MIT CEEPR
Center for Energy and
Environmental Policy Research

Working Paper
Series

Climate Policy Reform Options in 2025

John Bistline, Kimberly A. Clausing, Neil R. Mehrotra,
James H. Stock, and Catherine Wolfram

JULY 2024

CEEPR WP 2024-11

Working Paper Series.

Since 1977, the Center for Energy and Environmental Policy Research (CEEPR) has been a focal point for research on energy and environmental policy at MIT. CEEPR promotes rigorous, objective research for improved decision making in government and the private sector, and secures the relevance of its work through close cooperation with industry partners from around the globe. Drawing on the unparalleled resources available at MIT, affiliated faculty and research staff as well as international research associates contribute to the empirical study of a wide range of policy issues related to energy supply, energy demand, and the environment.

An important dissemination channel for these research efforts is the MIT CEEPR Working Paper series. CEEPR releases Working Papers written by researchers from MIT and other academic institutions in order to enable timely consideration and reaction to energy and environmental policy research, but does not conduct a selection process or peer review prior to posting. CEEPR's posting of a Working Paper, therefore, does not constitute an endorsement of the accuracy or merit of the Working Paper. If you have questions about a particular Working Paper, please contact the authors or their home institutions.

Climate Policy Reform Options in 2025[*]

John Bistline, EPRI
Kimberly A. Clausing, UCLA School of Law and NBER
Neil R. Mehrotra, Federal Reserve Bank of Minneapolis
James H. Stock, Harvard University and NBER
Catherine Wolfram, MIT Sloan School of Management and NBER

Abstract

With the expiration of many tax cuts and unmet climate targets, 2025 could be a crucial year for climate policy in the United States. Using an integrated model of energy supply and demand, this paper aims to assess climate policies that the U.S. federal government may consider in 2025 and to evaluate emissions reductions, abatement costs, fiscal impacts, and household energy expenditures across a range of policy scenarios. The model results show several key findings. First, the emissions reductions of the Inflation Reduction Act are significantly augmented under scenarios that add a modest carbon fee or, to a lesser extent, that implement a clean electricity standard in the power sector. Second, net fiscal costs can be substantially reduced in scenarios that include a carbon fee, especially if fossil fuel exports are taxed. Third, expanding the IRA tax credits yields modest additional emissions reductions with higher fiscal costs. Finally, although none of the policy combinations across these scenarios achieve the U.S. target of a 50-52% economy-wide emissions reduction by 2030 from 2005 levels, the carbon fee and clean electricity standard scenarios achieve these levels between 2030 and 2035.

Keywords: Climate policy; Inflation Reduction Act; tax credits; carbon fee; decarbonization

JEL Codes: H23, Q48, Q54

---

[*] We are grateful to Joseph Aldy, Adrian Bilal, Tatyana Deryugina, Matthew Kotchen, and Robert Stavins for helpful suggestions. All remaining errors are our own. The views expressed in this paper are those of the authors and do not represent the Federal Reserve System or the Federal Reserve Bank of Minneapolis.

I. Introduction

2025 could be a crucial year for U.S. climate policy choices. At the end of 2025, a large number of Tax Cuts and Jobs Act (TCJA) revenue provisions are scheduled to expire. Policymakers on both sides of the aisle have expressed support for extending at least some of the expiring tax cuts, but a full extension comes at a large revenue cost, potentially approaching $4 trillion over ten years (Clausing and Sarin, 2023), in a time of high deficits and debt. As a result, policymakers may seek revenue increases or spending cuts to pair with TCJA extensions.

Much of U.S. climate policy currently operates through the tax code. In particular, the Inflation Reduction Act (IRA), the largest piece of climate legislation in U.S. history, was passed through the reconciliation process and relies on tax credits, loans, and direct spending to address U.S. climate change mitigation. But even that major legislation appears to bring the U.S. only partway toward its Paris Agreement commitment of a 50-52% economy-wide greenhouse gas (GHG) emissions reductions by 2030 relative to 2005 (Bistline, et al., 2023), requiring greater action in the years ahead.

This combination of fiscal pressures and unmet climate targets suggests that a range of climate policy options could be under consideration. The objective of this paper is to improve understanding of potential climate policy options facing the U.S. federal government in 2025 and their associated tradeoffs. This analysis considers options that could arise under various outcomes of the 2024 election, including under budget reconciliation and under a split Congress and/or White House. Options range from enhancing the IRA's clean energy tax credits to their repeal. The scenarios also include the possibility of new policy tools, including a clean electricity standard (CES) and a carbon fee, either of which could be adopted alongside the portfolio of existing clean energy credits or could replace some of them. To analyze these policy options, the analysis uses EPRI's U.S. Regional Economy, Greenhouse Gas, and Energy (US-REGEN)[1] model to project potential emissions reductions, fiscal impacts, and effects on household energy and fuel expenditures.

The main findings from the analysis are fourfold. First, model results suggest that the emissions reductions of IRA's climate and energy provisions can be significantly amplified under scenarios that include a modest carbon fee (in line with prior legislative proposals) or, to a lesser extent, a

---

[1] EPRI's US-REGEN model features regional disaggregation and technological detail of the power sector and linkages to other economic sectors. The appendix contains further details, recent peer-reviewed articles and reports can be found at https://esca.epri.com/models.html, and detailed model documentation is available at https://us-regen-docs.epri.com/. For descriptions of IRA implementation, see Bistline et al. (2023).

CES in the power sector. Second, net fiscal costs can be substantially reduced in scenarios that include a carbon fee. Third, expanding the IRA tax credits yields modest additional emissions reductions at a significant fiscal cost. Fourth, although none of the policy combinations analyzed here achieves the U.S. target of a 50-52% economy-wide emissions reduction from 2005 by 2030 (and for reasons provided below, scenarios that would achieve the target are less plausible), the carbon fee and CES scenarios achieve these levels between 2030 and 2035.

The final section of the paper discusses several issues that are outside the REGEN model, including potential impacts of the scenarios on the fiscal score, distribution, and innovation. This section also estimates that, were the carbon fee applied to US fossil fuel exports, its revenues would increase by hundreds of billions of dollars.

II. The 2025 Policy Challenge

In 2025, the energy transition policies associated with the IRA will be less than three years old. The IRA undertook major investments, including over $120 billion in direct spending on conservation and carbon sequestration programs in the agriculture and forestry sectors, energy efficiency, industrial decarbonization, and green lending. The legislation also includes an array of clean energy tax credits incentivizing clean electricity production and investment, carbon capture, clean fuels, energy efficiency, electric vehicles (EVs), and clean manufacturing activity. Since IRA's enactment in 2022, official scorekeepers have substantially increased their estimate of the costs of these credits (from about $270 billion to over $700 billion), and outside estimates are even higher (see Bistline, Mehrotra, and Wolfram, 2023; Goldman Sachs, 2023; Penn-Wharton Budget Model, 2023).[2]

Modeling analyses indicate that the IRA could enable significant emissions reductions, which pass a benefit-cost test when measured against the social cost of carbon. For example, Bistline, Mehrotra, and Wolfram (2023) show central abatement cost estimates of $45-61 per metric ton of carbon dioxide (CO_2), which is well below current estimates of the social cost of carbon that have central values between $120-400/t-$CO_2$ in 2030 (Rennert, et al., 2022; Environmental Protection Agency, 2023). Drawing on multiple U.S. energy sector models, Bistline et al. (2023) project that, with the IRA in place, 2030 emissions may fall 33-40% below their 2005 levels, about 9 percentage points below a no-IRA counterfactual – but still falling short of the U.S.'s Paris Agreement goal of 50-52% reductions by 2030 (Figure 1). From the perspective of reducing emissions in keeping with the Paris target, although some of the implementation gap

---

[2] For a discussion of the evolution of these estimates, see Congressional Budget Office, 2024, Box 3-1. Outside estimates have some methodological differences relative to official scores; this issue is discussed at the beginning of Section VI.

might be filled by enhanced state targets or voluntary corporate targets, the magnitude of this gap – essentially as large as the reductions attributable to the IRA – suggests that additional federal policy may be needed to drive emissions reductions in 2030 and beyond.

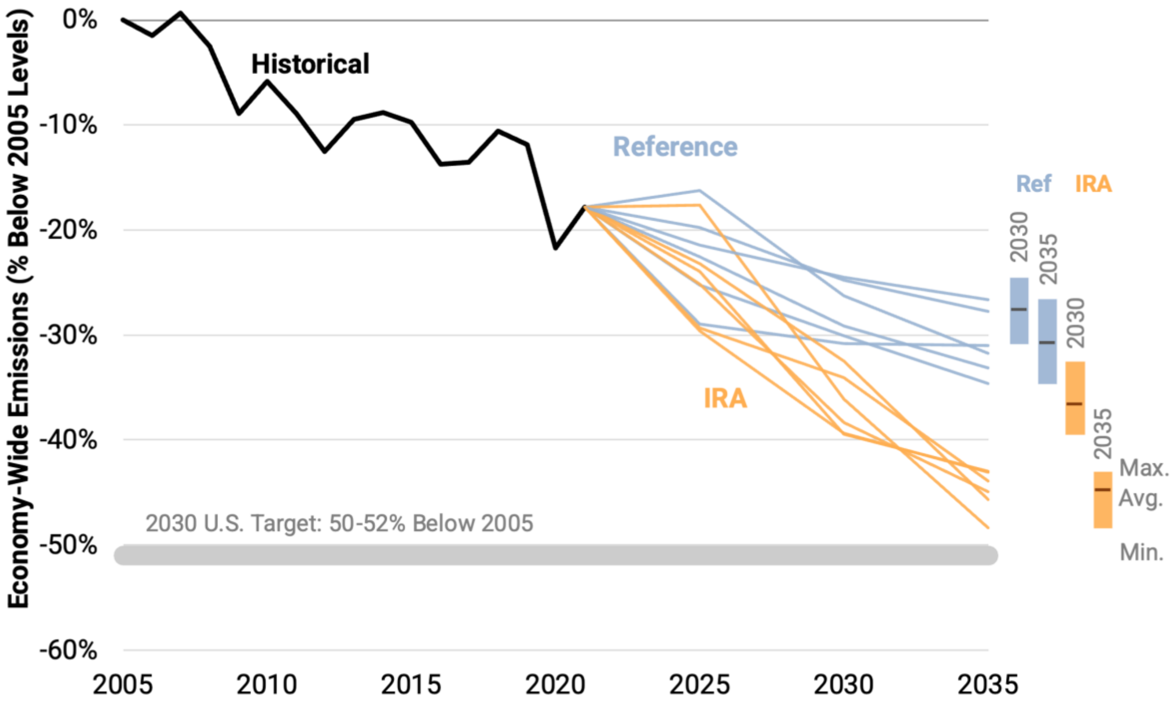


Figure 1: Multi-model comparison of economy-wide emissions over time with IRA incentives ("IRA") and without IRA ("Reference"). Lines represent emissions reductions from six different economy-wide models of IRA. Adapted from Bistline, et al. (2023).

At the same time, the energy provisions of the IRA remain controversial. Multiple legislative proposals have been put forward to repeal some or all of its provisions,[3] and future political support remains uncertain.[4]

Fiscal pressures, actual or perceived, may also play prominent roles in upcoming debates. The 2023 Congressional Budget Office (CBO) forecasts indicate that deficits could average 6% of GDP over the coming decade, with debt-to-GDP ratios rising to 119% by the end of the decade and, in the CBO long-term forecast, to 180% of GDP by 2053. Recent Congressional debate around the budget, the related Fitch downgrade of U.S. government debt, and higher interest

---

[3] These efforts have also led to updated JCT estimates of the IRA tax credits, as scores for repealing them. See, e.g. JCT's estimate of repealing many IRA provisions under the Limit, Save, Grow Act, JCT's score of amendments that would repeal IRA provisions, and JCT's score of the Build It In America Act.

[4] For news coverage, see https://www.bloomberg.com/graphics/2023-red-states-will-reap-the-biggest-rewards-from-biden-s-climate-package/.

rates (which make the existing stock of debt more burdensome) have all made budget pressures increasingly salient.[5] Interest payments on U.S. government debt exceeded $1 trillion on an annualized basis in late 2023.[6] Finally, the looming insolvency of the Social Security and Medicare trust funds may make these fiscal imbalances more pressing.[7]

A final factor impacting climate policy in 2025 will be the interplay of U.S. climate policy with policy actions abroad. While 39 national jurisdictions employed some form of carbon pricing in 2023, other jurisdictions rely more heavily on subsidies. As discussed in Clausing and Wolfram (2023), countries pursuing heterogeneous policy choices have important spillover effects on other jurisdictions. For instance, firms based in cost-imposing jurisdictions face disadvantages when competing internationally with firms based in cost-reducing jurisdictions.

Due in part to such competitiveness concerns, the current U.S. policy approach – which is both reliant on subsidies and employs some preferences for domestic or free trade area partner content – has received a mixed response abroad.[8] While the U.S. has taken some steps to address trading partner concerns, as described in Bown and Clausing (2023), fundamental tensions are unlikely to disappear as long as countries maintain differing policy approaches and stringencies. Toward this end, a well-designed and nondiscriminatory carbon border adjustment mechanism (CBAM), an import tariff on carbon-intensive goods that matches the domestic carbon price, can drive policy change in other countries. For example, several countries, including Indonesia, Thailand, Vietnam, and Türkiye, have contemplated adoption of carbon pricing regimes in response to the European Union CBAM.

III. Criteria for Evaluating Climate Policy Reforms

Section IV evaluates several tax-based climate policy options for 2025, with an eye toward five policy criteria. First is the key goal of emissions reductions. Second, given the magnitude of the emissions reduction challenge and the projected scope of investments needed to decarbonize the economy, the economic efficiency of policy action matters for policy sustainability, energy affordability, and broader social welfare. Following standard practice, the analysis measures

---

[5] See for example https://www.crfb.org/blogs/interest-rates-remain-near-record-highs.

[6] See for example https://www.bloomberg.com/news/articles/2023-11-07/us-debt-bill-rockets-past-a-cool-1-trillion-a-year.

[7] See for example "The 2023 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds."

[8] See for example Jiyeong Go, "EU and Japan Lash out at 'Discriminatory' US Green Subsidies." *FDi Intelligence* (*Financial Times*), November 15, 2022; George Parker, Andy Bounds, and Aime Williams, "Britain Joins EU in Criticising Biden's Green Subsidies Package," *Financial Times*, December 22, 2022.

economic efficiency of mitigation policies as the economy-wide costs (incorporating costs to businesses and households) per ton of carbon dioxide abated.

Third, for the reasons discussed above, potential federal budgetary impacts are likely to be a driving factor in 2025, suggesting that some revenue-raising or expenditure-reducing provisions could be considered. Fourth, given both political constraints as well as persistent, large economic inequality, it is important to evaluate the effects of these policy alternatives on the distribution of income. Both cost-imposing and cost-reducing policies have distributional effects, since subsidies come with fiscal opportunity costs, which makes it important to understand who benefits from subsidies as well as who is hurt by increased costs.

