

Budgetary Effects of Climate Change and of Potential Legislative Responses to It



At a Glance

In this report, the Congressional Budget Office outlines the primary channels by which climate change and policies intended to mitigate or adapt to it affect the federal budget.

- Climate change increases federal budget deficits, on net, by reducing revenues and increasing mandatory spending, both through its broad effects on the economy—which are negative, on average—and its specific effects on particular programs. Climate change may also increase the amount of discretionary funding provided by the Congress for certain activities and programs.
- Investment by the government or others in various types of mitigation or adaptation efforts could reduce the costs of climate change. The benefits of successful investments would generally accrue gradually over many years and might be only partially reflected in future savings to the federal budget. The extent of future budgetary savings might sometimes be a small proportion of the up-front costs. Currently, CBO has no basis for estimating future savings, because many of the linkages between climate change and the federal budget require further assessment.
- For some sufficiently large and effective efforts, increases in total output of the economy would be the main channel by which future budgetary savings would occur. Those savings might be less important than other benefits.

A key challenge in estimating future budgetary savings from investments in mitigation or adaptation is that currently available information is insufficient for estimating the long-lasting and diffuse effects of such investments. CBO continues to consult with various experts and to seek new data and scientific research on climate change.

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Notes

Unless this report indicates otherwise, all years referred to are federal fiscal years, which run from October 1 to September 30 and are designated by the calendar year in which they end.

Budgetary Effects of Climate Change and of Potential Legislative Responses to It

Summary

In this report, the Congressional Budget Office identifies the primary channels by which climate change affects the federal budget. The report also outlines how policies intended to mitigate climate change or adapt to its effects could affect the budget. CBO currently has no basis for estimating the extent to which the up-front costs of such policies might lead to future budgetary savings, because many of the linkages between climate change and the federal budget require additional information and analysis. This report discusses the challenges involved in estimating such savings. CBO continues to gather information to facilitate those estimates in the future.

How Does Climate Change Affect the Budget?

The environmental manifestations of climate change—which include increases in average temperatures, sea levels, and the severity of storms—affect both revenues and spending in the federal budget.

- Climate change affects revenues primarily through changes in the economy, such as net reductions in the productivity of outdoor labor and agricultural land and damage to physical capital and infrastructure. Those changes affect the amount of federal revenues from income taxes, payroll taxes, and other sources.
- Climate change can affect mandatory spending programs through changes in the economy overall and through specific effects on particular programs, including agricultural support programs, the National Flood Insurance Program, and a broad range of other insurance and benefit programs, such as those for income security, health, and financial institutions.
- Climate change can also affect the cost of discretionary programs if it influences decisions about the amount of money that lawmakers provide in the appropriation acts that fund those programs. For instance, military installations and equipment and public infrastructure may require repairs or modifications in response to damage or risks posed by storms, sea-level rise, and other events. Various

assistance programs may also be affected, such as those for disaster relief, wildfire control, and loans and loan guarantees for home mortgages.

The influence of climate change on the budget through those channels is already being felt. The overall effect is an increase in the deficit, and that effect is expected to increase over time as the climate continues to change.

This report focuses on the federal budget, but the effects of climate change on the economy and society go beyond those reflected in the budget—for example, by harming human health, shifting animal habitats, increasing extinction rates, and increasing national security threats caused or exacerbated by global shifts or reductions in food and water supplies.

How Would Federal Mitigation and Adaptation Efforts Affect the Budget?

The federal government could adopt policies or programs to prevent the harmful effects of climate change. Such policies and programs could include mitigation efforts that would limit the extent of climate change or slow its pace (for example, by reducing emissions of greenhouse gases) or adaptation efforts that would reduce the adverse consequences associated with a given change in the climate (for example, by restoring coastal wetlands to reduce flood risk). Both approaches can take different forms, including changes to the tax code, mandatory or discretionary spending, or regulations or other requirements imposed on the private sector or state, local, and tribal governments.

Federal mitigation and adaptation efforts are effectively investments: They impose up-front costs with the expectation that harmful effects of climate change will be prevented. Such benefits of prevention could generate budgetary savings in the future; the extent of future savings might sometimes be a small proportion of the up-front costs. The benefits may be important to policymakers regardless of any budgetary savings.

Some policies to increase investments in mitigation or adaptation would involve spending money on federal programs; the costs of those investments would be reflected in the federal budget. Other types of policies—such as imposing a carbon tax, auctioning emissions permits in a cap-and-trade system, or imposing regulations—would increase such investment by imposing costs on the private sector or state and local governments. Some of those alternatives, such as adopting a carbon tax, would raise substantial amounts of revenue that could be used to offset the effects of the tax on certain populations, to reduce the deficit, or to reduce other taxes or pay for other programs.

For policies that involve a large amount of federal spending or raise a large amount of revenue, the full budgetary effect would depend on how the government financed the spending or used the revenues; those effects are beyond the scope of this report. Other alternatives, such as adopting regulations, could impose costs on other entities. The effect on the federal budget would depend on whether such measures had a large or small effect on the overall economy.

Investments in mitigation or adaptation could result in future savings to the federal budget if the policies were effective—that is, if they reduced the extent of climate change or particular harmful effects. Ineffective policies could have up-front costs without yielding significant future savings. For example, if policies lowering emissions of greenhouse gases in the United States led to substantially offsetting increases in emissions elsewhere—say, by causing activity in carbon-intensive industries to shift to other countries—then climate change would be largely unaffected, and little budgetary savings would result.

