POLICY MEMO · BUILD BACK BETTER ACT

Assessing the Costs and Benefits of Clean Electricity Tax Credits

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The U.S. House of Representatives passed the Build Back Better Act in November 2021. If enacted, the Act will make unprecedented investments in climate change mitigation, including substantial changes to clean electricity tax credits. Building on previous modeling conducted by Rhodium Group, we analyze the costs and benefits of tax provisions similar to those passed by the House. These provisions reduce cumulative power sector carbon dioxide (CO_2) emissions by 13-22% from 2022-2050, compared to a scenario without these policies. This corresponds to a 64-73% reduction in 2031 electric power emissions below 2005 levels.

We find that the benefits of the clean electricity tax credits are roughly 3-4 times greater than the costs.[1] Cumulatively, the benefits from the policies range from $335 billion to $1.8 trillion, while the costs range from $130 billion to $309 billion.[2] On a per ton basis, the tax credits will reduce CO_2 emissions at a cost of roughly $33-$50 per ton. These costs are less than estimates of the damages from the release of an additional ton of CO_2, i.e. the social cost of carbon (SCC), and are substantially less expensive than most current policies to reduce CO_2 emissions. These benefits only account for reductions in CO_2 emissions and do not include any co-benefits from reductions in conventional air pollution emissions, which would likely further improve cost effectiveness.

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[1] Under 2% discount rate and $121 social cost of carbon (see below). For 2% discount rate in general, multiples range from 2:1 ($51 SCC; low cost scenario) to 8.1:1 ($250 SCC; central cost scenario).

[2] Using 2% discount rate (see below). Numbers presented in 2020 USD.

Build Back Better's Clean Electricity Tax Credits

On November 19, 2021, the U.S. House of Representatives passed the Build Back Better Act[1] (BBB), a broad, $2.2 trillion piece of legislation that includes major investments in climate change, as well as health care, education, and the social safety net. The bill is currently under consideration in the U.S. Senate.

Included among the bill's $550 billion[2] in climate change funding are several provisions critical to accelerating clean energy deployment in the United States. The bill extends and expands production tax credits (PTC) and investment tax credits (ITC) for zero-emitting generators. The bill provides a credit of up to 2.5 cents per kilowatt-hour (kWh) or up to 30% of qualified investment costs for new clean electricity generating facilities that meet apprenticeship and prevailing wage requirements. It does so first as an extension of existing PTC and ITC statutes through 2026 and then under a new clean electricity PTC and ITC thereafter (until predetermined emission reduction thresholds are met). Under a new zero-emission nuclear power PTC, the bill separately provides up to 1.5 cents/kWh to help existing nuclear plants stay online, scaled by the revenue of those plants. If they meet certain domestic content requirements, developers can take these tax credits via a direct pay mechanism. Direct pay eliminates the need to partner with tax equity investors, removing financing bottlenecks that would otherwise slow clean energy deployment.

Rhodium Group released[3] "Pathways to Build Back Better: Maximizing Clean Energy Tax Credits" in June 2021, which models several changes to tax policy similar to those proposed under BBB. Specifically, the report modeled a 2.5 cents/kWh PTC and 30% ITC available to new zero-emitting generating resources available through 2031, as well as a provision to retain existing nuclear generators without an announced retirement date. Though the modeled policies do not precisely align with the House-passed language, they are a reasonable proxy for the emissions impacts and costs of the provisions within BBB. Notably, the modeled policies do not include the extension of the ITC to grid storage and transmission projects, deadline extensions for residential and commercial distributed solar ITCs, or changes to the carbon capture tax credits in section 45(Q), so these policies are outside the scope of this analysis. In "Pathways to Paris: A Policy Assessment of the 2030 US Climate Target," Rhodium Group modeled the effects of this more expansive set of power sector tax credits, plus federal executive and state actions, and found still more opportunities for emission abatement, including beneficial interactions between tax policy and other decarbonization policies.