Finally, the U.S. policy stance influences climate policy adoption abroad. At present, the U.S. accounts for approximately one-eighth of worldwide greenhouse gas emissions.[9] U.S. policy that supports an ambitious emissions reduction path affects other countries' climate ambition both through providing credibility in international negotiations and reducing costs of low-carbon technologies through scale economies in mature technologies and by driving the development and commercialization of new advanced technologies. Also, as noted above, there are important interactions between countries' climate policies and the competitiveness of their domestic firms.

IV. Climate Policy Reform Menu

This section summarizes the climate policy options considered in this analysis. Scenarios include policies that (a) could plausibly be under consideration in 2025, with different options more or less likely depending on outcomes of the 2024 election and on economic conditions, and (b) are tax and expenditure policies with potentially major fiscal and/or emissions impacts. These delimiters exclude some policies that are potentially consequential but are not tax/expenditure policies, such as comprehensive permitting reform.[10] They also exclude policies that arguably have both small emissions and fiscal effects, such as extending the biodiesel blender tax credit after its current expiration at the end of 2024.

Two major proposed climate regulations, EPA's tailpipe CO_2 emissions standards for light-, medium-, and heavy-duty vehicles and EPA's power plant rule under Section 111 of the Clean Air Act (CAA), are on schedule to be finalized in 2024. Both, however, are likely to be subject to litigation and could be withdrawn by a subsequent administration and replaced by a less

---

[9] Data are from the World Bank in 2019.

[10] Summaries of permitting reform bills introduced in Congress in 2023 are at https://citizensclimatelobby.org/clean-energy-permitting-reform-in-congress/.

stringent regulation. The policy baseline assumes that these proposed rules are finalized, but to reflect this regulatory uncertainty, another scenario assumes neither regulation is present. In most cases (unless otherwise noted), the policy baseline is current policy as of late 2023 to early 2024 (including finalization of both EPA rules), as detailed in the reference case below.

The seven scenarios are summarized in Table 1 and are discussed in detail below.

Table 1: Scenario summary and abbreviations.

Policy	Scenario	Abbr.
Reference	On-the-books state and federal policies, including IRA incentives, EPA's proposed power plant and vehicle standards	1-Ref
No Proposed Standards	Reference without EPA's proposed power plant or vehicle standards	2-No111
Repeal IRA and Proposed EPA Standards	Repeal IRA's climate provisions (and assumed not to be replaced) as well as regulatory proposals for power plants and vehicles	3-Repeal
Expand IRA	Expand IRA tax credits by increasing magnitudes of power sector tax credits by 50%	4-IRAexp
Broad Carbon Fee with Carve Outs	Fee with carve out for retail gasoline sales; fee starts at \$15/t-CO_2 in 2027 and rises to \$65/t-CO_2 by 2035	5-Fee
Clean Electricity Standard	Assume reconciliation-compliant system of fees and rewards with targets that vary by region over time	6-CES
Fee with Carve Outs and Partial IRA Repeal	Same carbon fee with carve outs for retail gasoline sales as above with partial IRA repeal (retaining electric sector PTC/ITC and nuclear credits with expiration)	7-FeeIRAp

1. Reference with Existing Policies and Incentives (1-Ref)

The reference case reflects existing policies as of Fall 2023, including federal- and state-level policies. This scenario assumes that the several major in-process climate rules are finalized in their proposed state, specifically: EPA's proposed tailpipe standards requiring large shares of zero-emissions vehicles by 2032 (covering light-, medium-, and heavy-duty vehicles); EPA's proposed existing and new source performance standards for power plants[11] under the CAA Sections 111 (b) and (d); and the IRA as enacted in August 2022 with policy guidance as of Fall 2023. All scenarios use the same fuel price trajectories that are outputs from the US-REGEN fuels model, including natural gas prices shown in Figure S3 of the appendix.

2. Reference without Proposed Power Plant and Vehicle Standards (2-No111)

---

[11] See Bistline, et al. (2024) for a detailed discussion of the representation of EPA's proposed power plant rules in the US-REGEN model and comparisons of their impacts on generation, emissions, and costs.

This scenario removes the EPA's proposed regulations on both power plant and vehicle tailpipe emissions while keeping IRA's climate provisions. Repealing IRA would require Congressional support, and the geographical distributions of investments to date may insulate IRA from repeal.[12] The future of the EPA power plant and tailpipe regulations is more difficult to gauge.

3. Repeal of the Inflation Reduction Act (3-Repeal)

Given proposals to repeal the climate and the non-climate components of the IRA, as discussed above, this scenario assumes that all of the climate-related provisions are zeroed out after 2025 and not replaced by anything similar. There would be no federal tax credits for renewable electricity for the first time since 1992 (Congressional Research Service, 2020) and no federal tax credits for purchasing electric vehicles for the first year since 2005. Like the 2-No111 scenario, this scenario assumes that the EPA power plant rule and tailpipe standards are withdrawn and either not replaced or replaced by non-binding rules or ones that could increase emissions in some circumstances similar to the Affordable Clean Energy (ACE) rule.[13]

4. Expand the Inflation Reduction Act (4-IRAexp)

The IRA expansion scenario aims to reduce 2030 projected emissions at low economy-wide costs to narrow the implementation gap in Figure 1. Table 2 summarizes estimates of the abatement costs for several categories of tax credits in the literature, which are used to inform the scenario design. The first row of the table indicates that estimates of the overall cost-effectiveness of the climate and energy provisions of IRA are between \$42 and \$102 per ton of CO_2 reduced, based on Bistline et al. (2023). The lower rows summarize estimates of the tax credits for investment and production of clean electricity, carbon capture and sequestration, clean hydrogen, and passenger vehicle tax credits. The categories are not comprehensive – for example, we could not find estimates of the cost-effectiveness of credits for clean energy manufacturing (45X) or medium- and heavy-duty vehicles. Also, some of the estimates (Goldman Sachs, 2023 and Blanford and Bistline, 2023) measure the fiscal costs rather than the total resource costs. Fiscal costs capture the costs of the tax credits to the government, including payments for inframarginal investments, where total resource costs capture the incremental costs in the economy with a policy versus without it. (Domeshek et al., 2024 describe different cost accounting approaches.) The available estimates suggest that the tax

---

[12] See for example https://www.ft.com/content/06fcd3dd-9c39-48d3-bb08-6d75d34b5ed1.

[13] The ACE rule was proposed by the EPA in 2019 under President Trump and suggested that coal-fired power plants reduce greenhouse gas emissions by improving their fuel efficiency. Analysis of the ACE rule indicated that national CO_2 emissions were only slightly lower than without the rule but that there were some states where CO_2, SO_2, and NO_x could increase (Keyes, et al., 2019).

credits that are most cost-effective for reducing emissions are the technology-neutral investment and production tax credits for clean electricity. Based on those findings, this scenario expands the IRA by increasing those credits by 50%.

Table 2: Estimates in the literature of abatement costs of IRA provisions.

Provision	Study	Value ($/t-$CO_2$)
Climate/Energy Tax Credits	Bistline, et al., 2023 (link)	$42-102
	Goldman Sachs, 2023 (link) for fiscal costs	$52
Electric Sector Production and Investment Tax Credits	Bistline, et al., 2023 (link)	$27-60
	Bistline, Mehrotra, and Wolfram, 2023 (link)	$36-87
CO_2 Capture Credits (45Q)	Author calculations	$129
	Grubert and Sawyer, 2023 (link) for the "15 utilities with the highest potential 45Q value"	$148-418
Hydrogen Credits (45V)	Blanford and Bistline, 2023 (link) for fiscal costs	$750
Passenger Vehicle Credits	Cole, et al., 2023 (link)	$63-113

5. Carbon Fee with Gasoline Carveouts (5-Fee)

A carbon fee may be considered in 2025 owing to: 1. The fiscal considerations in Section II; 2. IRA's tax credits dampening some of the perceived negative impacts of carbon pricing, for example, by mitigating bill impacts or by spurring job creation in energy communities;[14] 3. International pressure from jurisdictions adopting carbon border adjustment mechanisms, including the EU and UK to date.

This scenario models a carbon fee starting at $15 per ton CO_2 in 2027 (in nominal terms), increasing to $65 per ton by 2035, and then increasing with inflation, as shown in Figure 2. This case assumes that the carbon fee is assessed on fossil fuel producers upstream (i.e., coal at the mine mouth, natural gas at the processing facility, oil at the wellhead, and imports at the import facility) and assumes complete pass-through. The scenario includes energy emissions as well as industrial process emissions from cement, iron, and steel but exempts retail gasoline given the political sensitivity of gasoline prices. (This exemption could be implemented through rebates to refineries in proportion to the volumes sold.) Fees are rebated on fossil fuel and refined product exports, so the carbon fee is equivalent to an assessment on domestic emissions, exempting gasoline. The fee is assumed to apply symmetrically to emissions and negative emissions; that is, it provides a per-ton subsidy to net negative emissions from resources such as bioenergy with carbon capture and storage (BECCS), direct air capture, and other carbon removal options.

---

[14] Clean energy investments were targeted towards energy communities. For one Administration analysis of these place-based investments, see U.S. Department of the Treasury (2023).

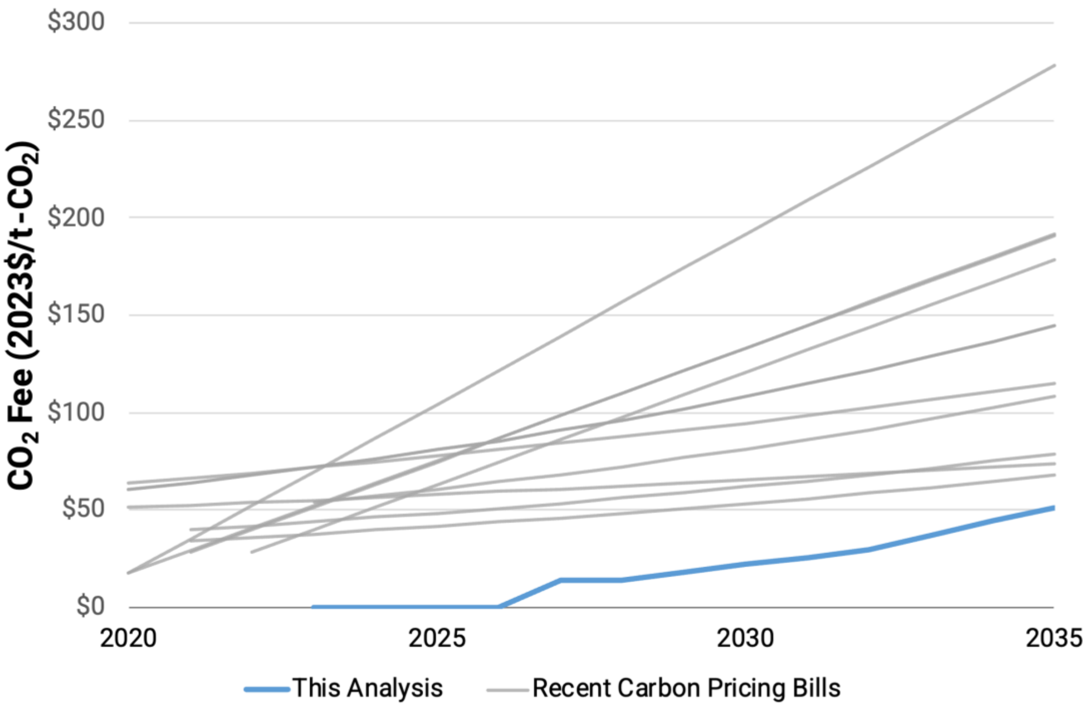


Figure 2: Modeled price path for carbon fee over time (blue) and recent carbon pricing bills (gray). Values are shown in real 2023 dollar terms per metric ton of CO_2. Recent carbon pricing bills come from the Resources for the Future "Carbon Pricing Bill Tracker" with proposals from the 116th and 117th Congresses.

A carbon fee could take many forms, including a higher or lower initial fee, more or fewer carveouts (e.g., it could be possible to carve out residential and commercial electricity sales by refunding load-serving entities an amount proportional to their sales to residential and commercial customers), and alternate trajectories over time. These design elements entail tradeoffs between the level of the carbon fee and its impacts on emissions reductions, affordability, fiscal impacts, and political barriers. Figure 2 shows how this modeled carbon fee compares with recent carbon pricing bills from the 116th and 117th Congresses, starting at a later date and lower level (given the start date of the 119th Congress and political economy considerations).

6. Clean Electricity Standard (6-CES)

A CES sets a target for the share of electricity that must be generated from qualified clean sources in future years and then imposes penalties for utilities or other load-serving entities that do not meet that target. There were 76 proposals for federal electricity portfolio standards introduced between the 105th and 116th Congress (Congressional Research Service, 2021), though none has become law.[15]

The CES considered here would require region-specific clean electricity targets with linear ramps from current levels to 100% by 2040 with tradeable credits across regions (Figure 3). Zero-emitting resources receive full credit, while others receive partial credit based on their individual annual emissions intensity relative to a 0.82 t-CO_2 per MWh benchmark (Figure S4), which can reflect differences in carbon intensity of emitting generation across the transition path. Requirements are imposed on total generation, which includes delivery and energy storage losses. Note that many alternate policy design elements are possible that can influence impacts of the CES (Santen, et al., 2021).[16]

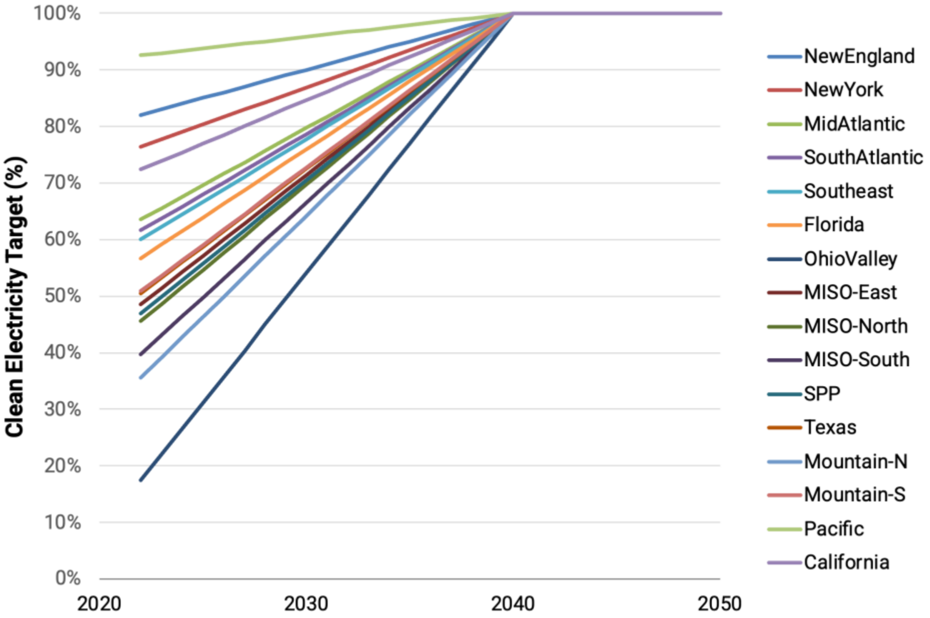


Figure 3. Region-specific clean energy targets under the modeled Clean Electricity Standard. Definitions of model regions are provided in the appendix (Figure S1).

