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Testimony

Statement of
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The Economic Effects of Legislation to Reduce Greenhouse-Gas Emissions

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Chairman Bingaman, Senator Murkowski, and Members of the Committee, thank you for the invitation to testify on the economic effects of legislation to reduce emissions of carbon dioxide (CO_2) and other greenhouse gases.

Global climate change poses one of the nation's most significant long-term policy challenges. Human activities are producing increasingly large quantities of greenhouse gases, especially CO_2. A strong consensus has developed in the expert community that, if allowed to continue unabated, the accumulation of greenhouse gases in the atmosphere will have extensive, highly uncertain, but potentially serious and costly impacts on regional climates throughout the world. Those impacts are expected to include widespread changes in the physical environment, changes in biological systems (including agriculture), and changes in the viability of some economic sectors. Moreover, the risk of abrupt and even catastrophic changes in climate cannot be ruled out.[1]

Those expected and possible harms may motivate policy actions to reduce the extent of climate change. However, the cost of doing so may be significant because it would entail substantial reductions in global emissions over the coming decades. U.S. emissions currently account for roughly 20 percent of global emissions. As a result, substantially reducing global emissions would probably entail large reductions in U.S. emissions as well as emissions in other countries. Achieving such reductions would probably involve transforming the U.S. economy from one that runs on CO_2-emitting fossil fuels to one that increasingly relies on nuclear and renewable fuels, accomplishing substantial improvements in energy efficiency, or implementing the large-scale capture and storage of CO_2 emissions.

One option for reducing emissions in a cost-effective manner is to establish a carefully designed cap-and-trade program. Under such a program, the government would set gradually tightening limits on emissions, issue rights (or allowances) consistent with those limits, and then let firms trade the allowances among themselves. Such a cap-and-trade program would lead to higher prices for energy from fossil fuels and for energy-intensive goods, which would in turn provide incentives for households and businesses to use less carbon-based energy and to develop energy sources that emit smaller amounts of CO_2.

Changes in the relative prices for energy and energy-intensive goods would also shift income among households at different points in the income distribution and across industries and regions of the country. Policymakers could counteract some but not all of those income shifts by authorizing the government to sell CO_2 emission allowances and using the revenues to compensate certain households or businesses, or to give allowances away to some households or businesses.

1. For additional information, see Congressional Budget Office, *Uncertainty in Analyzing Climate Change: Policy Implications* (January 2005).

My testimony makes the following key points:

- Climate change is an international problem. The economic impacts of climate change are extremely uncertain and will vary globally. Impacts in the United States over the next 100 years are most likely to be modestly negative in the absence of policies to reduce greenhouse gases, but there is a risk that they could be severe. Impacts are almost certain to be serious in at least some parts of the world.

- The economic impact of a policy to ameliorate that risk would depend importantly on the design of the policy. Decisions about whether to reduce greenhouse gases primarily through market-based systems (such as taxes or a cap-and-trade program) or primarily through traditional regulatory approaches that specify performance or technology standards would influence the total cost of reducing those emissions and the distribution of those costs in the economy. The cost of a policy to reduce greenhouse gases would also depend on the stringency of the policy; whether other countries also imposed similar policies; the amount of flexibility about when, where, and how emissions would be reduced; and the allocation of allowances if a cap-and-trade system was used.

- Reducing the risk of climate change would come at some cost to the economy. For example, the Congressional Budget Office (CBO) concludes that the cap-and-trade provisions of H.R. 2454, the American Clean Energy and Security Act of 2009 (ACESA), if implemented, would reduce gross domestic product (GDP) below what it would otherwise have been—by roughly ¼ percent to ¾ percent in 2020 and by between 1 percent and 3½ percent in 2050. By way of comparison, CBO projects that real (inflation-adjusted) GDP will be roughly two and a half times as large in 2050 as it is today, so those changes would be comparatively modest. In the models that CBO reviewed, the long-run cost to households would be smaller than the changes in GDP. Projected GDP impacts include declines in investment, which only gradually translate into reduced household consumption. Also, the effect on households' well-being of the reduction in output as measured by GDP (which reflects the market value of goods and services) would be offset in part by the effect of more time spent in nonmarket activities, such as childrearing, caring for the home, and leisure. Moreover, these measures of potential costs imposed by the policy do not include any benefits of averting climate change.