The federal budgetary savings from effective mitigation or adaptation efforts have three noteworthy characteristics:

- They would not start accruing until the efforts were implemented, which could take years, and would be realized over a span of decades or even centuries.
- They might be less important than other benefits (which would probably be much larger for some people than for others).
- For some sufficiently large and effective efforts, increases in total output of the economy would be the main channel by which future savings would occur.

Estimating future savings to the federal budget from mitigation and adaptation poses challenges, and CBO is working to quantify the potential savings from such efforts. To do so, the agency needs reliable quantitative evidence linking particular policy interventions to reductions in climate change or its damage and to the resulting budgetary effects. As CBO develops the capacity to quantify the linkages between the benefits of mitigation and adaptation policies and the budget, it will report that information when describing the basis of its estimates.

Better information is available about certain adaptation efforts, such as some measures to reduce flood risks; even in those cases, however, the savings may depend heavily on choices made by an administering agency, and budgetary savings anticipated within the 10-year period typically covered by cost estimates may be only a small fraction of the total. CBO is farther away from being able to trace the necessary linkages for other types of adaptation measures and much farther away for mitigation measures.

Budgetary Effects of Climate Change

The National Aeronautics and Space Administration defines climate change as “a long-term change in the average weather patterns that have come to define Earth’s local, regional and global climates.”¹ Aspects of climate change include higher average temperatures and a greater frequency of extremely high temperatures; increases in rainfall and snowfall in some places and times, along with water shortages and droughts in others; longer and shorter growing seasons for different crops in different locations; higher sea levels; stronger hurricanes; increased wildfire risk; and increases in ground-level ozone and other air pollutants.

Because climate change is continuing, its budgetary effects are expected to increase over time, but the nature and extent of those changes are very uncertain—in part because the complexity of the interactions among various environmental, economic, and social systems means that unanticipated and potentially catastrophic developments are possible.²

1. See National Aeronautics and Space Administration, “Overview: Weather, Global Warming and Climate Change” (accessed March 21, 2021), <https://climate.nasa.gov/resources/global-warming-vs-climate-change>.
2. See Leon Clarke and others, “Sector Interactions, Multiple Stressors, and Complex Systems,” in David Reidmiller and others, eds., *Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment* (U.S. Global Change Research Program, 2018), pp. 638–668, <https://nca2018.globalchange.gov/chapter/17>.

Through its effects on particular programs and on the economy as a whole, climate change has implications for federal revenues and spending (see Figure 1). Many effects of climate change are already influencing the budget.

Aspects of Climate Change That Affect the Budget

Many aspects of climate change affect the economy and the federal tax revenues it generates, as well as spending for specific federal programs; on net, the effects are negative, reducing economic growth and increasing the federal budget deficit.

Some aspects of climate change have a mix of positive and negative effects, depending on location or time of year. For instance:

- The productivity of agricultural land is expected to decline overall, because the negative effects of increased prevalence of crop pests and diseases, increased droughts and pressures on water supply in some areas, increased exposure to extreme temperatures, and shorter growing seasons in some areas will outweigh the positive effects of warmer temperatures and longer growing seasons in other areas.³
- Labor supply is expected to decline overall, because the negative effects of work days lost—to high temperatures; disruptions such as floods, wildfires, and hurricanes; and illnesses related to heat exposure, air pollution, and vector-borne diseases (those transmitted by mosquitoes and other living organisms)—will be greater than any beneficial effects of fewer work days lost to cold temperatures, winter storms, and cold-related illnesses and accidents (depending in part on the frequency and severity of polar vortices).⁴
- Labor productivity—that is, output per hour worked—is expected to decline overall, because reductions in the productivity of construction workers, agricultural workers, and others who work outside during hot weather are expected to exceed

increases in the productivity of outdoor workers in some locations during winter months.⁵

- The private sector's production costs are expected to increase, on net, despite reductions in heating costs in certain areas and at certain times, because of increased costs of air conditioning for workers' comfort, temperature control in a variety of industries, including pharmaceutical manufacturing and goods transport, and damage to infrastructure.⁶

Other aspects of climate change are entirely negative. For instance, wildfires, floods, hurricanes, and tropical storms reduce the nation's output of goods and services by damaging and destroying buildings, equipment, and inventory.

Drawing on studies that examine the historical relationship between regional output and regional temperature and precipitation, along with projections of future conditions, CBO has projected that, on net, climate change will lower the level of real (inflation-adjusted) gross domestic product (GDP) in 2051 by 1 percent from what it would have been if climatic conditions from 2021 to 2051 were the same as they were at the end of the 20th century. That figure is a central projection in a wide range of possible outcomes and does not reflect every channel by which climate change can affect GDP. Of the 1 percent, 0.8 percent is attributable to changes in temperature and precipitation, and 0.2 percent is attributable to hurricane damage.⁷

The overall negative effects of climate change are not distributed uniformly. Some communities benefit from milder winters and longer growing and outdoor construction seasons, whereas other communities suffer from extreme heat, increased coastal flooding, and other

3. See "Summary Findings," in David Reidmiller and others, eds., *Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment* (U.S. Global Change Research Program, 2018), Section 9 (Agriculture), pp. 29–30, <https://nca2018.globalchange.gov>.

4. See "Executive Summary," in Allison Crimmins and others, *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* (U.S. Global Change Research Program, 2016), pp. 1–24, <https://health2016.globalchange.gov/executive-summary>.

5. See "Labor," in Solomon Hsiang and others, *American Climate Prospectus: Economic Risks in the United States* (Rhodium Group, 2014), Chapter 7, pp. 54–60, www.impactlab.org/research/american-climate-prospectus.

6. See "Summary Findings," in David Reidmiller and others, eds., *Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment* (U.S. Global Change Research Program, 2018), Section 2 (Economy), pp. 25–26, <https://nca2018.globalchange.gov>.