---

[15] Congress debated a cousin of a CES, the Clean Electricity Performance Program, during the budget reconciliation discussion in 2021-22, which only requires the support of 50 senators. To be eligible for a reconciliation bill, a program must be primarily related to the budget, and the Clean Electricity Performance Program was designed to fit those criteria.

[16] The partial crediting, point of regulation, and alternative compliance payment assumptions are based on the reference CES design in Santen, et al. (2021), which comes from recent proposals.

7. Selective Repeal of IRA Coupled with Carbon Fee with Carveouts (7-FeeIRAp)

A divided government may also act on climate as part of the overall discussions of the tax code. With a divided government, both parties may need to make concessions, so the analysis considers a scenario that involves a repeal of certain provisions of IRA together with a carbon fee. Based on the literature summarized in Table 2, this scenario leaves the production and investment tax credits for electricity in place, along with the nuclear provisions (that include production tax credits incentivizing nuclear energy capacity), and removes the rest of the IRA climate provisions.

V. Results

This section reports results from modeling the scenarios in Table 2. Figure 4 depicts projected economy-wide CO_2 emissions through 2040 for each scenario. Because of the timing of policy and stock turnover, the emissions paths do not diverge substantially until the end of this decade; however, large differences appear in the emissions paths in the 2030s. All scenarios that augment the IRA and existing regulations drive additional emissions reductions, though the depth of those reductions varies. Reference emissions with current policies (1-Ref) decline over time and reach 49% below 2005 levels by 2035, which is lower than the scenarios with IRA repeal (3-Repeal) or no proposed EPA standards (2-No111) (36% and 42% reductions by 2035, respectively). Emissions reductions under the IRA repeal scenario are primarily driven by state policies, continued reductions in renewable prices, growing vehicle electrification, and IRA investments before the repeal.

With the assumptions in Section IV, model results suggest that the scenarios with the deepest emissions reductions are those that extend current policies with a carbon fee (5-Fee and 7-FeeIRAp), which drive deeper reductions in the power sector and more investment in carbon dioxide removal. The carbon fee scenarios lower CO_2 emissions by 45-47% by 2030 from 2005 and 57-62% by 2035, which is 8-13 percentage points below the IRA-only reference. The result that a modest carbon fee leads to significant emissions reductions is consistent with existing theoretical and simulation-based work suggesting diminishing marginal returns to carbon pricing (Dimanchev and Knittel, 2023.) Notably, the expansion of the IRA tax credits in 4-IRAexp is less effective in reducing emissions than augmenting the IRA by either a carbon fee, a CES, or repealing many IRA provisions and introducing the fee (7-FeeIRAp).[17]

---

[17] Domeshek, et al. (2024) model adding a carbon price to a baseline scenario that reflects IRA (but not proposed EPA regulations) in the electricity sector and find that with IRA the carbon price required to achieve an 80 percent

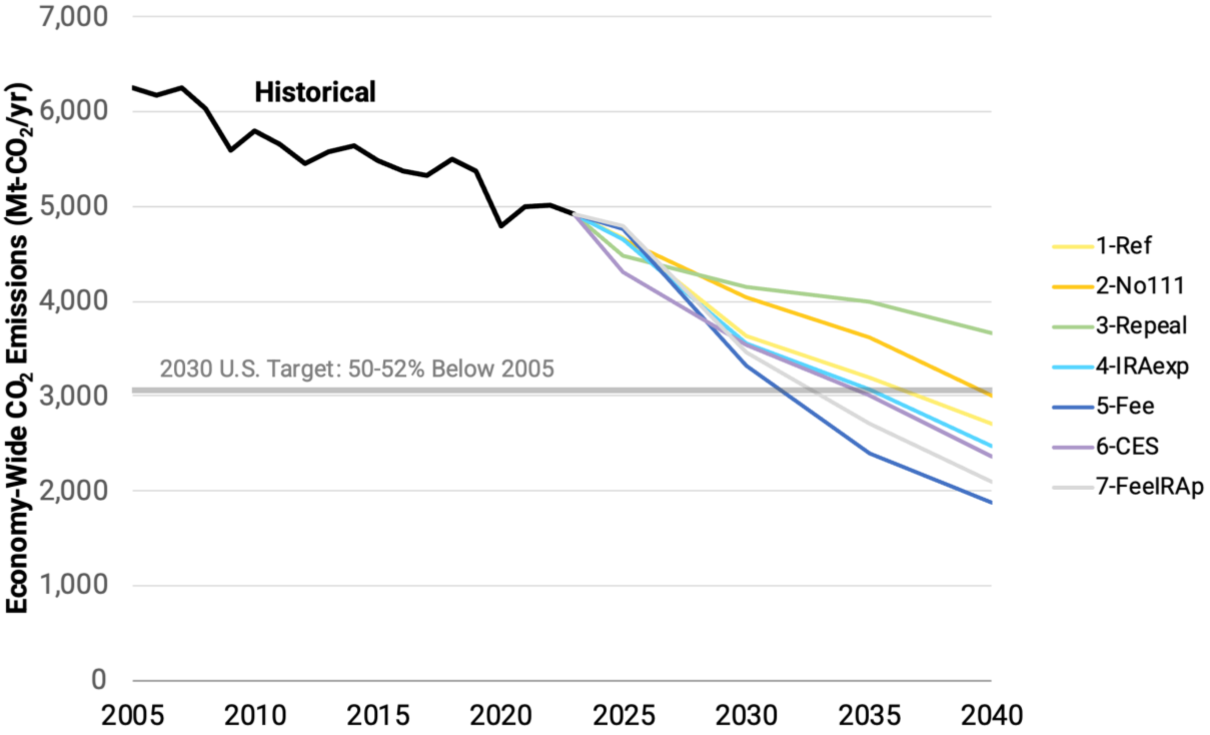


Figure 4: Historical and projected economy-wide CO_2 emissions by scenario. Emissions include gross energy and industrial process CO_2 emissions but do not include negative emissions from the land sink or non-CO_2 GHG emissions. Historical emissions come from the U.S. Environmental Protection Agency's "Inventory of U.S. Greenhouse Gas Emissions and Sinks."

None of the scenarios achieve the U.S. 2030 climate target under the Paris Agreement of reducing 2005 emissions by 50-52% by 2030, though these scenarios are much closer to this Nationally Determined Contribution than earlier multi-model studies with current policies (Bistline, et al., 2022).[18] While the reference scenario achieves a 50% emissions reduction just after 2035, the IRA-plus-fee scenarios achieve the 50% reduction target around 2032.

Figure 5 provides sector-specific emissions across the scenarios, highlighting sectors with the largest projected emissions reductions. Across scenarios, the power sector is the most sensitive

---

reduction in carbon emissions in the sector by 2030 is half as large as a hypothetical scenario that removes IRA. See also Rorke and Nystrom (2024).

[18] Notably, in the scenario with the carbon fee plus IRA (5-Fee), there is no unabated coal-fired electricity generation by 2030. Achieving the U.S. Nationally Determined Contribution of 50-52% reductions from 2005 levels may require imposing additional policy measures for several years before 2030 to incentivize economy-wide mitigation consistent with the 2030 target (Bistline, et al., 2022). Given emissions trends to date, reaching the 2030 target would entail roughly a five times acceleration in annual emissions reductions relative to historical levels.

to the policy mixes and achieves zero emissions (by design) in 2040 under the CES and near-zero emissions with the two scenarios that include a carbon fee. Power sector additions and retirements across scenarios are shown in Figure S5 in the appendix. Low emissions in the power sector also support cleaner transportation sectors in these three scenarios due to the prominence of transport electrification. By contrast, emissions in the power sector expand to over a gigaton by 2035 under the IRA repeal case and continue to grow to 2040. The two scenarios that involve a carbon fee also support carbon dioxide removal starting in 2035, which the model suggests could come from bioenergy with carbon capture and storage for fuels (180 MMT annually by 2040 in the 5-Fee scenario) and direct air capture (removing 49 MMT per year by 2040).

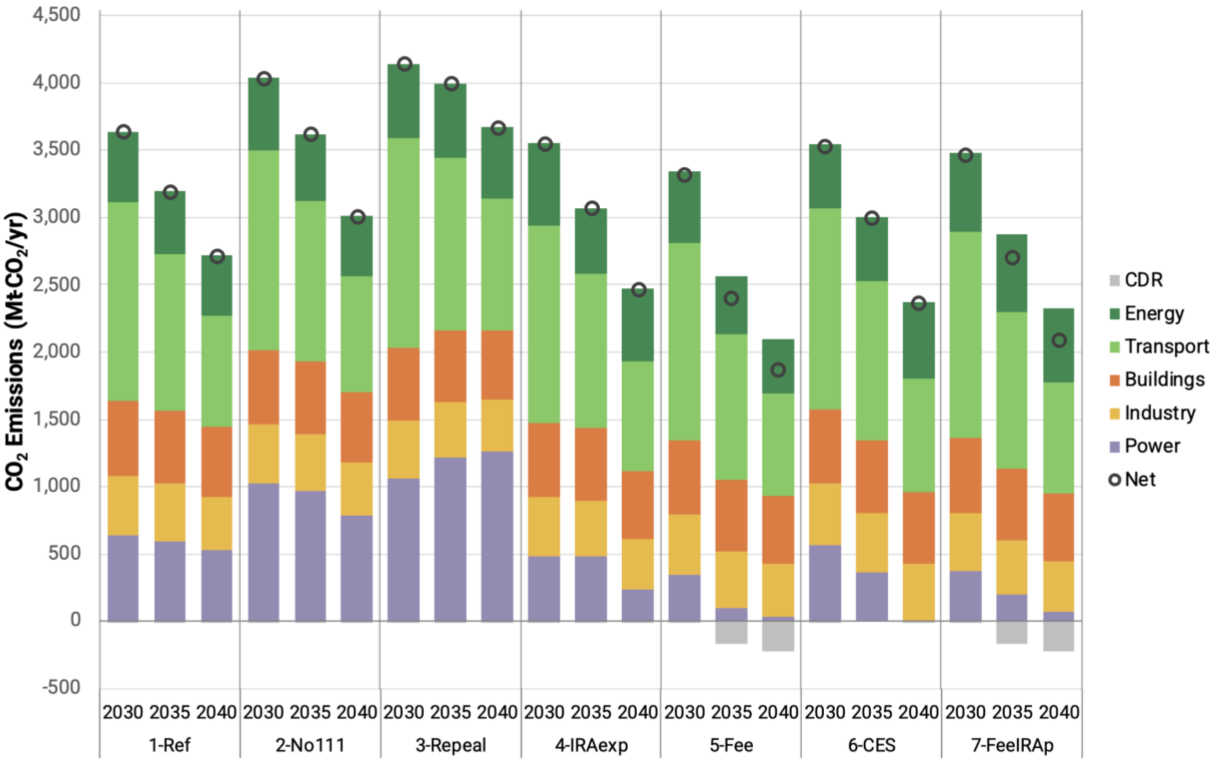


Figure 5: Projected sectoral CO_2 emissions over time by scenario. "Energy" refers emissions from all non-electric fuels upstream and conversion. CDR = carbon dioxide removal.

For additional perspective on how these policy scenarios might impact energy production and consumption, Figure 6 compares how different energy resources (left of each diagram) are transformed to support different end uses (right of each diagram) under the reference scenario (1-Ref) and carbon fee scenario (5-Fee) in 2040. Both scenarios entail lower coal and petroleum consumption relative to current levels, though the 5-Fee case has lower fossil fuel use. Adding a carbon fee under the 5-Fee scenario increases CCS and hydrogen deployment, spurs greater end-use electrification, increases bioenergy use, and lowers the carbon intensity of electricity generation in the modeling. The share of natural gas use in the power sector declines in the 5-Fee scenario, though there is still considerable gas consumption in buildings and industry.

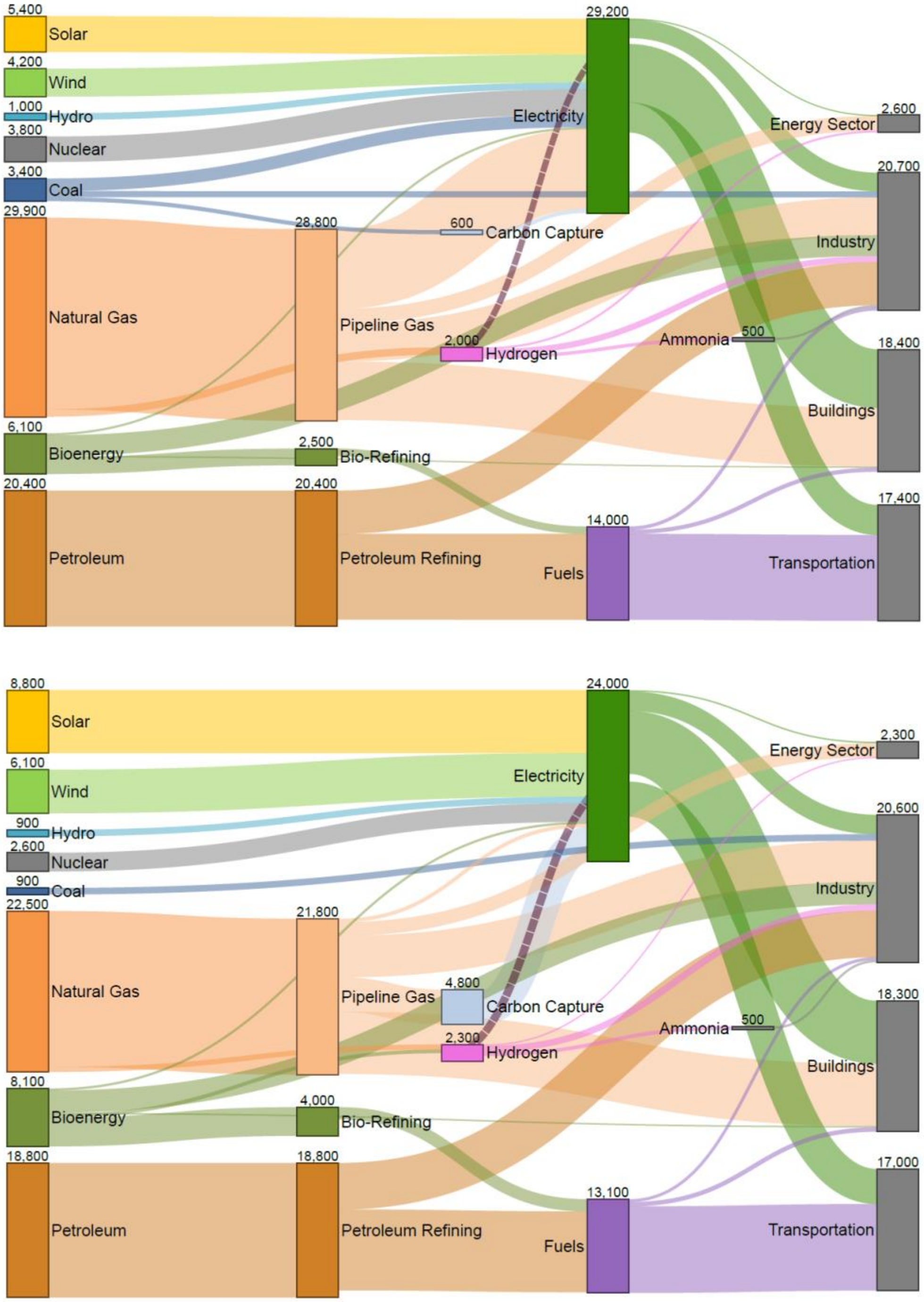


Figure 6: Sankey diagram of energy supply, conversion, and demand in 2040 under the 1-Ref (top panel) and 5-Fee (bottom panel) scenarios. Values are expressed in trillion Btu terms.