Method

Cost-benefit analyses compare the sum of potential benefits for a given policy against the associated costs, allowing for an economic assessment of policies. In our cost-benefit analysis of the modeled clean energy tax credits, we measure the benefits from projected reductions in CO_2 emissions. On the cost side, we account for projected increases in power system costs and the costs of raising government revenue to fund the tax credits. We then apply a discount rate to determine the present value of the policy's costs and benefits. To measure the dollar value of the policy's benefits, we apply estimates of the social cost of carbon (SCC), the monetized damages of an additional metric ton of CO_2, to the projected emissions reductions calculated by Rhodium Group. Thus, we calculate the gross benefits of the tax incentives as the present value of the product of reduction in CO_2 emissions and the SCC.

We run three scenarios with different values of the SCC. The Biden Administration set an interim value[4] of the SCC of $51 for 2020, which is a carryover from the Obama Administration. It is widely believed to be too low[5], but we nevertheless monetize benefits at this value. The State of New York updated the Obama numbers based on changes in international capital markets to $121 per metric ton[6] of CO_2 for 2020 and uses it for setting state policies. Therefore, we assess benefits at this value. Finally, we assess the benefits at $250[7] per ton of CO_2, which is a ballpark estimate of the effects of updating the SCC to reflect recent research that finds that climate damages are larger than previously understood.

To measure the policy's costs, we use Rhodium Group's estimates of total electric power system costs, inclusive of private sector costs and increased fiscal cost to the federal government. There is an increase in overall system costs when including both private and public expenditures as the tax credits are not precisely calibrated to pay for the incremental difference between the clean technology they are incenting and the incumbent fossil technologies they are meant to displace in the dispatch stack. Though private costs to utilities and clean energy developers decrease, the overall system costs increase owing to this inefficiency.

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[1] U.S. House of Representatives, "Build Back Better Act." (H.R.5376).

[2] House Committee on the Budget, "The Build Back Better Act."

[3] Larsen et al., "Pathway to Build Back Better: Maximizing Clean Energy Tax Credits."

[4] Interagency Working Group, "Technical Support Document."

[5] Carleton and Greenstone, "Updating the United States Government's Social Cost of Carbon."

[6] New York State Department of Environmental Conservation. "Climate Change Guidance Documents."

[7] The SCC grows over time, consistent with empirical findings. For the $250 value, we use the SCC growth rates from the SCC estimation of $121 by NYDEC (2021). For the $51 value, we follow the United State Government's time path, see Interagency Working Group (2021).

The Rhodium Group cost estimates include two scenarios[8]: a low cost scenario and a central cost scenario. These pathways reflect a range of cost and performance estimates for electric generating technologies from the National Renewable Energy Laboratory's Annual Technology Baseline as well as additional research conducted by Rhodium Group.[9]

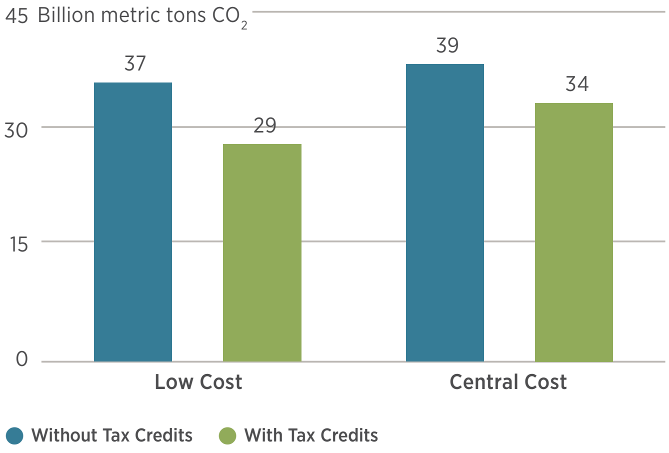
Moreover, we account for the cost of taxes levied to finance the policy. A well-studied phenomenon in economics is that taxes can reduce total economic production by distorting incentives in the market. For example, increasing corporate profit taxes may cause businesses to relocate their production to other countries with lower tax rates. Using a standard value from the literature, we assume that the cost of such distortions is 40%[10] of the total revenue raised.

Though tax incentives phase out in 2031, the costs and benefits of the policies are spread out over the next 30 years. We calculate the present value of the costs and benefits at discount rates of 2%, 3%, and 5%. The 3%[11] figure has been used historically to represent the riskless real interest rate, however, the 2%[12] value better reflects changes in international capital markets over the last several decades. The 5% discount rate is also commonly used to conduct cost-benefit analyses. We treat the 2% discount rate as the base case.