7. See Congressional Budget Office, *The 2021 Long-Term Budget Outlook* (March 2021), www.cbo.gov/publication/56977; and Evan Herrstadt and Terry Dinan, *CBO's Projection of the Effect of Climate Change on U.S. Economic Output*, Working Paper 2020-06 (Congressional Budget Office, September 2020), www.cbo.gov/publication/56505.

Figure 1.

Budgetary Effects of Climate Change and of Efforts to Address It



Data source: Congressional Budget Office.

adverse effects. Two communities experiencing the same adverse effects may not have the same financial resources available to ameliorate them.

The effects of climate change on the economy and society go beyond those reflected in GDP—for example, by harming human health, shifting animal habitats,

increasing extinction rates, and increasing national security threats caused or exacerbated by global shifts or reductions in food and water supplies.⁸

8. See Department of Defense, “National Security Implications of Climate-Related Risks and a Changing Climate” (July 2015), <https://go.usa.gov/xsR5f> (PDF, 121 KB).

Effects on Revenues

Most of the impact of climate change on federal tax revenues comes from its effects on the economy: A reduction in GDP—that is, a reduction in the value of goods and services produced in the country—reduces income subject to income taxes and payroll taxes. Climate change also affects income tax revenues through the individual deduction for casualty losses. Subject to various limitations, losses of personal property caused by federally declared disasters that are not compensated by insurance are deductible for federal tax purposes.

Effects on Mandatory Spending

Like revenues, mandatory spending programs—those whose spending is generally determined by formulas and eligibility criteria rather than by annual appropriations—can be affected by economic factors, such as health and productivity, the distribution of income, employment, the relative prices of goods and services in the economy, and total nominal income. In addition, some mandatory programs can be affected by specific physical or biological effects, such as droughts, storms, sea-level rise, and diseases in people and plants.

The future effects of climate change on mandatory spending are complex, as illustrated by the effects of illness and mortality on four of the largest mandatory programs—Social Security, Medicare, Medicaid, and Supplemental Security Income (SSI). Given the collective size of those programs (total outlays were about \$2.5 trillion in 2020), the changes attributable to climate change could be significant in dollar terms even if they are small in percentage terms:

- Costs for the health care programs are expected to rise as people who are enrolled in Medicare or eligible for Medicaid experience more cases of illnesses related to heat exposure, air pollution, or vector-borne diseases or more hazards such as consumption of contaminated water, smoke inhalation, or other conditions associated with storms, floods, and wildfires.⁹ Conversely, costs for those programs are expected to decline with any drop in the number of cases related to cold exposure. Costs for those programs will decline to the extent that participants die at younger ages than they would have otherwise.

9. The role of climate change in reducing biodiversity and changing habitat ranges has raised concerns about the possibility of an increasing risk of future pandemics; see Harvard T.H. Chan School of Public Health, Center for Climate, Health, and the Global Environment, “Coronavirus, Climate Change, and the Environment” (accessed February 23, 2021), <https://tinyurl.com/3wjbevuva>.

- Social Security and SSI costs are affected by similar forces. The costs of those programs would be expected to increase if people retired earlier or disability rates increased. As with Medicare and Medicaid, the costs of those programs will decline to the extent that participants die at younger ages. Moreover, lower earnings will reduce spending for Social Security and other programs with benefits that depend on past earnings.¹⁰

Climate change affects mandatory programs through other channels as well:

- The costs of agricultural support programs are likely to increase, despite longer growing seasons in some locations, because of shorter growing seasons in other locations and increases in droughts and water shortages, floods, and crop diseases and pests.
- Claims for policies under the National Flood Insurance Program are expected to increase with increases in damage from storm surges, coastal flooding from sea-level rise, and riverine flooding. The program’s average annual deficit will grow unless premiums or other charges paid by policyholders are adjusted to keep pace with flood risk.¹¹
- Federal receipts from oil and gas production in the Gulf of Mexico will probably decline as hurricanes and tropical storms disrupt producers’ operations.¹²
- Costs of the mortgage guarantees provided by Fannie Mae and Freddie Mac would increase if losses of residential properties from floods and wildfires increased faster than the guarantee fees they charge to cover losses.¹³

10. See Congressional Budget Office, *How Changes in Economic Conditions Might Affect the Federal Budget: 2020 to 2030* (February 2020), www.cbo.gov/publication/56096.

11. CBO’s most recent estimate of the expected deficit, based on 2016 data, was \$1.4 billion; see Congressional Budget Office, *The National Flood Insurance Program: Financial Soundness and Affordability* (September 2017), www.cbo.gov/publication/53028.

12. Such receipts, like other federal funds resulting from fees and charges, are classified as offsetting receipts and are recorded as negative mandatory spending.

13. Two recent studies have found that mortgage lenders can shift climate risk to Fannie Mae and Freddie Mac. See Jesse M. Keenan and Jacob T. Bradt, “Underwaterwriting: From Theory to Empiricism in Regional Mortgage Markets in the U.S.,” *Climatic Change*, vol. 162, no. 4 (October 2020), pp. 2043–2067, <https://doi.org/10.1007/s10584-020-02734-1>; and Amine Ouazad and Matthew E. Kahn, *Mortgage Finance and Climate Change: Securitization Dynamics in the Aftermath of Natural Disasters*, Working Paper 26322 (National Bureau of Economic Research, revised February 2021), www.nber.org/papers/w26322.