Figure 7 summarizes projections of the net fiscal costs associated with each scenario.[19] Bistline, Mehrotra, and Wolfram (2023) and Bistline, et al. (2023) show that projections of the fiscal costs associated with IRA based on US-REGEN and other models are higher than the official JCT estimates, although JCT have since revised their projections of the tax credit components of IRA upwards. Since the comparisons in Figure 7 are all based on the same model and reflect the same underlying assumptions and categories, the relative comparisons are likely more robust than comparisons with other studies.

In the reference case, the cumulative fiscal cost of IRA's energy provisions are approximately $1.6 trillion over the 2026-2035 budget window, with the tax credits for transportation accounting for nearly half of the expenditures (Figure 7).[20] The figure also shows projected costs to 2040 to emphasize that the federal government will continue to bear costs. This occurs both because most investments that come into service before the law expires continue to earn credits for 10-12 years of operations (e.g., PTC, 45V, and 45Q) and because the IRA specifies that the power sector tax credits continue until sectoral CO_2 is 25% of 2022 levels, which US-REGEN projects will not occur until after 2040 under the reference scenario. The carbon fee raises $590 billion in the scenario with IRA intact (5-Fee) and $660 billion in the scenario with a partial repeal of IRA (7-FeeIRAp). These revenues are somewhat offset by increased IRA subsidy costs, so that on net, fiscal costs are 9% lower in the fee plus IRA scenario (5-Fee) compared to the reference (1-Ref).[21] The scenario that adds a fee to a partial repeal of IRA (7-FeeIRAp) leads to an 89% reduction in net fiscal costs and to an additional emissions reduction of 8 percentage points in 2035, relative to the reference scenario.

---

[19] Estimates in this version do not yet include revenues from either border adjustments or taxes on exported fossil fuels. All recent carbon pricing bills include border adjustments, although the subset of products subject to the adjustments vary, as does the treatment of fossil fuel exports (see Resources for the Future, Carbon Pricing Bill Tracker).

[20] The projected fiscal costs are higher than reported in Bistline, Mehrotra, and Wolfram (2023), because of induced tax credit uptake stemming from the EPA's proposed power plant rule and vehicle standards, costs of the medium- and heavy-duty vehicle credits, and clean hydrogen credits (45V).

[21] The combination of 45Q tax credits and carbon fee induce additional CCS uptake (Figure S5), which are limited with either policy alone.

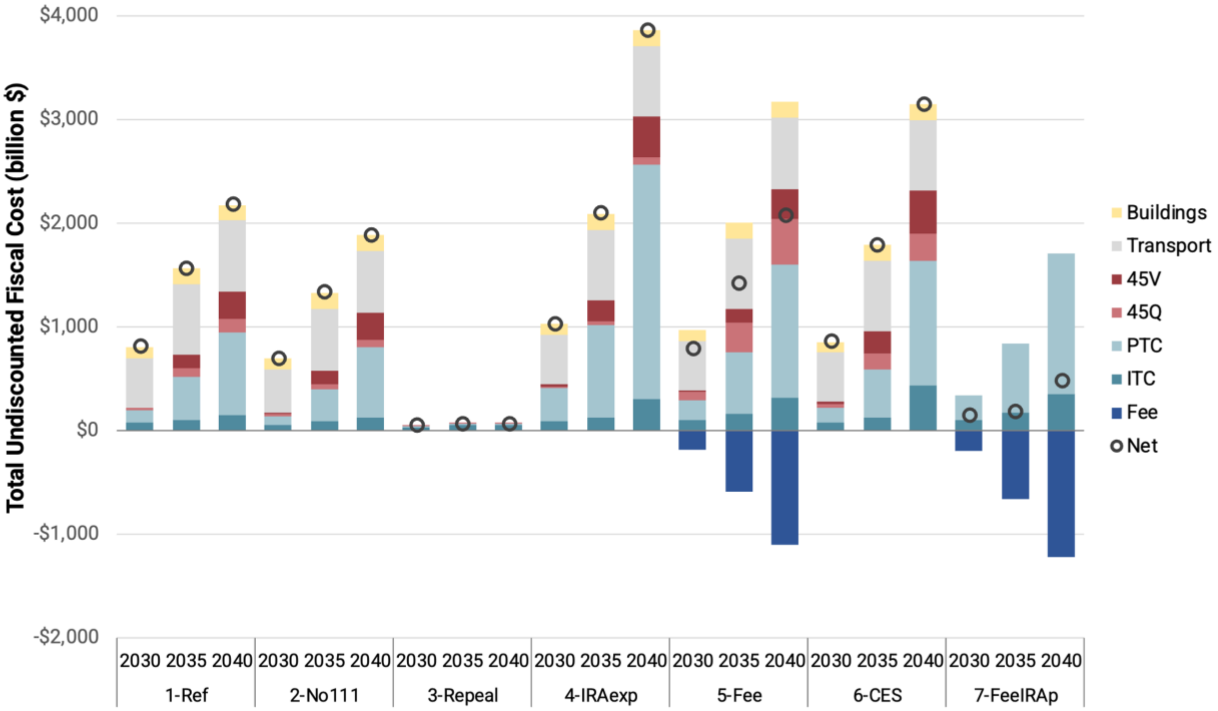


Figure 7: Cumulative fiscal impacts of IRA tax credits and carbon fee by scenario. Values are shown in nominal terms starting in 2026 and do not include $121 billion in direct spending through IRA.

Figure 8 summarizes the projected impacts on an average household's direct energy expenditures, including electricity, gasoline, and natural gas. In all scenarios, energy spending declines over time, primarily driven by reduced gasoline expenditures.[22] Expenditures on electricity increase over time in all scenarios, but not by as much as gasoline expenditures fall. Household expenditures are slightly higher than the reference scenario with either a fee (5-Fee) or a repeal (3-Repeal), and these two scenarios are similar in terms of overall household expenditures, with slightly more expenditures for gasoline and less for electricity under the 3-Repeal scenario.

---

[22] One might conclude that the reduced expenditures on gasoline are offset by increased expenditures for vehicles, but this is not the case. See Figure S6, which includes projected expenditures on appliances and vehicles. In all scenarios, household expenditures decline over time due to vehicle electrification, as expenditures switch away from liquid fuels and toward electricity.

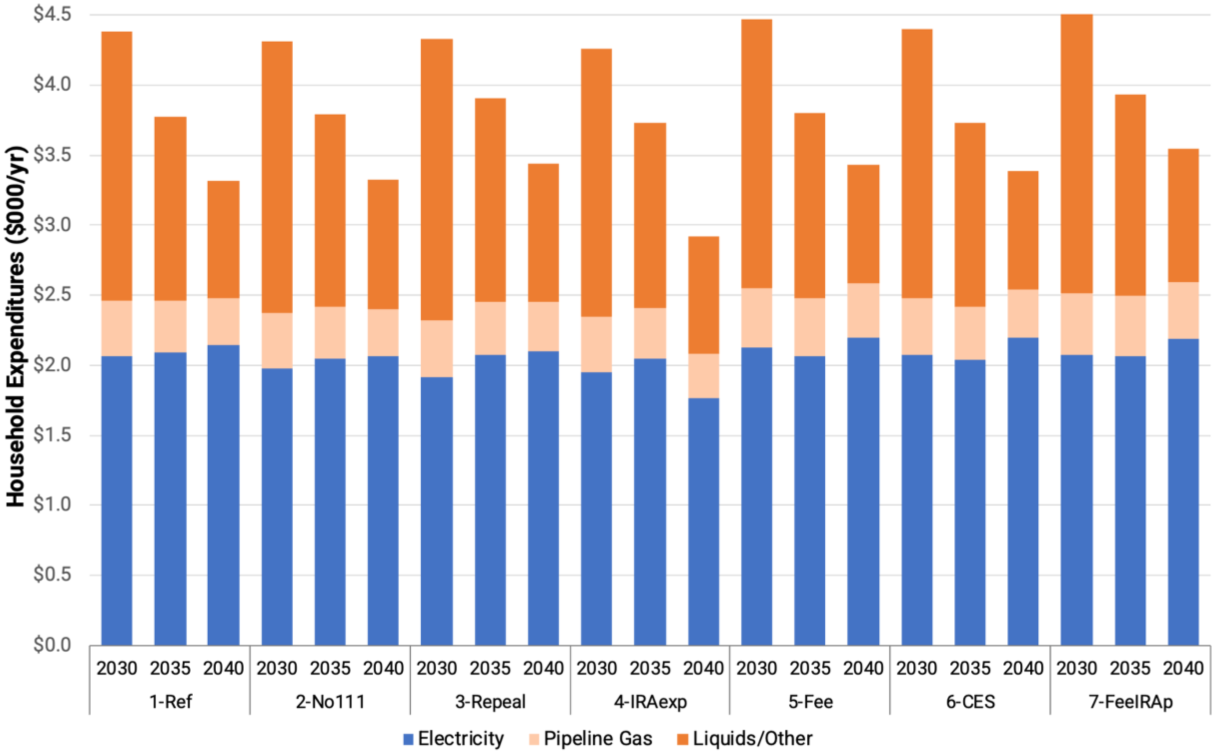


Figure 8: Household-level direct energy expenditures across scenarios. Values are shown in real 2023 dollar terms for an average household.

Table 3 summarizes the results presented so far, reflecting emissions, fiscal costs, carbon revenues, and household energy expenditures in 2035 for each scenario. The table adds a column with the average abatement costs relative to the repeal scenario, reflecting the change in discounted resource costs—across energy system supply and demand and including both fiscal and private costs—over the change in undiscounted emissions.[23] Abatement costs in the 1-Ref and 2-No111 scenarios ($43/t-$CO_2$ and $69/t-$CO_2$, respectively) are similar to the range of IRA abatement costs in a recent multi-model study, which range from $27-102/t-$CO_2$ with an average of $61/t-$CO_2$ across all models (Bistline, et al., 2023). Proposed EPA power plant rules lower abatement costs by targeting reductions in coal generation in the power sector (Bistline, et al., 2024), which are among the lowest cost abatement options (Davis, et al., 2023). Expanding IRA and adding a CES accelerates power sector investments and increase costs relative to the 1-Ref scenario from $43/t-$CO_2$ to $50/t-$CO_2$ and $59/t-$CO_2$, respectively. Adding a carbon fee lowers average abatement costs to $25/t-$CO_2$ and to $18/t-$CO_2$ with partial IRA repeal. The relatively low average abatement costs in the carbon fee scenarios reflect the following factors in the modeling:

---

[23] This metric includes incremental expenditures on capital costs, fuel costs, and maintenance costs.

- Extensive emissions reductions in these scenarios come from the power sector (Figure 4), which has several decarbonization options with very low abatement costs (Davis, et al., 2023). Note that the numerator in the average abatement cost calculation is the net present value of resource costs across the model's time horizon, and several low-carbon options have higher upfront costs but low operating costs, which are captured by summing across the time horizon.
- Transport emissions reductions come not only from electrification but also from biofuels. There are already bio-based liquid fuels in the reference scenario,[24] and given US-REGEN's updated feedstock supply curves for biomass and assumptions about conversion technologies, additional biofuels with a carbon fee can be a relatively low-cost source of emissions reductions (Figure 6).
- Fuel expenditures[25] include carbon tax markups; however, since the markup is a transfer from consumers to the federal government, abatement cost calculations do not include carbon fee expenditures or receipts.

Table 3: Summary of policy impacts across scenarios.

Scenario	**2035 Economy CO_2** **(Decline from 2005)**	**Fiscal Costs to 2035** **($ billion)**	**Revenue from Carbon Fee to 2035** **($ billion)**	**Average Abatement Cost** **($/t-$CO_2$)**	**2035 Household Energy** **($/yr)**
1-Ref	49%	$1,570	$0	$43	$3,770
2-No111	42%	$1,330	$0	$69	$3,790
3-Repeal	36%	$70	$0	N/A	$3,900
4-IRAexp	51%	$2,100	$0	$50	$3,730
5-Fee	62%	$2,010	$590	$25	$3,800
6-CES	52%	$1,790	$0	$59	$3,730
7-FeeIRAp	57%	$840	$660	$18	$3,930

Notes: Economy CO_2 includes energy and industrial process CO_2 only (not land sink or non-CO_2 GHGs). Cumulative fiscal costs and revenues from carbon fee revenues over ten-year budget window are shown in nominal terms. Costs do not include $121 billion in direct spending through the IRA. Average abatement costs are the change in discounted resource costs (across energy system supply and demand) over the change in undiscounted emissions relative to Scenario 3-Repeal and are shown in 2023 dollars. Household energy expenditures show annual spending on electricity, petroleum, natural gas, and other fuels and are shown in 2023 dollars.

---

[24] See Blanford, et al. (2022) for comparisons of bioenergy supply, conversion, and demand across reference and economy-wide net-zero scenarios: https://lcri-netzero.epri.com/en/results-comparison-supply-bioenergy.html.

[25] These scenarios use the same exogenous natural gas price assumptions, which are shown in Figure S3. If natural gas prices were endogenous, the lower demand under deeper decarbonization scenarios could put downward pressure on prices and expenditures on natural gas, though the magnitudes of these effects depend on supply elasticities, demand responses, and international market dynamics.

The analysis also considers sensitivities with higher tax credit and carbon fee levels, which are summarized in the appendix. Doubling the magnitude of IRA's power sector credits increases fiscal costs by 44% but only reduces economy CO_2 by two percentage points in 2035. Increasing the carbon fee lowers economy-wide CO_2 emissions by 66% by 2035 from 2005 (compared to 62% in the 5-Fee scenario) and brings more revenue—$2,010 billion from 2026 through 2035 (compared to $590 billion in the 5-Fee scenario). The higher carbon fee is the only scenario in this analysis that reaches the 2030 U.S. climate target (Figure S8).