- Climate legislation would cause permanent shifts in production and employment away from industries focused on the production of carbon-based energy and energy-intensive goods and services and toward the production of alternative energy sources and less-energy-intensive goods and services. While those shifts were occurring, total employment would probably be reduced a little compared with what it would have been without a comparably stringent policy to reduce carbon emissions because labor markets would most likely not adjust as quickly as would the composition of demand for different outputs.

- CBO has estimated the loss in purchasing power that would result from the primary cap-and-trade program that would be established by the ACESA. CBO's measure reflects the higher prices that households would face as a result of the policy and the compensation that households would receive, primarily through the allocation of allowances or the proceeds from their sale. The loss in purchasing power would be modest and would rise over time as the cap became more stringent and larger amounts of resources were dedicated to cutting emissions, accounting for 0.2 percent of after-tax income in 2020 and 1.2 percent in 2050.

- The expected distribution of the loss in purchasing power across households depends importantly on policymakers' decisions about how to allocate the allowances. The allocation of allowances specified in H.R. 2454 would impose the largest loss in purchasing power on households near the middle of the income distribution. Which categories of households would ultimately benefit from the allocation of allowances is more uncertain in 2020 than in 2050. A large fraction of the allowances in 2020 would be distributed to households via private entities, and the distribution of the allowance value would depend on whether those entities passed the value on to customers, workers, or shareholders. In contrast, most of the value of allowances in 2050 would flow to households directly.

Aggregate Economic Impacts of Climate Change

Many of the natural changes that are likely to result from climate change (such as more frequent storms, hurricanes, and floods) will affect agriculture, forestry, and fishing; the demand for energy; and the nation's infrastructure. Despite the wide variety of projected impacts of climate change over the course of the 21st century, published estimates of the economic costs of direct impacts in the United States tend to be small.[2] Most of the economy involves activities that are not likely to be directly affected by changes in climate. Moreover, researchers generally expect the growth in the U.S. economy over the coming century to be concentrated in sectors—such as information technology and medical care—that are relatively insulated from climate effects. Damages are therefore likely to be a smaller share of the future economy than they would be if they occurred today.

As a consequence, a relatively pessimistic estimate for the loss in projected real gross domestic product is about 3 percent for warming of about 7° Fahrenheit (F) by 2100.[3] However, even for the levels of warming that have been examined, most of the estimates cover only a portion of the potential costs. Other costs in the United States could come from nonmarket impacts (which are not measured in GDP) and from the potential for abrupt changes:

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2. For additional information, see Congressional Budget Office, *Potential Impacts of Climate Change in the United States* (May 2009).

3. See Dale W. Jorgenson and others, *U.S. Market Consequences of Global Climate Change* (Arlington, Va.: Pew Center on Global Climate Change, 2004), p. 36.

- *Nonmarket impacts.* Some types of impacts are very difficult to evaluate in monetary terms because they do not directly involve products that are traded in markets. Although such difficulties apply to effects on human health and quality of life, they are particularly significant for biological impacts, such as loss of species' habitat, biodiversity, and the various resources and processes that are supplied by natural ecosystems. Experts in such issues generally believe that those nonmarket impacts are much more likely to be negative than positive and could be large.

- *The potential for abrupt changes.* Experts believe that there is a small possibility that even relatively modest warming could trigger abrupt and unforeseen effects during the 21st century that could result in large economic costs in the United States. Two examples of such possible effects are shifts in ocean currents that could change weather patterns and affect agriculture over large areas, and rapid disintegration of ice sheets, which could dramatically raise sea levels around the world. The sources and nature of such abrupt changes, their likelihood, and their potential impacts remain very poorly understood.