- Costs for various means-tested programs and refundable tax credits (those that provide cash payments or other assistance to people with relatively low income or few assets) will probably increase because of dislocations in labor markets, such as those caused by major hurricanes, and reductions in economic growth overall. Moreover, because some benefits are indexed to prices, their costs will also increase to the extent that climate change increases prices (for instance, because of the net reduction in agricultural productivity).¹⁴
- Costs for unemployment insurance will also increase with dislocations in labor markets and reductions in economic growth.

Effects on Discretionary Spending

Discretionary spending results from appropriation acts passed by the Congress. Therefore, both the broad effects of climate change and its more specific consequences for individual federal programs affect discretionary spending only by changing lawmakers' perceived needs for various categories of such spending and, thus, influencing appropriation decisions.

The perceived needs for a wide variety of discretionary spending programs are likely to be affected. For example, the Congress may increase spending to restore, protect, or even relocate military and civilian facilities and equipment in areas vulnerable to flooding.¹⁵ In 2019, lawmakers provided supplemental appropriations of \$1.7 billion toward the costs of repairing and rebuilding Air Force facilities heavily damaged by Hurricane Michael in 2018 and Missouri River floodwaters in 2019. Spending for defense operations and for homeland security, border control, and humanitarian assistance may also increase in response to international tensions and migration spurred by shortages of food and water in some areas.

Climate change could also affect Congressional decisions about discretionary spending for a variety of other purposes:

- Floods, severe storms, and wildfires often lead to increased spending for federal disaster assistance provided both to private households and to state, local, and tribal governments.
- Concerns about flood risk can lead to increased spending for various forms of flood control (such as dams, levees, seawalls, and wetlands restoration) by the Army Corps of Engineers and through grants from the Federal Emergency Management Agency (FEMA).
- Increased needs for summer cooling and reduced needs for winter heating may lead to higher or lower spending overall for operation of federal facilities and for the Low Income Home Energy Assistance Program.

Discretionary spending could also be affected by climate change through its effects on inflation. To the extent that climate change increased or decreased the inflation rate, the government's costs to procure goods and services might change, affecting the amount of appropriations provided for various programs and activities.

Budgetary Effects of Federal Mitigation and Adaptation Efforts

Many legislative proposals have been made for federal policies and programs to mitigate climate change or adapt to it. Mitigation efforts intend to reduce the extent or pace of climate change, whereas adaptation efforts would reduce the adverse consequences of it.¹⁶ Some proposals involve increasing the size or scope of existing federal policies or programs; others involve creating new ones. Such proposals may have important benefits beyond their effects on the budget. To obtain those benefits, policymakers may undertake actions that have budgetary costs up front that exceed the budgetary savings in the future. This report focuses on the budgetary effects.

Mitigation and adaptation efforts can be viewed as investments; costs would be incurred by the federal government, nonfederal parties, or both before any potential savings to the budget (or other benefits of interest to policymakers) were realized (see Figure 1 on page 4). Like investments in general, some mitigation and adaptation efforts may not yield the desired results; such efforts may incur costs but yield little or no benefits. CBO

14. Payments to taxpayers for refundable tax credits, such as the earned income tax credit, are classified as mandatory spending. For a study linking hurricanes to increases in spending for certain programs, see Tatyana Deryugina, "The Fiscal Cost of Hurricanes: Disaster Aid Versus Social Insurance," *American Economic Journal: Economic Policy*, vol. 9, no. 3 (August 2017), pp. 168–198, www.aeaweb.org/articles?id=10.1257/pol.20140296.

15. For a discussion of the vulnerability of federally owned property, see Government Accountability Office, *High-Risk Series: Dedicated Leadership Needed to Address Limited Progress in Most High-Risk Areas*, GAO-21-119SP (March 2021), pp. 97–102, www.gao.gov/products/GAO-21-119SP.

16. In other contexts—for example, the federal Pre-Disaster Mitigation Grant Program to reduce the adverse consequences of floods and other natural disasters—the word *mitigation* is used to refer to efforts that would be identified here as *adaptation* (that is, efforts aimed at reducing potential damage). In this report, *mitigation* refers to reducing the extent or pace of climate change.

currently has no basis for estimating the extent of future budgetary savings or how they might compare with up-front costs, because many of the linkages between climate change and the federal budget require additional information and analysis. Moreover, investments that successfully reduced the effects of climate change would generally lead to budgetary savings but could also impose net budgetary costs through some channels.

Approaches to Mitigation and Adaptation

Efforts to mitigate climate change or adapt to it can take many forms and may be undertaken by different actors. For example, mitigation occurs on a small scale in many cases in which a household changes from a gasoline-powered passenger vehicle to a hybrid or electric vehicle, a corporation reduces its employees' air travel, or a city installs solar panels on its municipal buildings. Similarly, adaptation occurs whenever farmers change their planting decisions in light of higher expected temperatures, households plant shade trees to limit increases in their summer costs for air conditioning, or local governments restrict development in coastal areas thought to be susceptible to future flooding and storm damage or spend money to protect those areas such as by constructing seawalls. Federal policies can provide incentives or disincentives for such efforts by state, local, and tribal governments or the private sector, in addition to establishing or modifying direct federal efforts.

Broadly speaking, efforts to mitigate climate change include these approaches:

- Reducing emissions of greenhouse gases—for example, by reducing the use of fossil fuels in power generation;
- Removing from the atmosphere gases that have already been emitted—for example, by reforestation or by capturing carbon dioxide in the atmosphere; and, at least in theory,
- Offsetting the gases' effects by managing solar radiation to increase the proportion of light from the sun that is reflected back into space.

Approaches to adapting to location-specific hazards of climate change, such as wildfires and floods, may involve relocating individual properties, making properties less susceptible to damage, or reducing the hazard risk. With wildfires, for example, those strategies could correspond to moving homes, using more fire-resistant materials, or upgrading electricity transmission lines, poles, and transformers.