VI. Other Considerations for Policymakers

1. Fiscal Impacts

Policymakers will be particularly interested in the fiscal impacts of reform options as estimated by conventional CBO/JCT scores, so we consider these types of fiscal impacts here. CBO and JCT typically consider fiscal impacts over a ten-year window of a legislative proposal relative to a current-law baseline. Table 4 summarizes the estimated fiscal impacts adopting several CBO/JCT conventions. For one, repeal of the CAA Section 111 rules would not be scored, and the fiscal score would be relative to the reference scenario (Scenario 1). For these calculations, it is also assumed that current JCT methods would not adjust baseline uptake of IRA tax credits in response to a carbon fee.

Table 4: Adjusted fiscal impacts between 2026-2035 across scenarios.

Scenario	Estimated Fiscal Impact ($B)
1-Ref	N/A
2-No111	N/A
3-Repeal	+$1,500
4-IRAexp	-$530
5-Fee	+$590
6-CES	-$230
7-FeeIRAp	+$1,390

Notes: These estimates cover cumulative impacts across the ten-year budget window, assuming a baseline of current law. Positive numbers indicate factors that improve the government's fiscal situation through either additional government revenue sources or reduced expenditures. For Scenarios 5 and 7, only the direct carbon fees are calculated; the impact of the carbon fee on IRA credit uptake is not modeled. In Scenario 7, the total includes fiscal savings from a partial repeal of IRA.

The fiscal impact scores in Table 4 may differ from those of official scorekeepers in important ways. For instance, the revised JCT estimates of IRA tax provisions show a lower fiscal cost than many outside analyses, due in part to lower clean energy deployment as well as other factors.[26] If JCT assumptions are unchanged, official scores of the carbon fee may be higher than those presented here, which build in larger reductions in carbon emissions. On the other hand, the estimates in this section do not incorporate "offset" effects, where carbon fee revenues are lower due to lower tax collections elsewhere in the system in the wake of the carbon fee.

Overall, the estimates in this section are likely lower than those of official scorers. For example, the Committee for a Responsible Budget model implies higher carbon fee scores than those reported here.[27] Likewise, Clausing and Sarin (2023), using CBO scores as a guideline, calculate that the fee trajectory considered in Scenario 5, with the same price path and exemptions, and including offsets, might raise about $650 billion.[28] The lower revenues from the carbon fee in this analysis are due in part to the lower economy-wide emissions in these scenarios in addition to potential countervailing changes in IRA tax credits due to greater deployment of subsidized resources with a carbon fee in place.

2. Border Adjustments

All the carbon pricing bills introduced in Congress in recent years include provisions for border adjustments, although the details vary in important ways from bill to bill. One form of border adjustment is a rebate of the carbon fee for exports of either industrial products (e.g., H.R. 6665) or for exports of both industrial products and fossil fuels (e.g., H.R. 5744; S. 685).[29] Many of the bills assess the carbon price upstream, at the coal mine mouth, natural gas processing plant, refinery or point at which the fossil fuels are imported.[30] Without a rebate for fossil fuel exports, the fee would amount to a production tax rather than a consumption tax (Kortum and Weisbach, 2022). The economic rationale for rebating exports of industrial products is to preserve U.S. competitiveness in export markets that do not yet tax emissions.

---

[26] There are also methodological differences, including the fact that JCT includes offset effects to account for impacts of the policy on the tax system as a whole. For example, if IRA subsidies increase incomes for those involved in clean energy production, that will increase tax payments in other parts of the tax system.

[27] Their model (available here) does not allow an exact replication of the carbon fee scenario investigated here, but the difference between their estimates and carbon fees similar to our scenario suggest that they would find that similar fees generate hundreds of billions in additional revenue.

[28] Congressional Budget Office (2022) indicates that a similar tax would raise about $640 billion. Their estimates suggest that retail gasoline exemptions limit the tax to 74% of its potential revenue. The carbon fee considered in Scenario 5 would raise a bit less revenue since it would also exclude home heating oil, although in practice that is a small consideration. In addition, carbon border adjustment fee would be included, which would raise some revenue. The carbon fee considered here would raise more over subsequent decades since it starts at a lower level, increases gradually at first, then increases more steeply later in the budget window, ending at a higher level than the CBO tax.

[29] H.R. 6665 classifies refined petroleum products as an industrial product and so rebates the carbon fee for those exports, but not exports of other fossil fuels.

[30] See, for example, H.R. 6665, Sec. 9901(d).

Another form of border adjustment in recent bills is a fee on imports, akin to the European Union's carbon border adjustment mechanism. Every recent bill includes this, although the specific delineation of sectors to which the border adjustment applies varies from bill to bill, as does the process for calculating foreign emissions.

There are important unanswered questions about the global economic, emissions, geopolitical and distributional implications of the U.S. assessing a fee on imported goods and/or fossil fuels and rebating that fee on exports. If the export is destined for a country with a carbon fee assessed on imports that do not already have a carbon fee embedded, then the rebated carbon fee will simply be assessed in the destination country rather than domestically. To get a sense for the potential revenue at stake, Panel A of Table 5 summarizes estimates of the fiscal implications of *not* rebating fossil fuel exports. The magnitudes are substantial: not rebating fossil fuel exports could more than double the fiscal revenues from assessing a carbon fee.

These calculations do not include behavioral response, and U.S. exporters will likely export less if their supply is not perfectly inelastic and world prices increase by less than the amount of the tax. Still, strong projected export growth in the time ahead implies that revenues would be substantial. The calculations below reflect projections that between 2023 and 2035 U.S. exports of liquified natural gas (LNG) will more than double, while exports of petroleum products, crude oil, and coal will increase by 27%, 1%, and 25%, respectively. Coupled with declining domestic fossil fuel use, revenues from applying (or not rebating) the carbon fee on exports could overtake domestic revenues.

The revenues from a border adjustment on imports are estimated in Panel B of Table 5; these revenues are modest compared to the revenues foregone by rebating fees on fossil fuel exports. The calculations in Panel B of Table 5 follow the Clean Competition Act (S. 3422) and assess a carbon fee on imports of 14 energy-intensive, trade-exposed industries as well as products that include more than 100 pounds of material from these industries (e.g., machine parts or automobiles).[31] Like the Clean Competition Act, and unlike the calculations in Panel A, the revenues deduct export rebates for U.S. products in those industries destined for countries without carbon prices. The Clean Competition Act assesses fees based on the average emissions intensity of the source country. If instead, those emissions intensities are scaled up to reflect the global average emissions intensities of the 14 covered industries, border adjustment revenues would be almost twice as high, at $42.2 billion from 2027-2035.

---

[31] There are several important differences between the policy we model and the Clean Competition Act (CCA) (e.g., the CCA also assesses a carbon fee on some domestic production and does not assess a carbon fee on some imports).

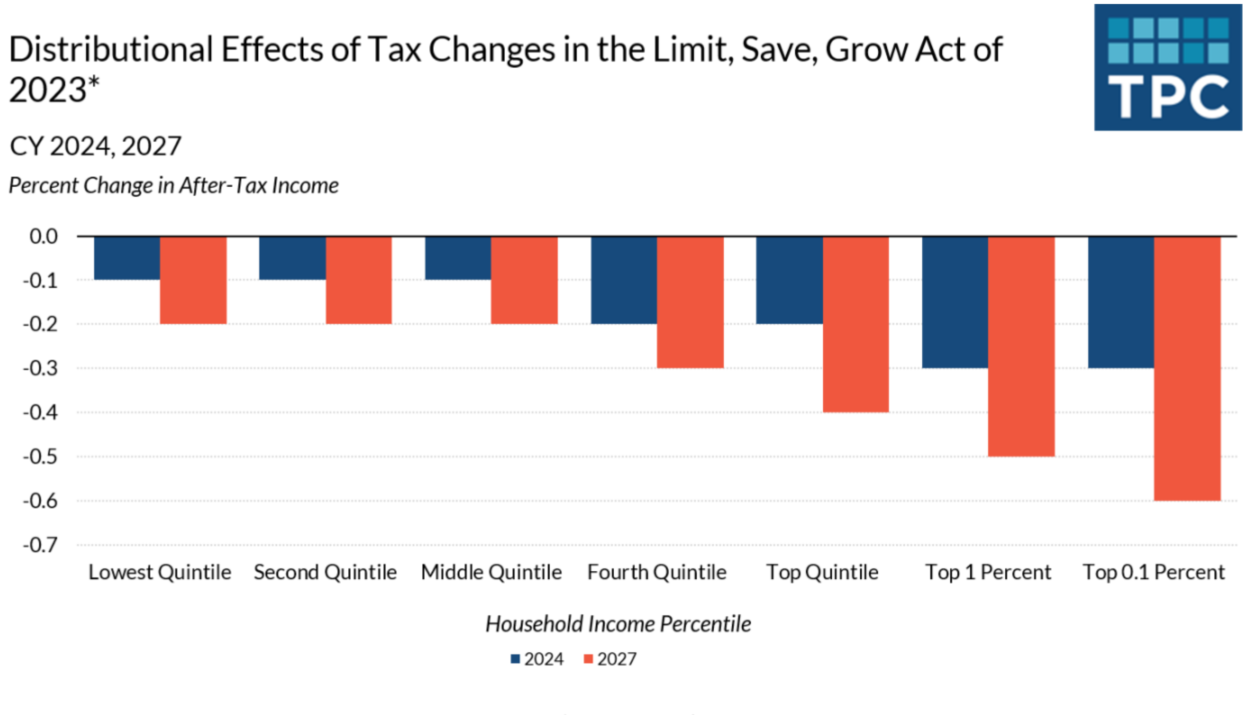
Table 5: Additional carbon fee revenues from border adjustments.

	Volume			Carbon fee revenues ($ billions)	
	Units	2023	2035	2035	2026-2035
PANEL A: Fossil fuel exports					
Natural gas (LNG and pipeline)	Tcf	7.9	13.6	49	202
Crude oil	MMb/d	3.3	3.4	30	139
Refined petroleum products	MMb/d	6.5	8.2	68	311
Coal	MMst	85.4	115.5	19	92
Revenue loss from export rebate				**166**	**745**
PANEL B: Energy-intensive, trade-exposed goods imports					
All covered sectors	$ billions	430	678	6	22
Revenue gain from import charges				**6**	**22**

Notes: The budget window of 2026-2035 is shown here, but since the carbon fee doesn't start until the second year of the window, revenues are generated in the period 2027-2035. Calculations reflect the carbon fee schedule modeled in Section IV and depicted in Figure 2 and report static estimates without behavioral response. Export projections for fossil fuels from U.S. Energy Information Administration's *Annual Energy Outlook 2023*, reference scenario. (Future natural gas exports will depend on future LNG export capacity, and there is considerable uncertainty about how much of the planned capacity will come online. Including LNG export facilities already permitted and under construction as well as facilities with pending export applications, which may or may not get built, brings 2035 exports to 20.0 Tcf [Stock and Zaragoza-Watkins 2024].) Revenues from refined product exports are reduced by approximately 10% based on 5-year average share of motor gasoline in refined product exports to reflect carveout for motor gasoline. Panel B calculations follow assumptions in S. 3422, the Clean Competition Act. Panel B calculations show revenues from border adjustments on relevant imports less rebates on relevant exports. Panel B calculations account for the average emissions intensity of the source country's economy but do not account for industry-specific emissions intensity. Further details are provided in the appendix.

3. Distributional Impacts

Policymakers may also analyze the potential distributional consequences of these policy options. Distributional impacts of IRA's climate provisions vary based on the tax credit, analysis framework, and assumptions (Brown, et al., 2023; Buhl, 2023). In analyzing the suite of IRA production tax credits, Tax Policy Center finds that IRA tends to have regressive impacts, using standard incidence analyses.[32] Tax Policy Center models lower energy costs as affecting the relative price of energy-intensive products as well as the returns to labor and rents (above normal returns to capital). The incidence is skewed toward the top, with the top quintile receiving more than 40% of the tax benefit. The suite of investment tax credits is modeled as targeting investment, and thus is borne by labor and capital in similar proportions, following standard Tax Policy Center incidence assumptions. The incidence is again skewed toward the top, with the top quintile receiving more than 60% of the tax benefit. Finally, the consumer credits are distributed according to the distribution of housing and automobile wealth in the United States, subject to legislated income limits; the top quintile receives more than 40% of the tax benefit. As a consequence, Tax Policy Center estimates of the distributional effects of IRA repeal show a progressive increase in tax burdens, as discussed in Buhl (2023). Figure 9, reproduced from Buhl (2023), summarizes the negative impacts of IRA repeal, indicating that households in higher percentiles suffer bigger losses.



Source: Urban-Brookings Tax Policy Center Microsimulation Model (version 0323-1).
Note: *Excludes proposed repeal of the electric vehicles tax credit.

Figure 9: Distributional effects of tax changes in the Limit, Save, Grow Act of 2023. Source: Tax Policy Center (Buhl, 2023), reprinted with permission.

Other studies with different methodologies and assumptions may find contrasting results. For example, Brown, et al. (2023) find progressive effects from the IRA tax credits, using linked

---

[32] Tax Policy Center analyzes the distributional effect of the energy investment tax credits here, the production tax credits here, and the energy efficiency and clean vehicle credits here.

computable general equilibrium, power sector capacity expansion, microsimulation, and air quality models to estimate distributional effects from the IRA power sector credits. Their analysis both includes other criteria (e.g., positive effects from improved air quality) as well as different fiscal assumptions (e.g., assuming increased capital taxes to avoid reduced government transfers due to the government budget constraint).

Likewise, the inclusion of a carbon fee may have important distributional consequences. When modeling the distributional effects of a carbon fee, both Treasury and Tax Policy Center model the carbon fee as akin to a consumption tax, focusing on how relative price changes affect distribution (e.g., lower-income households may consume more energy-intensive consumption bundles than higher-income households). If the economy-wide price level is fixed, firms are modeled as "passing back" the effects of the tax, which will affect labor and business owners that earn above-normal returns, as the normal return to capital is untaxed under a consumption tax.

Both Treasury and Tax Policy Center find regressive effects from carbon fees, although they do not model the carbon fee assumed here (which carves out gasoline). In the Tax Policy Center modeling, discussed in Rosenberg, Toder, and Lu (2018), effects are similarly regressive as the IRA tax credits as a whole. Treasury, discussed in Horowitz, et al. (2017), finds a flatter outcome than Tax Policy Center, since it does not assume an impact on social security wages, which would only occur over longer time horizons. In both cases, any effects on regressivity can be offset through targeted tax reductions elsewhere in the system or offsetting per-capita household rebates, both of which can make carbon fees (on net) progressive.[33] Finally, the design of the carbon fee considered here, which both exempts gasoline and layers on top of energy price declines due to IRA subsidies, is likely to dampen any regressive impacts.

Finally, both the CES and regulatory measures may have distributional impacts of their own, although such impacts are not well-modeled in the current literature. That said, both would be expected to raise energy prices in a way that would have analogous effects to those of a carbon fee (Borenstein and Kellogg, 2023).