The Benefits of Clean Energy Tax Incentives

FIGURE 1

Cumulative Power Sector CO_2 Emissions, 2022-2050



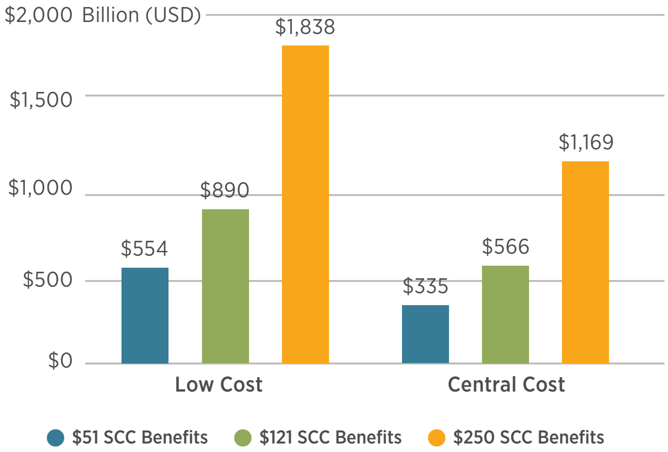
Note: Reduction in CO_2 emissions over time can be found in Figure A1 in the appendix.

The tax incentives lead to large reductions in CO_2 emissions in both technology scenarios. Figure 1 plots cumulative emissions with and without the tax credits from 2022 through 2050. The cumulative reduction in CO_2 emissions under the low and central clean energy technology cost pathways are 8.1 billion metric tons and 5.1 billion metric tons, respectively. This represents a 13-22% reduction in emissions, relative to a scenario without tax credits. At peak, the tax credits reduce CO_2 emissions by 33-45% in the power sector in 2031, relative to a baseline without those investments. This corresponds to a 64-73% reduction in 2031 electric power emissions below 2005 levels.

The monetary benefits of these CO_2 emissions reductions are substantial. Figure 2 reports the gross benefits for the two technology scenarios at the three SCC estimates. The benefits range from $335 billion to $1.2 trillion in the central cost pathway and from $554 billion to $1.8 trillion[13] in the low cost pathway.

FIGURE 2

Climate Benefits of the Tax Incentives



Note: Present value of gross benefits of tax incentives as captured by $51, $121, and $250 SCC, in billions of dollars. Gross benefits are discounted at 2%. Year-specific SCC is applied.

It is noteworthy that the estimates of the gross benefits are likely to be conservative. Specifically, they understate the full benefits because they do not account for any co-benefits[14] from reductions in conventional air pollution emissions, like particulate matter and sulfur dioxide.

The Costs of Clean Energy Tax Incentives Are Less than the Benefits

The tax incentives have two costs: increased overall costs to the electric power system (including private and public expenditures) and a deadweight loss owing to reductions

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[8] Larsen, et al., "Taking Stock 2020: The COVID-19 Edition."

[9] See the "Taking Stock 2020: Technical Appendix" for further detail. A short summary of the two pathways is summarized in the appendix.

[10] Finkelstein and Hendren "Welfare Analysis Meets Causal Inference."

[11] OMB, "Circular A-4."

[12] Greenstone and Stock, "The Right Discount Rate for Regulatory Costs and Benefits."

[13] Gross benefits assuming 2% discount rate.

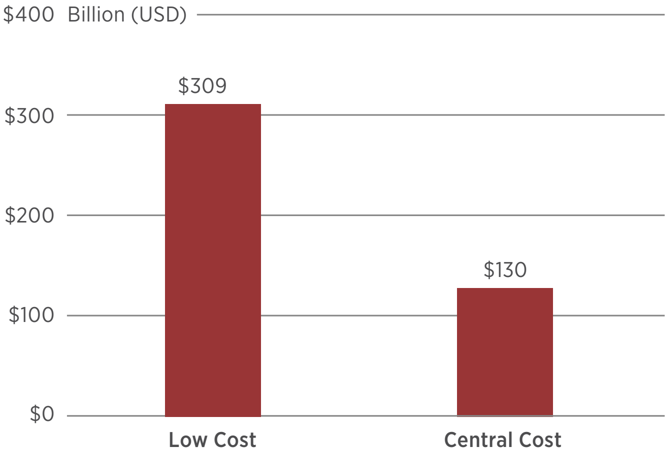
[14] Lee and Greenstone, "Air Quality Life Index Annual Update."