The costs of climate change can be spread more widely through federal or federally supported insurance. That insurance can be explicit, such as the coverage available under the National Flood Insurance Program, or implicit, such as disaster assistance. In addition to spreading costs, federal or federally supported insurance may encourage individuals and businesses to take fewer adaptation measures, such as moving to lower-risk areas, on their own—a “moral hazard” that can make the total costs of climate change higher than they would be otherwise.¹⁷ The degree of this moral hazard depends on the design of the insurance.

Costs of Investing in Mitigation and Adaptation

Policies designed to address climate change could use different approaches to try to increase investment (up-front costs incurred with the aim of generating future benefits) in mitigation and adaptation. The policies could involve investment by the federal government, use pricing mechanisms such as a carbon tax or a system of tradable permits, or impose requirements on other parties. Those approaches differ in terms of who bears the up-front costs and how they affect the federal budget.

Investments by the Federal Government. Many current and proposed policies and programs to address climate change involve federal spending and thus have near-term budgetary costs. Examples of federal investments in mitigation include spending for research and development of carbon capture technologies, for improving the energy efficiency of federal buildings, and for grants, loans, and loan guarantees for renewable energy systems serving rural areas. As an example of investing in adaptation, a 2019 bill would have authorized appropriations to FEMA of about \$1.4 billion over the 2020–2024 period for grants to reduce flood damage.¹⁸

Using Pricing or Tax Preferences to Encourage Others to Invest. Another approach that could ultimately lead to investment in mitigation or adaptation would be to give other parties—typically in the private sector—price

17. Moral hazard occurs when an entity has an incentive to increase its exposure to risk because it does not bear the full costs of that risk.

18. In that estimate, CBO and the staff of the Joint Committee on Taxation also estimated that a portion of those appropriated funds used to capitalize state revolving loan funds would reduce the revenues collected by the federal government because some state governments would use the grants to leverage additional funds by issuing tax-exempt bonds. See Congressional Budget Office, cost estimate for H.R. 3167, the National Flood Insurance Program Reauthorization Act of 2019 (October 4, 2019), www.cbo.gov/publication/55698.

incentives to do so. Under that approach, the budgetary effects would differ from the costs of the investments.

One such incentive would be a price on emissions of greenhouse gases, established by a carbon tax or a cap-and-trade system. In December 2020, the staff of the Joint Committee on Taxation (JCT) and CBO reported that implementing a particular tax, starting at \$25 per metric ton in 2021 and rising at an annual real rate of 5 percent, would increase federal revenues by \$1.0 trillion over 10 years.¹⁹ A cap-and-trade system would require producers and importers of fossil fuels and some major emitters of greenhouse gases to obtain government-issued permits corresponding to the amount of their emissions. The number of permits issued would be set to limit emissions below their previous level so that their scarcity would make them valuable; a market for them would develop and determine their price. CBO treats cap-and-trade proposals as creating a source of federal revenues because the government could capture the value of the permits by auctioning them; a proposal that calls for the government to distribute the permits without charge would be treated as creating both a source of revenue and an equal expenditure.²⁰

Under either a carbon tax or a cap-and-trade system, the costs of mitigation efforts and the budgetary effects of the price incentives would be distinct. The mitigation costs would be incurred to reduce emissions; the budgetary effects would depend on the emissions that continued despite the investments. The effects of a carbon tax on the U.S. economy and the budget would depend, in part, on how the revenues from the tax were used. Options include using the revenues to offset the costs that a carbon tax would impose on certain groups of people, to reduce budget deficits, to decrease existing marginal tax rates (the rates on an additional dollar of income), or to pay for other programs unrelated to climate change.

Like imposing a carbon tax, making other changes to the tax code could also encourage investments in mitigation and increase federal revenues by increasing the cost of activities that contribute to climate change. For example,

tax preferences (such as special deductions and tax credits) that encourage the production of fossil fuels could be reduced or eliminated.²¹

Other changes to the tax code could decrease federal revenues by establishing or expanding preferences for activities that contribute to mitigation or adaptation. Those changes could include adopting preferences for the sequestration of carbon by, for instance, capturing carbon dioxide emissions from power plants and storing them deep underground; expanding existing preferences for producing renewable energy; and expanding eligibility or increasing the subsidy for tax-exempt bonds issued by state, local, and tribal governments for mitigation or adaptation projects, such as those to improve the resilience of water systems.²² For those changes, to the extent that the increased incentives spurred additional nonfederal investments in mitigation or adaptation, the forgone federal revenues would represent a portion of the up-front costs; to the extent that the increased incentives merely subsidized investments that would have occurred without them, the forgone revenues would increase the deficit with no impact on mitigation or adaptation.

Imposing Requirements That Lead Others to Invest.

A third policy approach, which could lead to a variety of responses, potentially including investing in mitigation and adaptation, would impose requirements on the private sector or on state, local, and tribal governments. Existing examples of such requirements include renewable portfolio standards, which require that a certain share of electricity be generated using renewable forms of energy, such as wind or solar power; vehicle fuel-efficiency standards; and minimum floodplain management standards required for communities to participate in the National Flood Insurance Program. (The floodplain management standards may diminish the moral hazard problem that occurs when people covered by

19. See Congressional Budget Office, “Impose a Tax on Emissions of Greenhouse Gases” (budget option, December 2020), www.cbo.gov/budget-options/56873.

20. See Testimony of Peter R. Orszag, Director, Congressional Budget Office, before the Senate Committee on Finance, *Implications of a Cap-and-Trade Program for Carbon Dioxide Emissions* (April 24, 2008), www.cbo.gov/publication/41686.