The most comprehensive published study includes estimates of nonmarket damages as well as costs arising from the risk of catastrophic outcomes associated with about 11°F of warming by 2100.[4] That study projects a loss equivalent to about 5 percent of U.S. output and, because of substantially larger losses in a number of other countries, a loss of about 10 percent of global output.

The Effects of Policy Design Choices

The economic impact of any policy to reduce greenhouse-gas emissions would depend on a variety of policy and program design decisions that would be made by the Congress or the regulatory agencies that implemented such a policy. Most importantly, the economic impact would depend on whether the policy worked primarily through taxes on emissions, a cap-and-trade program for emissions, regulatory standards to reduce emissions, or a combination of those approaches. The economic impact would also depend on the stringency of the cap, whether other countries also adopted programs to reduce emissions, and other factors that would be specific to the approach chosen.

Approaches to Reducing Emissions

The most fundamental choice facing policymakers is whether to adopt conventional regulatory approaches, such as standards for energy-using machinery and equipment, or to employ market-based approaches, such as taxes on emissions or cap-and-trade programs. Market-based approaches, most experts conclude, would generally limit emissions at a lower cost than command-and-control regulations would. Whereas conventional regulatory approaches would impose specific requirements that might

4. William D. Nordhaus and Joseph Boyer, *Warming the World: Economic Models of Global Warming* (Cambridge, Mass.: MIT Press, 2000), pp. 95–96.

not be the least costly means of reducing emissions, market-based approaches would provide more latitude for firms and households to determine the most cost-effective means of accomplishing that goal.

A tax per unit of emissions would effectively fix the incremental cost of reducing emissions in any given period. Proposals for such taxes would generally specify rates that gradually increased year by year, with the aim of making activities that produced emissions increasingly expensive. A cap-and-trade system, by contrast, would explicitly restrict the annual quantity of emissions. Under such programs, allowances would be allocated or sold, and the trading of allowances would permit emissions reductions to be achieved in the lowest-cost manner. If caps increased in stringency over time, then the incremental costs of reducing emissions would rise as well.

If policymakers had full and accurate information about the cost of reducing emissions, taxes and caps could be equivalent: Policymakers could set a cap, and they would know what allowance price it would yield, or they could set a tax at that same allowance price and achieve the same reduction in emissions as under the cap. However, because policymakers face uncertainty, there is a crucial difference between the two approaches: A tax would leave the resulting amount of emissions uncertain, whereas a fixed cap would leave the resulting allowance price uncertain.

Most economists conclude that in the face of uncertainty about the cost of reducing emissions, a policy that set a year-by-year price path for greenhouse-gas emissions (such as a gradually increasing tax) would probably cost less overall than a policy that specified year-by-year emissions targets.[5] That conclusion is based on three observations:

- Climate change results from the accumulation of greenhouse gases in the atmosphere over many decades and centuries. As a result, reducing the potential risk of climate change would entail reducing cumulative emissions of greenhouse gases over multiple decades, but year-to-year fluctuations in emissions have little effect on the climate. By contrast, the economic cost of reducing emissions can vary a lot from year to year—depending on the weather, economic activity, and the prices of fossil fuels. A tax would motivate firms to cut their emissions more when the cost of doing so was relatively low and allow them to emit more when the cost of cutting emissions was high. A cap-and-trade program would offer firms less flexibility (although such a program could incorporate features, such as banking and borrowing of allowances, that would allow a degree of flexibility, as described below).

5. For additional information on the difference between taxes and cap-and-trade programs, see Congressional Budget Office, *Policy Options for Reducing CO_2 Emissions* (February 2008).