in economic efficiency due to taxes levied by the federal government to pay for the policies. Figure 3 plots the present value of these costs, which range from $309 billion in the low cost case to $130 billion in the central cost case.[15] More clean energy is deployed in the low cost pathway relative to the central cost pathway, thus the economic costs are higher in that case (as are the emission reductions). On an annual basis, these costs peak in 2031, the year that the modeled tax credits expire, as developers rush to take advantage of the credits. In the subsequent years, the costs reflect the continuing higher costs for operating the electric power system and tax expenditure costs for the remaining PTC payments. These costs decline as the increasing numbers of projects reach the end of the ten-year payment period of the PTC.

Figure 4 plots the present value of the benefits (as seen in Figure 2) along with the costs of the clean energy tax incentives under the two technology cost scenarios and for the three estimates of the SCC. Under the low technology cost scenario, the net benefits range from $245 billion to $1.5 trillion, while they range from $205 billion to $1 trillion with the central technology cost scenario.[16] The most striking feature of these results is that the benefits significantly outweigh the costs in all scenarios. With a $121 SCC[17], the ratio of the benefits to costs is 3:1 in the low technology case and 4:1 in the central technology case.[18]

FIGURE 3

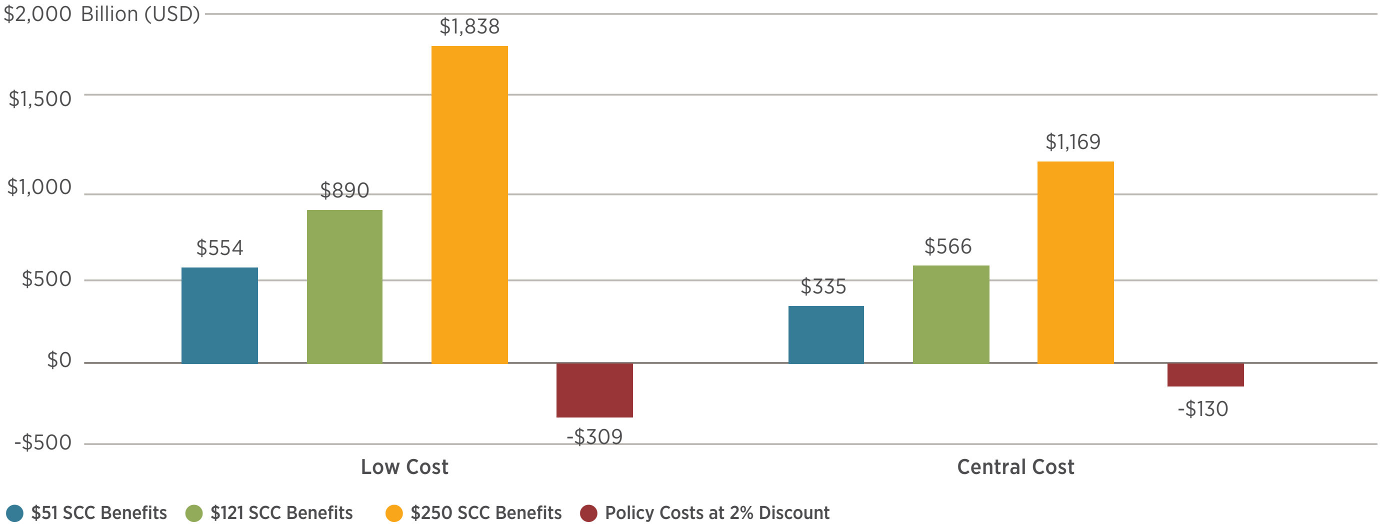
Costs of the Tax Incentives



Note: Present value of policy costs discounted at 2%. Policy costs over time can be found in Figure A2 in the appendix.

FIGURE 4

Costs and Climate Benefits of the Tax Incentives



Note: Present value of net benefits of tax incentives as captured by $51, $121, and $250 SCC. Gross benefits and costs are discounted at 2%, and year-specific SCC is applied. Estimates under 3% and 5% discount rates are presented as net benefits in Table A1 in the appendix.