21. See Testimony of Terry Dinan, Senior Adviser, Congressional Budget Office, before the Subcommittee on Energy, House Committee on Energy and Commerce, *Federal Support for Developing, Producing, and Using Fuels and Energy Technologies* (March 29, 2017), www.cbo.gov/publication/52521.

22. For more information, see Tax Policy Center, “What Tax Incentives Encourage Alternatives to Fossil Fuels?” (May 2020), <https://tinyurl.com/bht2yh76>; Congressional Research Service, *Oil and Gas Tax Preferences*, Report IF11528, version 3 (updated May 1, 2020), <https://crsreports.congress.gov/product/pdf/IF/IF11528> (477 KB); and Congressional Budget Office, “Repeal Certain Tax Preferences for Energy and Natural Resource-Based Industries” (budget option, December 2018), www.cbo.gov/budget-options/2018/54811.

insurance—in this case, federal flood insurance—take on additional risk.)²³

The costs of investments to comply with such requirements are typically borne by state, local, and tribal governments or the private sector; however, the federal government may provide partial funding. Other federal budgetary effects related to such requirements are not directly related to up-front costs—for example, receipts from fees imposed for noncompliance with a federal requirement.

Savings From Successful Investments in Mitigation and Adaptation

Because climate change has a negative overall effect on the budget and the economy, successful investments in mitigation or adaptation—those that reduce the extent of climate change or its adverse consequences—can generally be expected to yield future savings to the federal budget. Even when those budgetary savings are a small proportion of the up-front costs, other benefits may be more important to policymakers.

Such future savings may stem from reductions in physical damage, increases in the productivity of land and outdoor labor, or lower health care costs. Conversely, ineffective policies could impose costs on federal, state, and local governments or the private sector without yielding budgetary savings or other benefits to justify those costs.

The federal budget deficit would tend to increase as a side effect of some types of successful mitigation policies. For example, policy-induced declines in production of oil and gas on federal lands or in consumption of gasoline and diesel fuel would reduce federal receipts from royalty payments and from the federal taxes on those fuels.

The savings from successful investments may differ in their timing, their distribution among various beneficiaries, and the extent to which they reflect increases in the output of the economy.

Timing of Savings. The benefits of successful mitigation and adaptation generally last a long time. Because greenhouse gases persist in the atmosphere, climate science

models predict that reductions (or increases) in emissions can affect global temperatures for hundreds of years. Physical changes made as part of adaptation efforts—such as home elevations, seawall construction, or planting of shade trees—may yield benefits for decades.²⁴ In turn, those benefits could generate long-lasting future budgetary savings through the resulting productivity and health effects, among others.

Some efforts take time to be implemented. For those involving major construction, for instance, it can take years to identify and design a project, secure permits for it, and then build it before savings can even begin to start accruing. Of the \$48 billion spent to date by FEMA in response to Hurricanes Katrina, Rita, and Wilma in 2005, \$9 billion was spent more than five years after those events.²⁵ Such spending continues to the present: In 2020, FEMA spent \$336 million on recovery projects, such as pumping and drainage systems, largely designed to reduce future flooding.

Distribution of Effects That Generate Savings. Because effective mitigation reduces the extent of climate change itself, budgetary savings are the net result of that mitigation on everyone affected by climate change. Particularly vulnerable individuals and groups, such as coastal communities at risk from rising sea levels, could be affected more than others.

Budgetary savings from effective adaptation tend to be the net result of effects that are more concentrated than those of mitigation, in one or more of the following ways:

- Geographically—for example, a seawall in a particular location or upgrades to electricity transmission lines to reduce local wildfire risk;
- In particular sectors of the economy—for example, support to state governments for constructing disaster-resistant roads and bridges; or
- On particular households—for example, subsidies for air conditioning or for elevating flood-prone properties.

23. Moral hazard can be avoided by charging premiums that accurately reflect the insured's risk. For more information on the National Flood Insurance Program and its premium rates, see Congressional Budget Office, *The National Flood Insurance Program: Financial Soundness and Affordability* (September 2017), www.cbo.gov/publication/53028.

24. The timing of benefits from adaptations that reduce the costs of particular events, such as floods, coastal storms, and wildfires, depends on when the events occur, which is uncertain. With sufficient data, such benefits can be analyzed in terms of their annual averages (also called expected values).

25. CBO calculated that spending using information from monthly reports on the Disaster Relief Fund (available at <https://go.usa.gov/xsSVC>) and from the Office of Management and Budget.

In general, successful mitigation and adaptation would provide various benefits to nonfederal parties beyond the effects on the federal budget. Those benefits may be the primary purpose of the policies.

Savings Due to Macroeconomic Effects. Budgetary and nonfederal benefits of successful mitigation and adaptation may be associated with increases in the nation's output. Because climate change has a negative effect on economic output, efforts that are sufficiently large and effective may increase the size of the economy, leading to higher average incomes and increased employment. Such an increase would have many positive effects on the budget, including increased tax revenues and lower spending for unemployment insurance and means-tested programs.

Challenges in Estimating Savings From Mitigation and Adaptation

CBO is working to quantify the budgetary savings in the future from proposed mitigation and adaptation efforts. Limited information is available to provide a sufficient basis for estimating the effects of such efforts, which are long-lasting and diffuse. Because of that limited information, CBO's past cost estimates and other products have not reported estimates of budgetary savings in the future stemming from mitigation and adaptation policies.