- There is such great uncertainty about how a given quantity of emissions would ultimately affect global temperatures that there is very little additional certainty to be gained from choosing a fixed emissions goal (even one that is set over multiple decades) rather than a price path that is expected to achieve the same emissions goal—but that may exceed or may fall short of it depending on actual cost conditions. In essence, the additional certainty that a cap-and-trade program could provide about the amount of cumulative emissions would be bought at a relatively high cost without yielding corresponding certainty about the amount of climate change that would occur.

- The greater certainty about the price of emissions in the future that a tax would offer would provide affected firms and households with greater certainty about the conditions they would face in adjusting to restrictions than a cap would provide. That greater certainty would ease planning for capital investments and could lower the risk associated with developing new technologies.

Many proposals would augment basic cap-and-trade or tax provisions with subsidies for activities that reduced emissions or with regulations (such as standards for energy-using machinery and equipment). Some such approaches—subsidies for basic energy research, for example—would probably be useful and effective supplements to market-based approaches. Standards might also be the most effective regulatory approach in cases where market forces are unable to convey appropriate incentives, such as when a tax on energy would not provide an incentive for building owners to make efficiency improvements when renters are responsible for their electricity bills. Moreover, subsidies could help protect certain people or industries from the adverse economic effects of reducing emissions. However, to the extent that such additional elements supplanted the effective reliance on market forces to determine the lowest-cost means of reducing emissions, they might increase the overall economic costs of the program even though they might result in a lower allowance price in a cap-and-trade program.[6]

Government policy beyond research and standards directly tied to climate change would also indirectly affect the cost of restricting emissions. The tax treatment of investment could influence the cost and availability of particular technologies. Many experts believe that nuclear power could easily displace a significant amount of fossil fuel use, but only if the regulatory framework was adjusted to allow it. Similarly, existing land-use regulations and highway building might limit efforts to increase urban density and to foster the development of public transportation networks.

Cap-and-Trade Design Features

Many proposals for reducing emissions would include cap-and-trade systems to limit emissions of carbon dioxide and other greenhouse gases. Such systems raise numerous

6. Congressional Budget Office, *How Regulatory Standards Can Affect a Cap-and-Trade Program for Greenhouse Gases*, Issue Brief (September 16, 2009).

design issues. Four issues are especially important in considering the economic effects of a cap-and-trade system: the coverage and stringency of the cap, the degree of international coordination, flexibility in the timing of emissions reductions, and the allocation of emission allowances.

Coverage and Stringency. Under a cap-and-trade system, policymakers would face decisions about which emissions to control and when and how much to reduce them. Coverage could sharply affect costs: A given quantity of reductions in greenhouse-gas emissions could be achieved at a lower cost if the cap covered more types of gases and more sources of emissions. For example, although carbon dioxide emissions account for roughly 80 percent of greenhouse-gas emissions, some cuts in emissions of other greenhouse gases, such as methane or nitrous oxide, could be achieved at a relatively low cost. Likewise, even though research suggests that the bulk of reductions in CO_2 emissions would probably come from the electricity-generating sector, cost-effective reductions could also be found in other sectors, such as the transportation and residential sectors. Thus, a cap-and-trade program that covered as many types of greenhouse gases and sources of emissions as possible would be most likely to yield the most cost-effective reductions.

Most recent policy proposals would control nearly all CO_2 emissions from the burning of fossil fuels and would cover at least some emissions of non-CO_2 gases. In recognition of the difficulties in monitoring and measuring emissions, no proposal would include all types of emissions from all sources. Nevertheless, many proposals would provide incentives for sources of emissions that are not covered under the program to voluntarily participate. For example, landowners could earn credits by planting trees that absorb CO_2 from the atmosphere—credits that might then be sold to covered entities who would submit them in lieu of emission allowances. Some proposals would limit the use of such "offsets" to a fixed annual amount or a fixed fraction of total emissions. Greater latitude for such activities by uncovered sources could help moderate the costs of achieving a given emissions target because cheap reductions by uncovered sources could substitute for expensive reductions by covered ones. However, difficulties in ensuring the credibility and permanence of offsets could at least partially undermine their effectiveness in reducing overall costs.[7]

Cumulative U.S. greenhouse-gas emissions through 2050 are projected to total more than 300 billion metric tons of CO_2 equivalent (CO_2e). Recent legislative proposals vary in the magnitude of the reduction in cumulative emissions that they would require. Because requiring larger cuts in emissions would typically require deploying increasingly costly technologies, doubling the magnitude of the cuts required would be expected to more than double the cost of achieving them.