4. Impacts on Innovation

---

[33] This caveat also applies to other policy packages when they are combined with offsetting progressive policy changes. There is a large literature examining the incidence of carbon pricing policies, which points toward specific design elements being critical to whether the policy is regressive or progressive (Goulder, et al., 2019; Horowitz, et al., 2017; Metcalf, 2019; Caron, et al., 2018).

Policymakers may also consider the impacts that different approaches to climate mitigation could have on innovation. For example, they may be interested in spillovers to the rest of the world from technology deployment in the United States. Economists have long recognized that addressing climate change requires confronting multiple market failures, including the negative externality from greenhouse emissions and innovation frictions (see, e.g., Jaffe, Newell and Stavins, 2005). Theoretical work on the role of subsidies versus carbon prices explores several mechanisms that may impact new technologies, including induced innovation, learning-by-doing, economies of scale, and network effects (see, e.g., Acemoglu, et al., 2012; Li, et al., 2017; Aghion, et al., 2019; Bistline, Mehrotra, and Wolfram, 2023). Theory does not provide a strong conclusion that either subsidies or carbon prices lead to more innovation, and, in practice, differences in how specific policies treat new technologies may be more important than the broad policy approach.

The theoretical uncertainty makes it difficult to project how the modeled scenarios might impact innovation. Scenarios with more deployment are more likely to contribute to learning by doing or scale economies. Figure S10 in the appendix demonstrates that scenarios 4 through 7 have broadly similar impacts on capacity expansion of renewable and other low-carbon sources in the power sector. 4-IRAExp leads to the largest increase in new capacity, although the differences are driven by utility-scale wind and solar, technologies that may be too mature to benefit from much more learning-by-doing or economies of scale, especially when considering U.S. investments relative to the rest of the world. 5-Fee and 6-CES lead to more CCS capacity additions than any of the other scenarios.

VII. Conclusion

This paper considers U.S. climate policy adoption in 2025, since much of climate policy is currently orchestrated through the tax code and tax code revisions are likely to be considered in 2025 due to the looming expiration of many of TCJA provisions. The study analyzes a wide range of possible climate policy options, reflecting the possibility that U.S. policy may evolve due to several drivers at the federal level.

Under the reference scenario with current policies, model results project that carbon emissions fall by 49% by 2035 from 2005 levels. If instead the IRA is repealed and regulatory processes are rolled back, emissions reductions are only 36% in 2035 from 2005. On the other hand, if the status quo is augmented by a carbon fee, a clean electricity standard, or greater IRA subsidy levels, emissions reductions will exceed reference reductions, with declines of 62%, 52%, and 51% from 2005, respectively.

A possible compromise scenario adds a carbon fee but repeals the parts of IRA that are least cost-effective in terms of emissions reductions (saving $1,390 billion in fiscal costs through 2035), while retaining electric sector production and investment tax credits. This scenario generates an emissions reduction of 57% by 2035 from 2005, the second-largest reduction scenario in this paper. This scenario may also be the most cost-effective in terms of emissions reduction per dollar of economy-wide cost; the average abatement cost per metric ton of emissions reduction is \$18/t-CO_2, compared to \$25 for the carbon-fee layered on top of the status quo, and \$43 for the reference scenario. Other scenarios have higher abatement costs ranging from \$50-69/t-CO_2 across the economy. Direct energy costs borne by households have more limited variation across scenarios, by less than 5%.

Policymakers may also consider how the scenarios are likely to be scored by JCT as well as the distributional effects of these scenarios. The compromise scenario of partial IRA repeal combined with a carbon fee is estimated to score as raising $1.4 trillion over the budget window, or potentially over $2 trillion if the fee applies to fossil fuel exports. Distributional consequences of these scenarios are also important and require additional analysis to evaluate. Of note, the distributional consequences of these policy scenarios are likely to be minor relative to other tax tools available in the context of tax reform (such as changes in brackets, child tax credits, or earned income tax credits).

Beyond the tax reform debate that is likely to occur in 2025, other factors could also shape U.S. climate policy, including policy developments abroad, climate change impacts, macroeconomic developments, and unknown geopolitical events. There are also many important areas where future research will inform the tradeoffs discussed in this paper. Continued analysis of the early experience with IRA tax subsidies will improve understanding of how these provisions interact with federal regulations, state policies, and company and household behavior.

References

Acemoglu, et al. (2012).The Environment and Directed Technical Change. *American Economic Review*, 102(1): 131-166.

Aghion, et al. (2019). Path Dependence, Innovation and the Economics of Climate Change. In The Handbook on Green Growth, Roger Fouquet (ed.).

Bistline, et al. (2024). Analysis of EPA's Proposed New and Existing Source Standards for Power Plants. EPRI Report 3002028858 (Palo Alto, CA).

Bistline, Mehrotra, and Wolfram (2023). Economic Implications of the Climate Provisions of the Inflation Reduction Act. *Brookings Papers on Economic Activity*, forthcoming.

Bistline, et al. (2023). Emissions and Energy Impacts of the Inflation Reduction Act. *Science*, 380(6652): 1324-1327.

Bistline, et al. (2022). Actions for Reducing U.S. Emissions at Least 50% by 2030. *Science*, 376(6596): 922-924.

Blanford and Bistline (2023). Impacts of IRA's 45V Clean Hydrogen Production Tax Credit. EPRI Report 3002028407 (EPRI, Palo Alto, CA).

Blanford, et al. (2022). Net-Zero 2050: U.S. Economy-Wide Deep Decarbonization Scenario Analysis. EPRI Report 3002024882 (EPRI, Palo Alto, CA).

Borenstein and Kellogg (2023). Carbon Pricing, Clean Electricity Standards, and Clean Electricity Subsidies on the Path to Zero Emissions. *Environmental and Energy Policy and the Economy*, 4(1): 125-176.

Bown and Clausing (2023). How Trade Cooperation by the United States, the European Union, and China Can Fight Climate Change. PIIE Working Paper 23-8*.* October 2023.

Brown, et al. (2023). Tax Credits for Clean Electricity: The Distributional Impacts of Supply-Push Policies in the Power Sector. NBER Working Paper 31621.

Buhl (2023). House GOP Plan to Repeal IRA Incentives Would Hike Taxes For Households, Tilted Toward High-Income Earners. Tax Policy Center. 3 May 2023. Available at https://www.taxpolicycenter.org/taxvox/house-gop-plan-repeal-ira-incentives-would-hike-taxes-households-tilted-toward-high-income.

Caron, et al. (2018). Distributional Implications of a National CO_2 Tax in the U.S. Across Income Classes and Regions: A Multi-Model Overview. *Climate Change Economics*, 1840004.

Clausing and Sarin (2023). The Coming Fiscal Cliff: A Blueprint for Tax Reform in 2025. The Hamilton Project. Available at https://www.brookings.edu/wp-content/uploads/2023/09/20230927_THP_SarinClausing_FullPaper_Tax.pdf.

Clausing and Wolfram (2023). Carbon Border Adjustments, Climate Clubs, and Subsidy Races When Climate Policies Vary. *Journal of Economic Perspectives*, 37(3): 137-162.

Cole, et al. (2023). Policies for Electrifying the Light-Duty Vehicle Fleet in the United States. *American Economic Association Papers & Proceedings*, 113: 316-322.

Committee for a Responsible Federal Budget (2023). Tax Cut Extensions Cost Over $3.3 Trillion. Available at https://www.crfb.org/blogs/tax-cut-extensions-cost-over-33-trillion.

Congressional Budget Office (2022). Options for Reducing the Deficit, 2023 to 2032– Volume I: Larger Reductions. Congressional Budget Office (Washington, DC).

Congressional Budget Office (2024). The Budget and Economic Outlook: 2024 to 2034. Congressional Budget Office (Washington, DC), February 2024.

Congressional Research Service (2021). A Brief History of U.S. Electricity Portfolio Standard Proposals. Available at https://crsreports.congress.gov/product/pdf/IF/IF11316.

Congressional Research Service (2020). Energy Tax Provisions Expiring in 2020, 2021, 2022, and 2023 ("Tax Extenders"). Available at https://crsreports.congress.gov/product/pdf/R/R46451.

Davis, et al. (2023). Ch. 32. Mitigation. In: "Fifth National Climate Assessment." Crimmins, et al., Eds. (U.S. Global Change Research Program, Washington, DC).

Dimanchev and Knittel (2023). Designing Climate Policy Mixes: Analytical and Energy System Modeling Approaches. *Energy Economics*, 122(June): 106697

Domeshek, et al. (2024) Leveraging the Inflation Reduction Act to Achieve 80x30 in the US Electricity Sector. *Economics of Energy and Environmental Policy*, forthcoming.

Environmental Protection Agency (2023). A Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances. Available at https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf

Goldman Sachs (2023). Carbonomics: The Third American Energy Revolution.

Goulder, et al. (2019). Impacts of a Carbon Tax Across U.S. Household Income Groups: What Are the Equity-Efficiency Trade-Offs? *Journal of Public Economics*, 175: 44-64.

Grubert and Sawyer (2023). U.S. Power Sector Carbon Capture and Storage under the Inflation Reduction Act Could Be Costly with Limited or Negative Abatement Potential. *Environmental Research Infrastructure and Sustainability*, 3:015008.

Horowitz, et al. (2017). Methodology for Analyzing a Carbon Tax. Office of Tax Analysis Working Paper 115. Available at https://home.treasury.gov/system/files/131/WP-115.pdf.

Jaffe, et al. (2005). A Tale of Two Market Failures: Technology and Environmental Policy. *Ecological Economics*, 54(2-3): 164-174.

Keyes, et al. (2019). The Affordable Clean Energy Rule and the Impact of Emissions Rebound on Carbon Dioxide and Criteria Air Pollutant Emissions. *Environmental Research Letters*, 14(4): 044018.

Kortum and Weisbach (2022). Optimal Unilateral Carbon Policy. Working paper.

Li, et al. (2017). The Market for Electric Vehicles: Indirect Network Effects and Policy Design. *Journal of the Association of Environmental and Resource Economists*, 4(1): 89-133.

Metcalf (2019). On the Economics of a Carbon Tax for the United States. *Brookings Papers on Economic Activity*, 405-484.

Penn-Wharton Budget Model (2023). Update: Budgetary Cost of Climate and Energy Provisions in the Inflation Reduction Act. April 27, 2023. Penn Wharton Budget Model (Philadelphia, PA). Available at https://budgetmodel.wharton.upenn.edu/estimates/2023/4/27/update-cost-climate-and-energy-inflation-reduction-act.

Rennert, et al. (2022). Comprehensive Evidence Implies a Higher Social Cost of CO_2. *Nature*, 610: 687-692.

Rosenberg, et al. (2018). Distributional Implications of a Carbon Tax. July 2018. Columbia SIPA, Center for Global Energy Policy and Tax Policy Center (New York City and Washington, DC). Available at https://www.taxpolicycenter.org/publications/distributional-implications-carbon-tax/full.

Rorke and Nystrom (2024). Revisiting Carbon Pricing in a New Landscape. Climate Leadership Council. Available at https://clcouncil.org/Revisiting%20Carbon%20Pricing%20in%20a%20New%20Landscape.pdf?_t=1709240336.

Santen, et al. (2021). Analyzing Federal 100% Clean Energy Standards: Policy Design Choices and Future Electric Power Sector Outcomes. EPRI Report 3002020121 (EPRI, Palo Alto, CA).

Stock and Zaragoza-Watkins (2024). The Market and Climate Implications of U.S. LNG Exports. NBER Working Paper 32228.

Appendix

EPRI's U.S. Regional Economy, Greenhouse Gas, and Energy (US-REGEN) model features regional disaggregation and technological detail of the power sector and linkages to other economic sectors.[34] The power sector model is formulated as an intertemporal optimization of generation investments and retirements, system operations, energy storage investment, transmission investments and trade, carbon removal options, and hydrogen production. The model includes five-year timesteps through 2050. Model regions are shown in Figure S1.

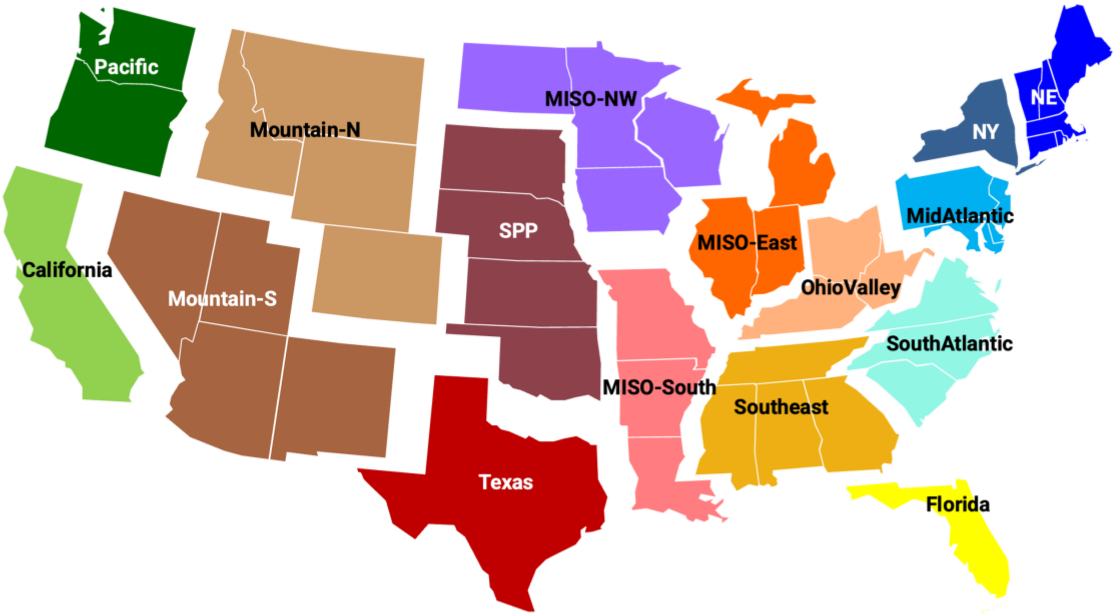


Figure S1: Regional aggregation for US-REGEN in this analysis.

The model also includes integrated energy end use and fuels production decisions (Figure S2). These pathways use explicit technology representations for converting, storing, and delivering primary energy to end-use customers. Technology cost and performance assumptions are based on EPRI's well-established Technology Assessment Guide (TAG) framework. Detailed discussions of the model's structure and key parameter assumptions can be found in the US-REGEN online documentation at https://us-regen-docs.epri.com/.

---

[34] Recent peer-reviewed articles and reports can be found at https://esca.epri.com/models.html, and detailed model documentation is available at https://us-regen-docs.epri.com/.