CBO continues to consult with various experts and to seek out new data and scientific research on mitigation and adaptation—and on climate change more generally—on which it can base cost estimates and other information to serve the needs of the Congress. As a result of such efforts, CBO provided climate-related information in a working paper describing an estimate in *The 2020 Long-Term Budget Outlook*: that real GDP in 2050 is projected to be 1 percent lower than it would have been if the climate of the late 20th century prevailed from 2020 through 2050.²⁶ That estimate, the first of its kind by CBO, was a central projection in a wide range of outcomes. It reflects some but not all of the channels by which climate change can affect GDP and did not require information about the effectiveness of any particular mitigation strategy.

26. See Evan Herrstadt and Terry Dinan, *CBO's Projection of the Effect of Climate Change on U.S. Economic Output*, Working Paper 2020-06 (Congressional Budget Office, September 2020), www.cbo.gov/publication/56505.

Information Needed for Estimates of Savings. CBO is working to trace the linkages between proposed legislation, reductions in damage from climate change, and the federal budgetary effects. In most cases, the agency will need more information than is now available. Currently, more information is available about some forms of adaptation than others, and little is available about mitigation measures.

Information about the effects of some types of adaptation in reducing damage is available, such as for some measures to reduce flood risks. Studying such information allows CBO to address one link in the chain from legislative proposals to adaptation activities, damage, and budgetary outcomes.

To estimate budgetary effects, CBO also needs information on the other links—from legislation to adaptation activities and from reduced damage to specific budgetary items (programs or revenue sources). For example, that first link is important because the effects of an adaptation program authorized by legislation often depend heavily on the specific projects selected by the program's administering agency, which are difficult to predict.²⁷ Savings from proposed adaptation measures are more feasible to estimate when legislation would give an agency narrow authority to implement the law, creating more certainty about that agency's actions, and when it would give the agency enough time and funding to implement it effectively. Implementation will be a key source of uncertainty in estimates of savings, which CBO will discuss in its cost estimates and other analyses.

For mitigation efforts, reliable quantitative evidence is lacking in three areas:

- The effectiveness of policies in reducing emissions, removing greenhouse gases from the atmosphere, or managing solar radiation and, in turn, the impacts

27. A 2019 report by the National Institute of Building Sciences examined five federal grants for acquisition of property subject to riverine flooding and found benefit-cost ratios ranging from 2.3 to 12.5; see National Institute of Building Sciences, *Natural Hazard Mitigation Saves: 2019 Report* (December 2019), p. 78, www.nibs.org/reports/natural-hazard-mitigation-saves-2019-report. Those differences in benefit-cost ratios could be expected to lead to differences in budgetary effects—for example, through differences in spending for disaster assistance.

on climate phenomena such as temperatures, storms, droughts, and sea levels;²⁸

- How the effects of those changes in climate phenomena relate to specific revenue sources and spending programs; and
- The extent to which reinforcing or offsetting changes in emissions would occur in other countries in response to policy changes in the United States (which accounted for 15 percent of global emissions of carbon dioxide from fuel combustion in 2018).²⁹

To illustrate the last point, a binding agreement among nations that are major emitters of greenhouse gases would probably be more effective in reducing global emissions than an independent U.S. policy that did not have similar counterparts elsewhere.³⁰ Conversely, a U.S. policy that substantially shifted carbon-intensive activities, such as steel and cement production, to other countries would reduce or eliminate the net effect of any reductions by the United States on global emissions.

Challenges in Providing Cost Estimates for

Legislation. Two characteristics of savings from adaptation and mitigation make it difficult to reflect those savings in cost estimates. Whereas the savings typically are not realized until some years have passed and then may continue for decades or centuries, most cost estimates focus on the 10-year period covered by budget rules for revenues and mandatory spending. And although savings may be related to increases in economic output, most cost estimates take that output as given.³¹

28. A 2016 CBO report on the potential costs of future hurricanes illustrates the kinds of analytical methods required by the uncertainty associated with climate change. In that report, CBO constructed distributions of damage for calendar years 2025, 2050, and 2075 using thousands of simulations that drew on 18 different projections of hurricane frequencies and distributions of sea level rise. See Congressional Budget Office, *Potential Increases in Hurricane Damage in the United States: Implications for the Federal Budget* (June 2016), www.cbo.gov/publication/51518.

29. See International Energy Agency, “IEA Atlas of Energy” (accessed November 17, 2020), <http://energyatlas.iea.org/#/tellmap/1378539487>.

30. For a proposed example of such an agreement, see William Nordhaus, “Climate Clubs: Overcoming Free-Riding in International Climate Policy,” *American Economic Review*, vol. 105, no. 4 (April 2015), pp. 1339–1370, <https://doi.org/10.1257/aer.15000001>.

31. See Congressional Budget Office, “Does CBO Do ‘Dynamic Analysis?’” (accessed February 21, 2021), www.cbo.gov/faqs#dynamic.

Over the years, CBO has produced a few cost estimates that cover more than 10 years or account for changes in population or economic output. Such estimates have been undertaken when information is available to provide the agency with a sufficient basis for them and when the potential effects have been large. Such analyses have taken several months to produce. For example:

- For proposed major changes to the Social Security program, CBO has provided analyses that cover 75 years and indicate the trajectory of the program’s spending and revenues in subsequent years.³² Such analyses have been possible because of the high degree of stability and predictability of demographic trends and other key factors.
- The 2013 immigration reform bill would have significantly increased the size of the U.S. labor force, so the cost estimate by CBO and JCT incorporated the effects of changes in the U.S. population, employment, and taxable compensation. The analysis of those effects was limited to 20 years.³³

Because of the many linkages between climate change and the federal budget that require assessment, not enough information has been available to give CBO a sufficient basis for including in its cost estimates any savings occurring over decades or resulting from changes in population or output. CBO continues to seek and evaluate such information.