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[15] Assuming 2% discount rate. Under 3% discount rate, these costs are $270 billion in the low cost case, and $116 billion in the central cost case. Similarly, under 5% discount rate, costs are $208 billion in the low cost case, and $94 billion in the central cost case.

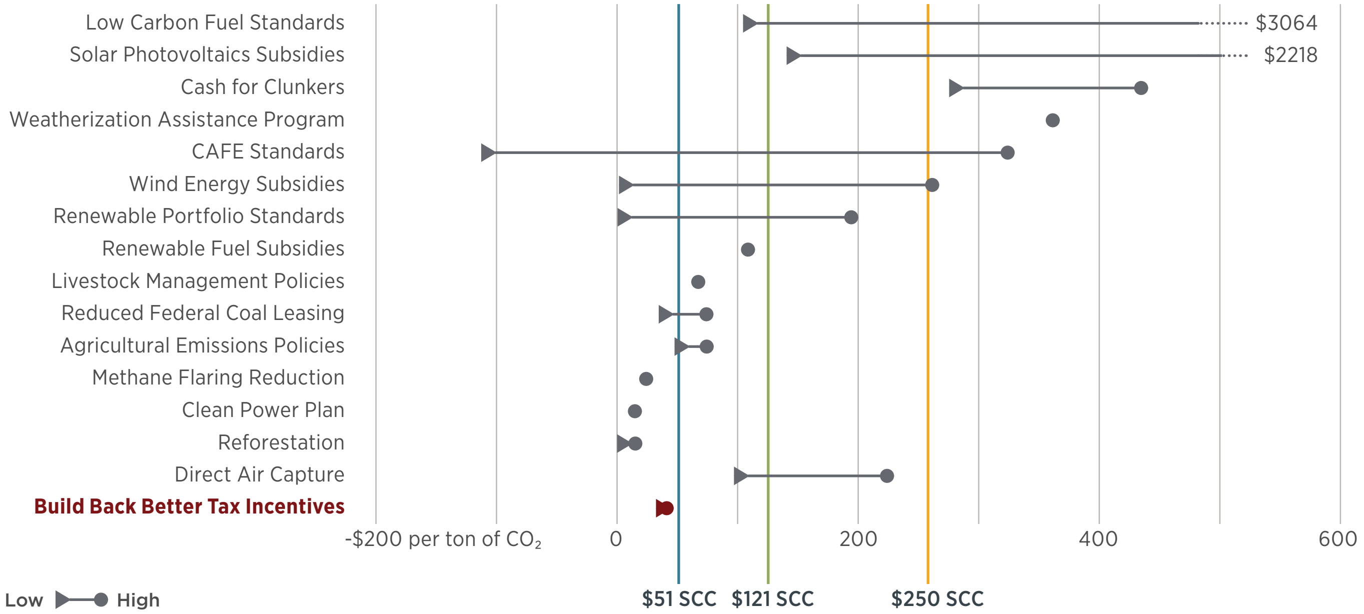
[16] Net benefits assuming 2% discount rate. Net benefits under 3% and 5% discount rate, as well as central estimates for each discount rate, are presented in Table A1 in the appendix.

[17] Under $51 SCC, the ratio of the benefits to costs is 2:1 in low cost scenario and 3:1 in central cost scenario. Similarly, under $250 SCC, the ratio is 6:1 in low cost scenario and 9:1 in central cost scenario, assuming 2% discount rate.

[18] Using 2% discount rate. Under both 3% and 5% discount rates instead, the benefits to costs ratio is 1:1, 3:1 and 6:1 in low cost scenario under $51, $121, and $250 SCC, respectively, and 2:1, 4:1, and 9:1 in central cost scenario under $51, $121, and $250 SCC, respectively.