International Coordination. Climate change is an international problem that cannot be resolved without significant international cooperation and coordination. Emissions

7. For additional information, see Congressional Budget Office, *The Use of Offsets to Reduce Greenhouse Gases,* Issue Brief (August 3, 2009).

from anywhere in the world contribute to the global change in climate, so reducing emissions in any single country—even the United States—will do relatively little to avert climate change. Moreover, the stringency of foreign efforts to reduce emissions could strongly influence the cost of limiting them domestically. As long as a significant fraction of the world did not adopt similar policies, some of the reductions in the United States would probably be offset by increases in emissions elsewhere. For example, foreign consumption of oil would rise as declining domestic consumption pushed down international oil prices, and energy-intensive production overseas (and exports of such products to the United States) would most likely grow as domestic manufacturing costs rose relative to foreign costs. Such emissions "leakage" would lead countries that were controlling emissions to incur greater costs while achieving smaller reductions in global emissions.

Leakage could be avoided if most or all countries restricted emissions at the same time. Moreover, if a domestic cap-and-trade system was linked to similar systems in other countries, the United States might benefit from being able to buy low-cost foreign allowances—or it could find that prices for domestic allowances were driven up by foreign demand.

Flexibility in the Timing of Emissions Reductions. Offering firms subject to the cap flexibility as to when they made cuts in greenhouse gases—by including provisions that would require them to meet the annual caps only on average—could result in substantial cost savings while producing the same effect on the climate.[8] The ability to shift efforts to cut emissions over time could lower costs while achieving an equivalent reduction in warming because of the long-run nature of climate change.

Options for granting flexibility in the timing of emissions reductions fall into two categories. The first category would permit firms to transfer allowances across time. One important such provision would allow regulated entities to "bank" allowances in any given year for use many years after they were initially allocated. If, for example, reducing emissions this year proved less costly than expected, a firm might choose to do so and save some allowances for use in future years. A similar "borrowing" provision would allow firms to use allowances from future years (to be repaid with interest) during earlier periods when particularly high demand led to spikes in the cost of reducing emissions. A variant would create a "reserve pool" of allowances from future years that could be used in earlier years only under certain circumstances, such as when allowance prices rose above a threshold.

The second category of provisions would allow regulators to manage the price or quantity of allowances in a manner that induced a cost-effective time pattern of emissions reductions by specifying a path for allowance prices over time. For example, one such provision would allow annual caps to be exceeded if the market price for allow-

8. For additional information, see the statement of Douglas W. Elmendorf, Director, Congressional Budget Office, before the House Committee on Ways and Means, *Flexibility in the Timing of Emission Reductions Under a Cap-and-Trade Program* (March 26, 2009).

ances rose above some specified value (referred to as a "safety valve"). That value—typically specified to rise over time—would determine the maximum incremental cost in any given period. An alternative provision would set a ceiling and a floor—sometimes called a "price collar"—for the price of allowances.[9]

Allocation of Allowances. A key decision is how to distribute the value of the allowances. One option would be to have the government capture the value of the allowances by selling them, as it does with licenses to use the electromagnetic spectrum. Another possibility would be to give the allowances to energy producers, some energy users, or other entities at no charge. The European Union has used that approach in its cap-and-trade program for CO_2 emissions, and nearly all of the allowances issued under the 14-year-old U.S. cap-and-trade program for sulfur dioxide emissions are distributed in that way. Giving the allowances away to specific entities is equivalent to selling the allowances and giving the entities cash because those allowances could be sold in a liquid secondary market and thus could be easily converted into cash.