In addition, Congressional procedures sometimes limit what is shown in a cost estimate (see Box 1). For example, the budgetary totals that can be used for enforcing Congressional budget rules exclude anticipated changes to a mandatory spending program that may result if a bill only increases or decreases discretionary funding without making substantive changes to the operation of the program.³⁴ When possible, such information is reported separately as supplemental information.

32. For example, see Congressional Budget Office, letter to the Honorable Kevin Brady, providing an analysis of effects on Social Security of H.R. 860, the Social Security 2100 Act (September 13, 2019), www.cbo.gov/publication/55627.

33. See Congressional Budget Office, cost estimate for S. 744, the Border Security, Economic Opportunity, and Immigration Modernization Act (July 3, 2013), www.cbo.gov/publication/52481.

34. See Congressional Budget Office, *CBO Explains Budgetary Scorekeeping Guidelines* (January 2021), www.cbo.gov/publication/56507.

Box 1.

CBO's Cost Estimates for Legislation

When the Congress considers climate-related legislation, the Congressional Budget Office will provide estimates of the budgetary effects in a manner consistent with its statutory mission. By law, CBO provides information to the House and Senate that can be used to enforce budgetary rules or targets, mostly after a committee has approved legislation.¹ That information includes estimates of changes in mandatory spending, revenues, and the deficit in the current year and the subsequent 10-year period, as well as estimates of the amounts needed to fund modified or newly created discretionary programs.²

To help the House and Senate Budget Committees determine whether certain budgetary procedures apply to the legislation, CBO's cost estimates also state whether the bill is estimated to increase the on-budget deficit (by more than a specified threshold) in any of the subsequent four decades. The adverse effects of climate change are expected to grow for decades to come, as the effects of past greenhouse gas emissions continue to accumulate and new emissions continue to add to the levels in the atmosphere, but the long time horizon adds great uncertainty to analyses of those effects or of measures to reduce them.

Budgetary effects can stem from legislation that has one or more of these features:

- The legislation affects mandatory programs or revenues.³
- It establishes programs and activities and authorizes, but does not appropriate, money to implement those programs and activities.
- It appropriates money for discretionary federal programs.

Different budget enforcement procedures apply for different types of legislation under consideration. Bills that affect mandatory spending or revenues are subject to Congressional

parliamentary procedures known as points of order as well as statutory pay-as-you-go procedures. Funding that is provided in appropriation bills is subject to caps on discretionary spending through fiscal year 2021; those caps are enforceable through a process of across-the-board reductions called sequestration. Those types of bills directly affect the deficit upon enactment, and CBO's cost estimates provide projections of those deficit effects.

By contrast, legislation that authorizes programs and activities whose implementation is contingent on the enactment of subsequent appropriation acts has no effect, by itself, on the deficit. Nonetheless, CBO's cost estimates include estimates of the potential costs or savings that would occur in the current year and the subsequent five years if appropriation actions consistent with the authorizing legislation were enacted.

Most cost estimates include information on whether the bill would impose mandates, as defined in the Unfunded Mandates Reform Act (UMRA), on state, local, and tribal governments and private-sector entities. The agency's analysis of mandates states whether, in CBO's assessment, the aggregate costs of complying with the mandates in the bill would exceed the thresholds established in UMRA.

Each cost estimate tells a concise story about a legislative proposal's likely effects on federal outlays or revenues, compared with what would occur under current law (that is, if the proposal was not enacted). All budget estimates are inherently uncertain, but the budget process requires point estimates for enforcement purposes; to the extent feasible, CBO describes the uncertainty associated with those estimates.

CBO's cost estimates generally incorporate behavioral responses to a proposal. However, by long-standing convention, those estimates typically do not account for changes that would affect total output of the economy (often called dynamic effects), including any changes resulting from efforts to mitigate or adapt to climate change. Completing dynamic analyses of individual proposals usually is not practicable because such estimates tend to require complex modeling and a significant amount of effort, which is usually not feasible within the time frames for Congressional action. Furthermore, most legislative proposals analyzed by CBO would have negligible macroeconomic effects.

1. For more information on CBO's role and work, see www.cbo.gov/faqs.

2. See Congressional Budget Office, *CBO's Cost Estimates Explained* (February 27, 2020), www.cbo.gov/publication/56166.

3. CBO prepares estimates for provisions that would affect revenues without amending the Internal Revenue Code, whereas the staff of the Joint Committee on Taxation produces estimates for proposals that would amend that code.

About This Document

This report was prepared to enhance the transparency of the work of the Congressional Budget Office in analyzing legislative proposals to address climate change. In keeping with CBO's mandate to provide objective, impartial analysis, the report makes no recommendations.

Perry Beider (formerly of CBO) prepared the report with contributions from Susan Willie and with guidance from Joseph Kile. Rachel Austin, Nicholas Chase, Terry M. Dinan, Kathleen FitzGerald, Sebastien Gay, Kathleen Gramp, Theresa Gullo, Evan Herrnsstadt, Deborah Kilroe, Lilia Ledezma, John McClelland, Kevin Perese, Charles Pineles-Mark, Joseph Rosenberg, Robert Shackleton, Janani Shankaran, Jon Sperl, and Jeffrey Werling provided helpful comments, as did Alex Brill of the American Enterprise Institute and Christy Goldfuss of the Center for American Progress. The assistance of external reviewers implies no responsibility for the final product, which rests solely with CBO.

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CBO continually seeks feedback to make its work as useful as possible. Please send any comments to communications@cbo.gov.



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