FIGURE 5

Abatement Cost of Various U.S. Climate Policies



Note: The final row indicates the estimated abatement cost of the tax incentives in red (2020 USD). The other rows present the estimated abatement costs of other policies in black. The blue, green, and yellow vertical lines represent different values of the SCC: $51, $121, and $250, respectively. Adapted from the "U.S. Energy & Climate Roadmap" by the Energy Policy Institute at the University of Chicago. Source: EPIC Analysis with data from Gillingham and Stock (2018)

Clean Energy Tax Incentives Deliver Inexpensive Reductions in CO_2

Policymakers often compare the effectiveness of policy options to address climate change in terms of dollars per ton of CO_2 abated. With the central discount rate of 2%, the clean energy tax incentives are projected to reduce CO_2 emissions at a cost of $33-$50 per ton[19], with the range determined by the technology cost scenario. These values are on par with or lower than the values of the SCC used in this memo. In other words, the tax incentives reduce emissions at a lower cost than the estimated damages from the emissions per ton.

The clean energy tax incentives cost much less to reduce a ton of CO_2 compared to many other climate policies. Figure 5 compares the tax incentives to a wide range of existing United States climate policies and is adapted from the "U.S. Energy & Climate Roadmap" by the Energy Policy Institute[20] at the University of Chicago (EPIC). The red range represents the tax incentives' projected range of costs per ton of CO_2 abated, while the other policies' costs per ton are denoted with black ranges. The blue, green, and yellow vertical lines at $51, $121, and $250 denote the SCC values used in this report.

There are at least two critical points that come out of Figure 5. First, these tax incentives not only have benefits that exceed costs, but they are less expensive, substantially so in most cases, than almost all significant existing carbon policies. Second, most of the other policies represented cover relatively small parts of the economy, so they produce only modest reductions in CO_2 emissions. In contrast, the clean energy tax incentives cover the entire electricity sector, which is the second largest source of emissions, and are projected to reduce that sector's emissions by 33-45% in 2031 relative to a baseline scenario without these tax credits.

Conclusion

While the fate of Build Back Better is in the hands of the Senate, deliberations will in part focus on whether the extended and expanded clean energy tax credits merit inclusion in the final bill. Across a wide range of potential assumptions, we find that their projected benefits greatly exceed their projected costs. Additionally, on a cost per ton of CO_2 abated basis, they tend to deliver greater carbon abatement bang for the buck than many other climate policies in place or under discussion in Congress and elsewhere. While tax credits are typically not considered a "first best policy," such as pricing carbon emissions with a tax or targeting them with a cap-and-trade program, they have the potential to make substantial progress in decarbonizing the electric power sector while generating significant net-benefits to society.

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[19] Abatement costs per ton are calculated using discounted metric tons of CO_2 to make estimations comparable. If undiscounted tons of CO_2 are used instead, the abatement costs are lower than presented.

[20] EPIC, "U.S. Energy & Climate Roadmap."

Appendix

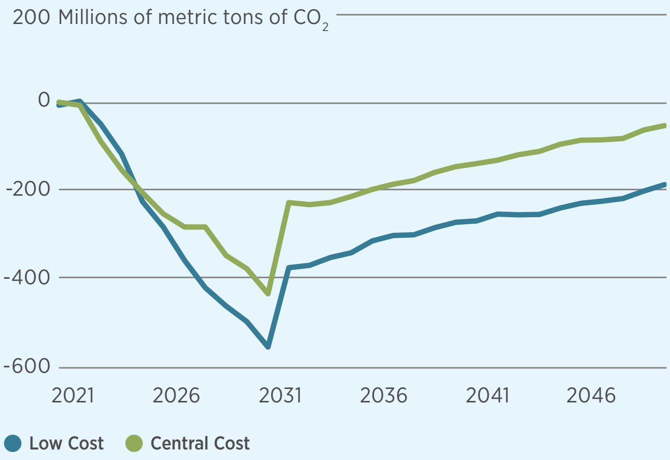
Low and Central Technology Cost Scenarios

This memo bounds the costs and benefits of changes to tax credit policies with low- and central technology cost assumptions. Under low-cost technology assumptions, this modeling assumes that capital and operating and maintenance costs for most renewable generators are in line with the National Renewable Energy Laboratory's Annual Technology Baseline[21] 2020 advanced cost projections. Under central-cost technology assumptions, renewables achieve the ATB 2020 moderate cost projections. Low and central cost and performance assumptions for fossil generating technologies equipped with carbon capture capability are based on Rhodium Group's previous work[22] on CCS. The remainder of the cost and performance assumptions are aligned with the Energy Information Administration's Annual Energy Outlook 2019.[23]