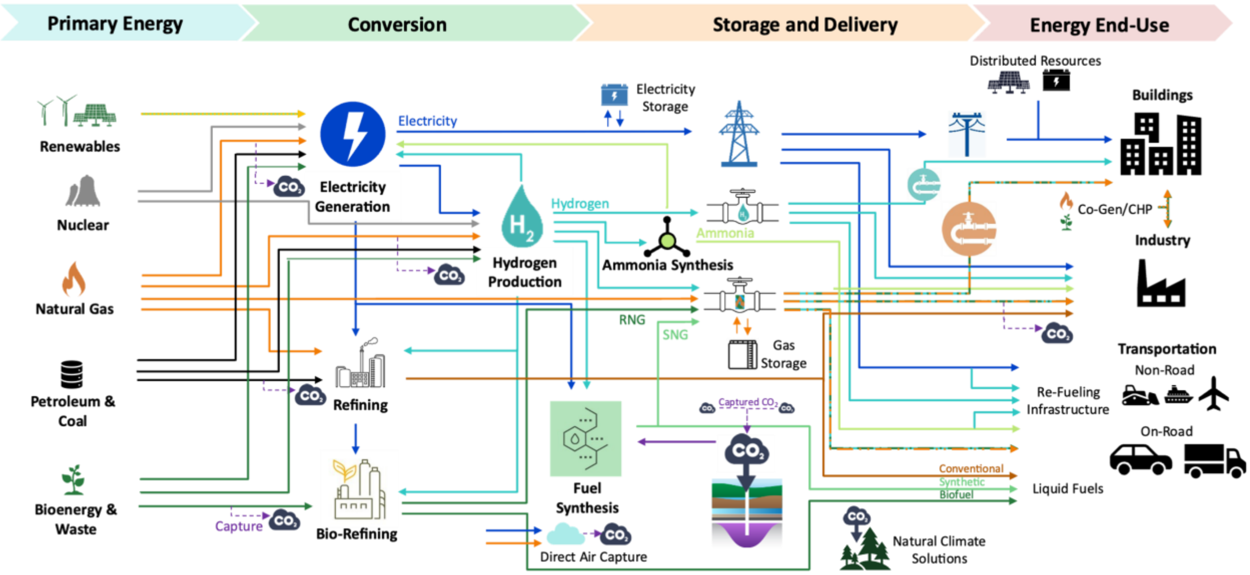


Figure S2: Economy-wide energy conversion pathways modeled in US-REGEN.

Natural gas prices in this analysis are shown in Figure S3. The analysis assumes exogenous natural gas prices, which are the same across all scenarios.

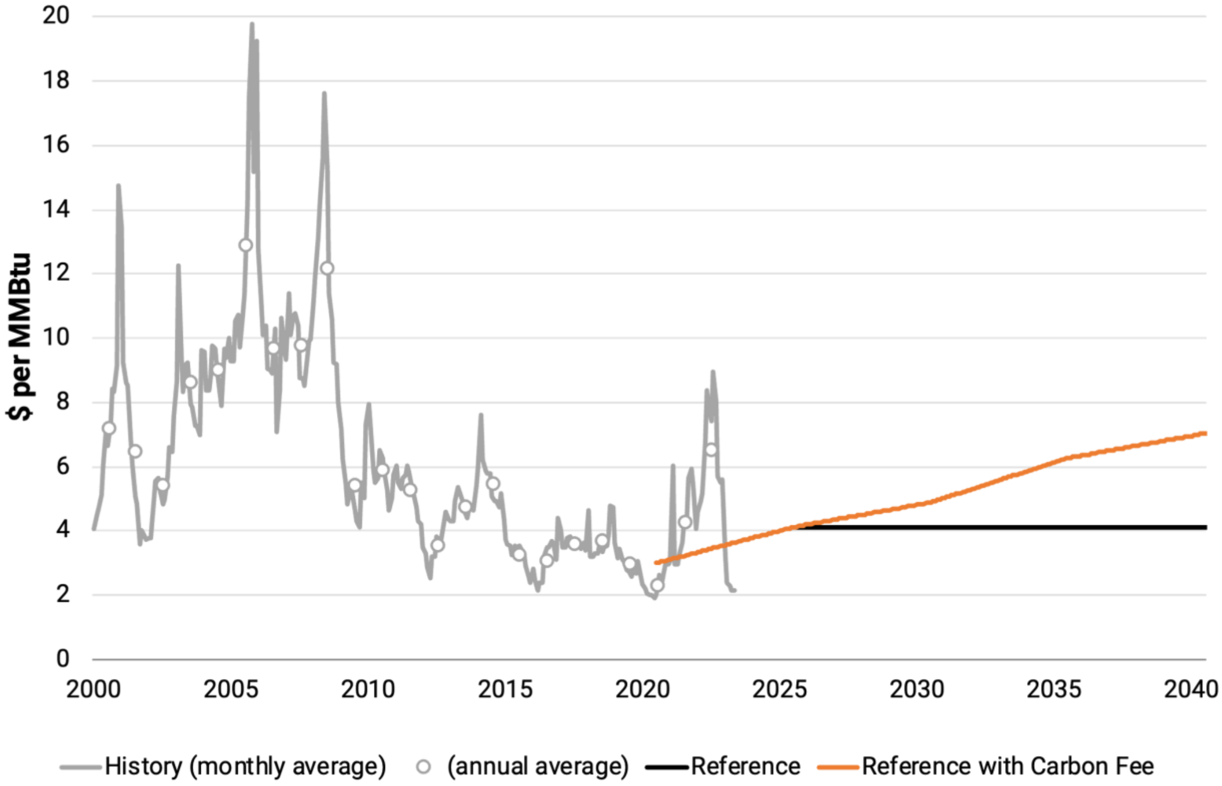


Figure S3: Historical and projected natural gas price assumptions. Prices delivered to the power sector are shown in real 2023 dollars.

Assumptions for partial crediting in the CES scenarios are shown in Figure S4. Zero-emitting resources receive full credit, while others receive partial credit based on their individual annual emissions intensity relative to a 0.82 t-CO_2 per MWh benchmark.[35]

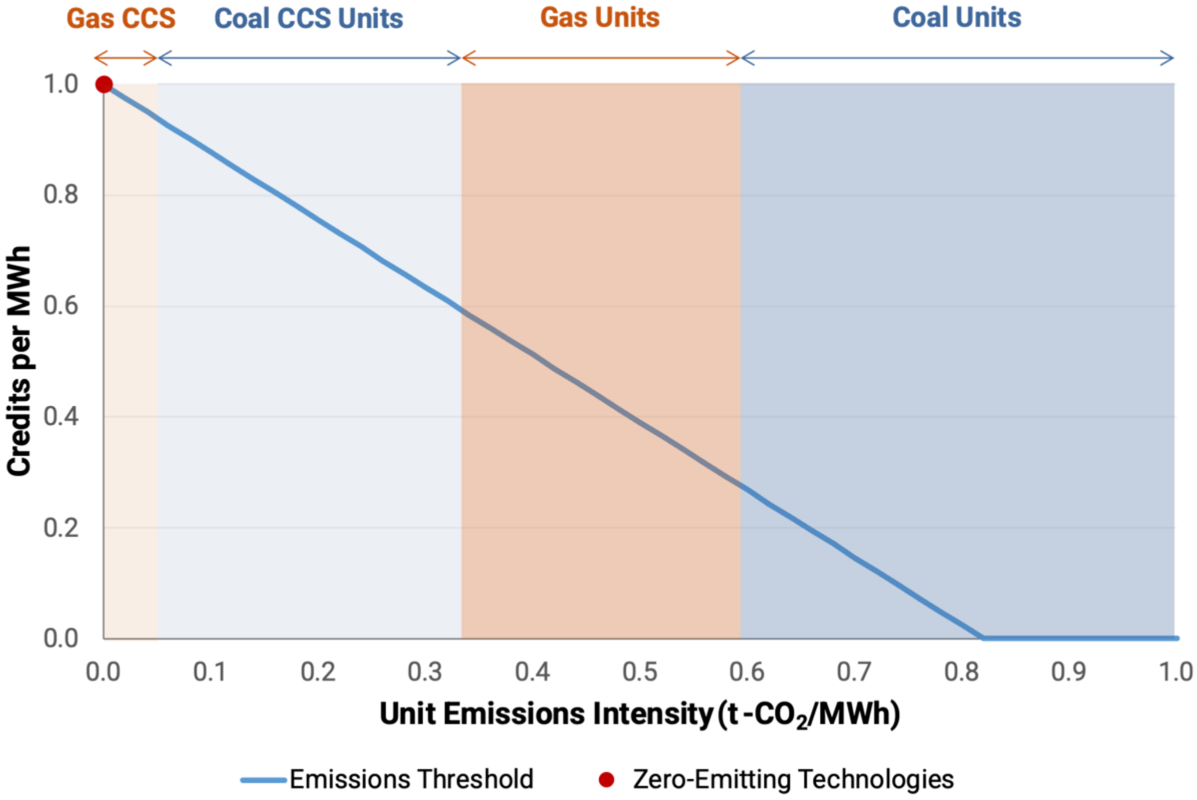


Figure S4: Clean electricity standard credits based on a unit's emissions intensity of generation.

Electric sector capacity additions and retirements by technology are shown in Figure S5. All scenarios entail extensive coal retirements and higher wind, solar, and energy storage additions than current levels; however, the extent of these trends varies by scenario. Variable renewable deployment is highest under the extended IRA scenario and is higher than levels under scenarios with carbon fees and a CES. The carbon fee with current IRA provisions has greater CCS-equipped gas deployment than the carbon fee scenario without 45Q credits. The CES scenario with IRA tax credits also has large-scale gas with CCS deployment.

---

[35] Assumptions for partial crediting, point of regulation, and alternative compliance payment in the CES scenario are based on the core CES scenario in Santen, et al. (2021).

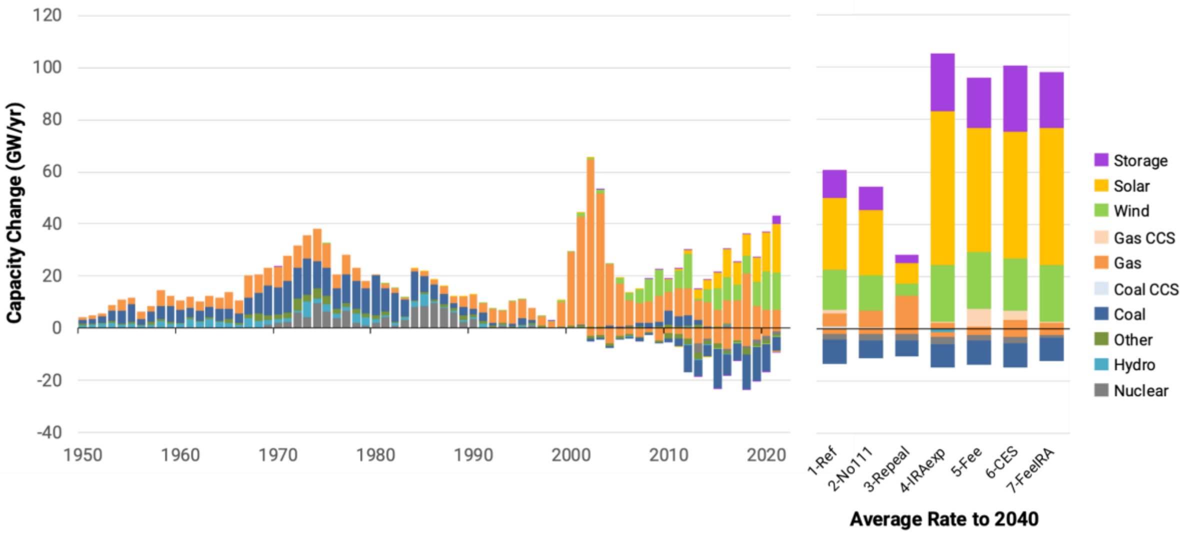
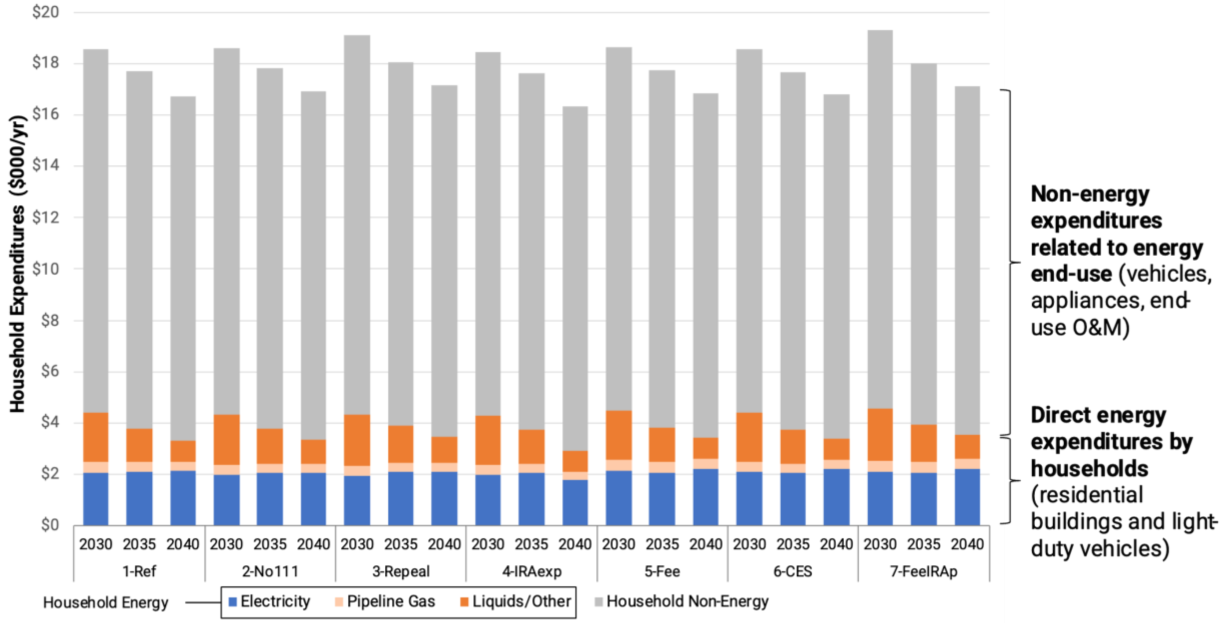


Figure S5: Historical and projected power sector capacity additions and retirements by technology. Projections show the average annual rate through 2040.

Household energy expenditures and associated spending on vehicle, appliances, and maintenance are shown in Figure S6.



Non-energy expenditures related to energy end-use (vehicles, appliances, end-use O&M)

Direct energy expenditures by households (residential buildings and light-duty vehicles)

Figure S6: Household-level energy expenditures across scenarios. Values are shown in 2023 dollars for an average household.

In addition to the scenarios in Table 1, the analysis also includes scenarios to understand how emissions and fiscal outcomes could change with alternate tax credit and carbon fee levels:

- **IRAexpH:** Expands IRA's power sector credits by 100% beginning in 2026 (instead of 50% in 4-IRAexp).
- **FeeH:** Uses a higher carbon fee that starts at a higher initial price ($64/t-$CO_2$ in 2026) and rises at 6% annually plus inflation (Figure S7).

