-children-december-2018-0>.
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