Annual Changes in CO_2 Emissions

FIGURE A1

Change in CO_2 Emissions by Year

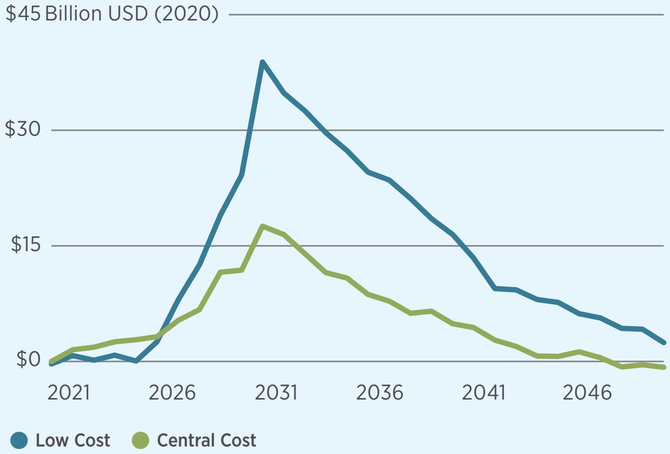


In both technology scenarios, the tax incentives lead to large reductions in CO_2 emissions relative to a baseline scenario where the tax incentives aren't in place. Figure A1 plots the reductions in both scenarios annually through 2050. These reductions peak in 2031, the last year when a new zero-emitting generator can come online and claim the PTC or ITC and the last year when existing nuclear plants receive support in this modeling. Power sector emissions rise sharply in 2032 as expiration of support for existing nuclear leads a large portion of the nuclear fleet to retire; generation from these zero-emitting generators is largely replaced with increases in gas generation. The change in emissions from baseline then gradually shrinks from 2033 through 2050, as installation of new zero-generating capacity slows dramatically under the policy case (after a surge caused by the tax credits), while new zero-generating capacity continues to gradually increase in the baseline case. The cumulative reduction in CO_2 emissions under the low and central clean energy technology cost pathways are 8.1 billion metric tons and 5.1 billion metric tons respectively.

Annual Tax Incentives Costs

FIGURE A2

Tax Incentives Costs Annually



Note: All numbers are in billions of 2020 USD. Tax expenditure projections are converted to 2020 USD using Congressional Budget Office's (CBO) projected GDP price index for year 2021-2031,[26] and assuming 2.1% inflation rate thereafter (same as CBO's annual average projections for years 2026-2031).

Figure A2 plots the undiscounted annual costs of the tax incentives, measured as the sum of increased costs to energy sector and deadweight loss from raising public funds. These costs peak in 2031, the final year that the modeled tax credits expire, as developers rush to take advantage of the credits and the last year of support for existing nuclear plants. In the subsequent years, the costs reflect the continuing higher costs for operating the electric power system and tax expenditure costs for the remaining PTC payments; these costs decline as the increasing numbers of projects reach the end of the ten-year payment period of the PTC.

Present Value of Net Benefits

Table A1 shows present values of net benefits under all

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[21] NREL, "Annual Technology Baseline."

[22] King et al., "Opportunities for Advancing Electric Power Sector Carbon Capture."

[23] EIA, "Annual Energy Outlook 2018."

[24] CBO, "An Update to the Budget and Economic Outlook: 2021 to 2031."

TABLE A1

Present Value of Net Benefits by Discount Rate and SCC Value

	Low Cost Scenario			Central Cost Scenario		
	Discount Rate			*Discount Rate*		
	2%	3%	5%	2%	3%	5%
● **$51 SCC**	$245.28	$87.75	$66.79	$205.28	$113.49	$89.44
● **$121 SCC**	$581.10	$505.88	$391.53	$436.20	$386.74	$309.14
● **$250 SCC**	$1,529.67	$1,332.96	$1,031.43	$1,039.58	$922.84	$738.72

Present value of net benefits under 2%, 3%, and 5% discount rates and $51, $121, and $250 values of the SCC. Values for both low cost and central cost scenarios. All values presented in billions of 2020 USD.

combinations of the SCC values and discount rates used for the cost-benefits analysis. Net benefits represent the difference between cumulative benefits and costs. One striking fact that can be seen from the table is that benefits exceed the costs in both scenarios even under lower values of the SCC and high discount rates.

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