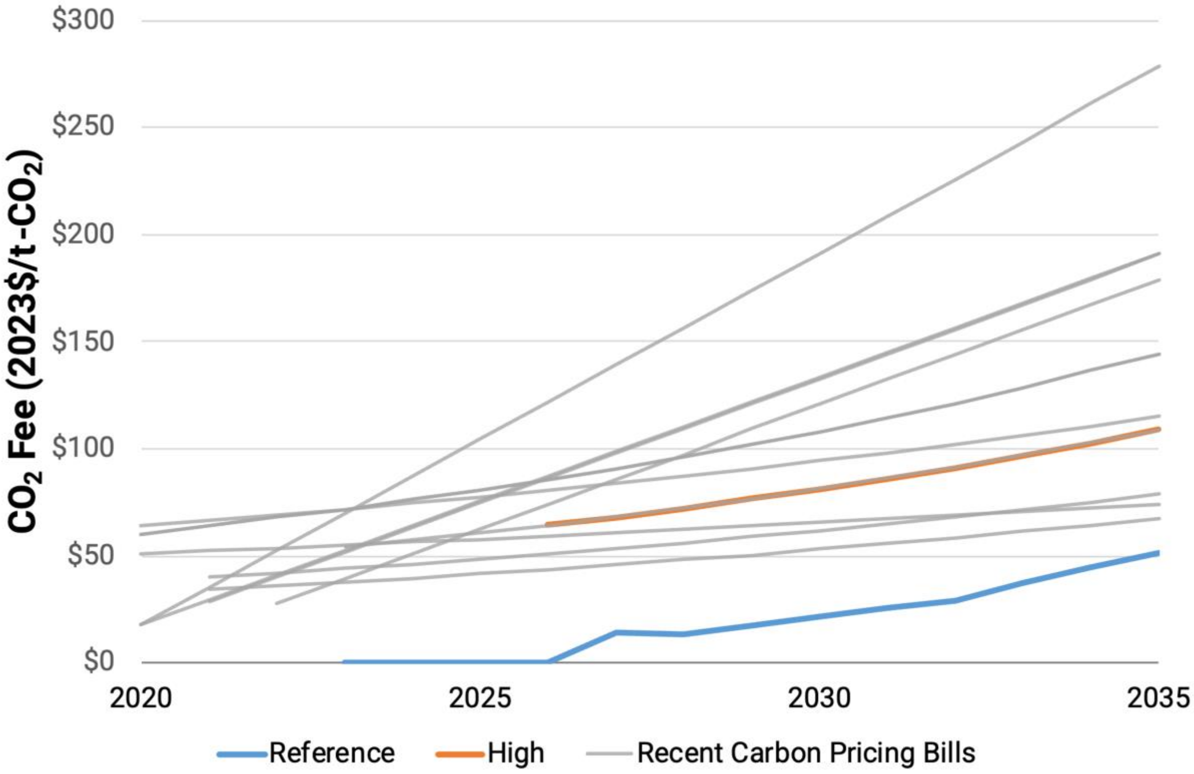


Figure S7: Modeled price path for carbon fee in the 5-Fee scenario (blue), higher fee scenario (orange), and recent carbon pricing bills (gray). Values are shown in real 2023 dollar terms per metric ton of CO_2. Recent carbon pricing bills come from the Resources for the Future "Carbon Pricing Bill Tracker" with proposals from the 116th and 117th Congresses.

Table S1 compares policy impacts of these alternate tax credit and carbon fee scenarios. Doubling the magnitude of IRA's power sector credits increases fiscal costs by 44% (from $2,100 billion to $3,390 billion cumulatively through 2035) due to the larger outlays per unit output and greater deployment. Lower electricity prices from subsidized resources lead to increases in 45V uptake from electrolytic hydrogen in addition to higher fiscal costs of investment and production tax credits. Despite these higher fiscal costs, 2035 economy-wide CO_2 reductions are 53% lower than 2005, which is only 2 percentage points lower than the 4-IRAexp scenario, suggesting diminishing returns as tax credit magnitudes increase.

Table S1: Summary of policy impacts across sensitivities.

Scenario	2035 Economy CO_2 (Decline from 2005)	Fiscal Costs to 2035 (\$ billion)	Revenue from Carbon Fee to 2035 (\$ billion)
4-IRAexp	51%	\$2,100	\$0
IRAexpH	53%	\$3,390	\$0
5-Fee	62%	\$2,010	\$590
FeeH	66%	\$2,830	\$2,010

Notes: Economy CO_2 includes energy and industrial process CO_2 only (not land sink or non-CO_2 GHGs). Cumulative fiscal costs and revenues from carbon fee revenues over ten-year budget window are shown in nominal terms. Costs do not include \$121 billion in direct spending through the IRA.

Increasing the carbon fee lowers economy-wide CO_2 emissions by 66% by 2035 from 2005 (compared to 62% in the 5-Fee scenario), which is the only scenario in this analysis that reaches the 2030 U.S. climate target (Figure S8). Fiscal costs of IRA credits also increase due to the greater adoption of subsidized resources, increasing from \$2,010 billion to \$2,830 billion through 2035. The higher carbon fee also brings more revenue—\$2,010 billion from 2026 through 2035 (compared to \$590 billion in the 5-Fee scenario). Note that the FeeH scenario assumes a carve out for retail gasoline sales, but without this carve out, carbon fee revenues would be about \$800 billion higher through 2035 (carbon revenues would be about \$200 billion higher in the 5-Fee scenario without the carve out).

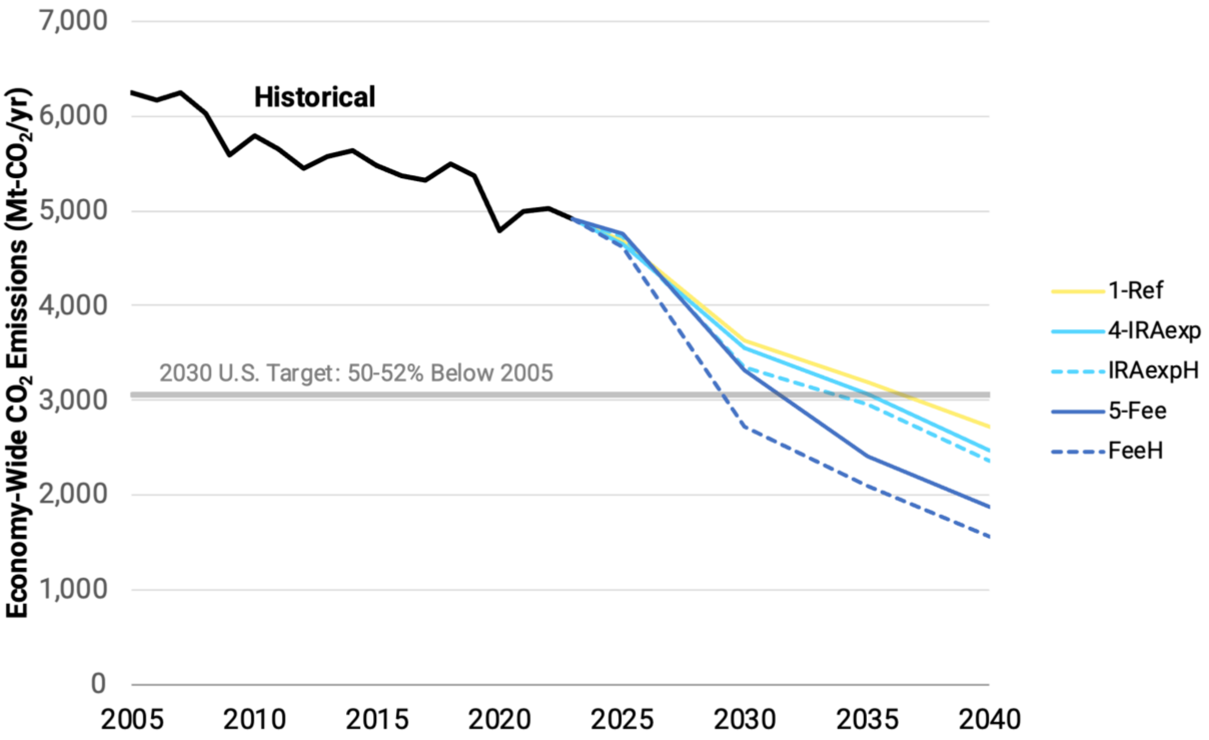


Figure S8: Historical and projected economy-wide CO_2 emissions by scenario. Emissions include gross energy and industrial process CO_2 emissions.

Table S2 lists the border adjustment revenues by industry. These calculations consider potential revenues on U.S. imports and potential rebates on U.S. exports from 2027 to 2035 for goods that fall within the covered industries listed in the Clean Competition Act (CCA) as well as goods that fall outside the listed industries but contain more than 100 pounds of any combination of goods in the covered industries ("100lbs+ Products"). These calculations exclude industries relating to fossil fuels because the REGEN model already captures emissions from imported fossil fuels.

Table S2: Summary of projected border adjustment revenues, 2027 to 2035.

	CBAM Revenues (m USDs) *2027 - 2035*		*Export Rebates (m USDs)* *2027 - 2035*	
NAICS Name	**Projected CBAM Revenues (w/o Intensity Adj)**	**Projected CBAM Revenues (w/ Intensity Adj)**	**Projected Rebates (w/o Intensity Adj)**	**Projected Rebates (w/ Intensity Adj)**
Pulp Mills	$219	$367	$304	$510
Paperboard Mills	$21	$35	$225	$377
Asphalt paving mixture and block manufacturing	$6	$14	$4	$10
Asphalt shingle and coating materials manufacturing	$15	$36	$6	$13
Petrochemical manufacturing	$117	$184	$234	$367
Industrial gas manufacturing (hydrogen only)	$0	$0	$1	$1
Ethyl alcohol manufacturing	$48	$23	$112	$55
Other basic organic chemical manufacturing (production of adipic acid only)	$4	$6	$5	$8
Nitrogenous fertilizer manufacturing	$1,616	$4,307	$35	$93
Glass	$2,225	$919	$237	$98
Cement	$216	$2,950	$4	$56
Lime and gypsum product manufacturing	$27	$63	$5	$11
Iron and Steel	$5,958	$20,924	$530	$1,860
Aluminum	$1,198	$4,301	$70	$250
Subtotal	**$11,669**	**$34,129**	**$1,771**	**$3,707**
Goods with more than 100lbs of Covered Materials	$16,002	$16,002	$4,229	$4,229
Total	**$27,671**	**$50,132**	**$6,000**	**$7,936**

Notes: The budget window of 2026-2035 is shown here, but since the fee doesn't start until the second year of the window, estimates are for 2027-2035. The "w/o Intensity Adj" columns assess import fees and export rebates based on the average emissions intensity of the source country. The "w/ Intensity Adj" columns scale up those emissions intensities to reflect the global average emissions intensities of the 14 covered industries.

Specifically, for 100lb+ Products, we determined aluminum, steel, iron, and glass to be the most likely covered materials from the CCA to contribute to 100lb+ Products. Thus, these calculations account for products likely to contain more than 100 pounds of aluminum, steel, iron, and/or glass. Moreover, for simplicity, these calculations only account for vehicles and machinery products that represented at least $1 billion in trade value in 2021. In total, 39 products (comprising automobiles, airplane parts, and household equipment) met these criteria.

CBAM revenues on imports are calculated separately for each industry/country/year permutation. Aggregate revenues and rebates across the entire model period from 2027 to 2035 represent the sum of the results for each year. There are 77 countries included in the analysis, including all those that are in the top 20 countries by import value to the U.S. in 2021 for at least one of the NAICS codes listed in the CCA. CBAM revenues with industry-specific carbon intensity adjustments for each industry/country/year permutation are calculated as the product of four variables, described below. CBAM revenues without industry-specific carbon intensity adjustments are calculated as the product of only the first three variables described below.

The first variable is the dollar value of total imports from the given partner country to the U.S. in the given industry in the given year. Trade data are from the Harvard Atlas Growth Lab. To project future imports, we used U.S. import data across all CCA-relevant industries, calculated an aggregate 10-year growth rate for the total imports across all CCA-relevant industries (excluding fossil fuel industries) from 2013 to 2023, and applied the 10-year growth rate to 2021 import values to arrive at projected import values from each country in each industry in each year. The second variable is the carbon intensity of the partner country's economy, which is represented as the partner country's 2021 CO2 emissions[36] (in tons) over its 2021 nominal GDP[37] (in USD thousands). The third variable is the carbon tax differential, which is represented as the excess of (i) the U.S. carbon tax per ton of CO2 for the given year (which changes year-to-year following the schedule outlined in Figure 2) relative to (ii) the partner country's national carbon price[38] (which is based on 2024 carbon pricing and is modeled to stay constant from year to year). The calculations only assign carbon prices to countries that have already implemented a carbon price as of 2024. The fourth variable is the carbon intensity adjustment for the given industry, which is represented by the carbon intensity of that industry (calculated as the Scope 1 CO2e emissions per USD $1m of revenue in that industry) [39] relative to global economy-wide carbon intensity (calculated as global CO2 emissions per USD $1m of global nominal GDP). The carbon intensity adjustment figures are industry-specific but country-agnostic and do not change year-to-year.

Rebates for exports are calculated separately for each industry/country/year permutation. There are 64 countries included in the analysis, including those in the top 20 countries by export value from the United States in 2021 for at least one of the NAICS codes listed in the CCA. Rebates on exports are calculated in a similar manner to the abovementioned methodology for revenues on imports, with two key differences. For the first variable, we use export data instead of import data. For the second variable, we measure the carbon intensity of the United States's economy in all permutations instead of each partner country's economy.

---

[36] CO2 emissions data throughout was sourced from the EU Joint Research Centre's EDGAR Database. https://edgar.jrc.ec.europa.eu/report_2023 Emissions are from the 2022 report titled "CO_2 Emissions of all World Countries," which publishes 2021 CO_2 emissions for every country.

[37] GDP data throughout was sourced from the World Bank. https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2021&start=2021

[38] Carbon pricing data for non-U.S. countries was sourced from the World Bank's Carbon Pricing Dashboard. https://carbonpricingdashboard.worldbank.org/compliance/price

[39] Source: S&P Global, Sustainability Quarterly, 2022 Q4 edition. https://www.spglobal.com/esg/insights/featured/sustainability-journal/sustainability-q4_2022_v9_double-page-spread-view.pdf

Contact.

MIT CEEPR Working Paper Series
is published by the MIT Center for Energy and Environmental Policy Research from submissions by affiliated researchers.
For inquiries and/or for permission to reproduce material in this working paper, please contact:

General inquiries: ceepr@mit.edu
Media inquiries: ceepr-media@mit.edu

MIT CEEPR

Center for Energy and
Environmental Policy Research

MIT Center for Energy and
Environmental Policy Research
Massachusetts Institute of Technology
77 Massachusetts Avenue, E19-411
Cambridge, MA 02139-4307
USA

ceepr.mit.edu

MASSACHUSETTS INSTITUTE OF TECHNOLOGY