How policymakers decided to use the value of the allowances would affect the overall cost of a policy. For instance, the government could use the revenues from auctioning allowances to reduce existing taxes that tend to dampen economic activity. Some of the effects of a CO_2 cap would be similar to those of raising such taxes: The higher prices caused by the cap would reduce real wages and real returns on capital, which would be like raising marginal tax rates on those sources of income. Using the value of the allowances to reduce taxes could help mitigate the overall economic impact of a cap. Alternatively, policymakers could increase the cost of meeting the desired cap on emissions if they gave the allowances away in a manner that undermined the market incentives that the cap-and-trade program was intended to provide. For example, if electricity generators were given allowances on the basis of the amount of electricity that they produced with no further restrictions, they would be less likely to pass on the cost of meeting the cap to their customers in the form of higher prices. As a result, their customers would lack an incentive to find cost-effective ways to reduce their use of electricity. Moreover, as discussed below, decisions about how to allocate the allowances would have significant implications for the distribution of gains and losses among U.S. households.

The American Clean Energy and Security Act of 2009

H.R. 2454, the American Clean Energy and Security Act of 2009, as passed by the House of Representatives on June 26, 2009, would create two cap-and-trade programs for greenhouse-gas emissions—one applying to CO_2 and most other greenhouse gases, and a much smaller one for hydrofluorocarbons—and make a number of other significant changes in climate and energy policy. The cap-and-trade program

9. Ibid.; also see the statement of Douglas W. Elmendorf, Director, Congressional Budget Office, before the Senate Committee on Finance, *The Distribution of Revenues from a Cap-and-Trade Program for CO_2 Emissions* (May 7, 2009).

would restrict greenhouse-gas emissions from covered entities to 17 percent below 2005 levels by 2020 and 83 percent below 2005 levels by 2050.

In the main cap-and-trade program, covered entities would be phased into the program between 2012 and 2016. When the phase-in was complete, the cap would apply to entities that account for roughly 85 percent of total U.S. greenhouse-gas emissions. H.R. 2454 would not restrict the types of entities or individuals that could purchase, hold, exchange, or retire emission allowances in the main cap-and-trade program. An unlimited number of allowances could be banked for future use or sale, and a limited number of allowances could be borrowed from future allocations. A portion of each entity's compliance obligation could be met by purchasing offset credits from either domestic or international providers; in the aggregate, entities could use offset credits in lieu of reducing up to 2 billion tons of greenhouse-gas emissions annually, or more than half the emissions reductions projected around the middle of the policy period (roughly in 2030).

CBO estimates that the price of the allowances under H.R. 2454 would be $15 in 2012, the initial year that the cap took effect, and would rise at an annual real rate of 5.6 percent over the course of the policy, reaching $23 in 2020 and $118 by 2050 (all in 2007 dollars).[10] As a result of the price on emissions, the prices of goods and services throughout the economy would increase in rough proportion to the emissions associated with their production and consumption. At the same time, the allowances would become a source of income for the government or others. The government could capture the value of the allowances by selling them, or it could allow others to capture the value by giving them the allowances for free.

Key design features of H.R. 2454's cap-and-trade policy that influenced CBO's price estimate included:

- *Coverage and stringency.* CBO found that allowing firms to comply by purchasing offset credits (from both domestic and international providers) would reduce the allowance price by 70 percent.

- *Timing flexibility.* If covered entities were required to use all of their allowances in the designated year, then the price of the allowances would rise at a rate that was dictated by the speed at which the cap became more stringent. Banking helps to smooth out the price path—and compliance costs—over time. In CBO's projections, firms would bank allowances in the early years of the program, when the cap was relatively lenient, leading them to make more emissions reductions than neces-

10. For additional information, see Congressional Budget Office, cost estimate for H.R. 2454, the American Clean Energy and Security Act of 2009, as ordered reported by the House Committee on Energy and Commerce on May 21, 2009 (June 5, 2009). The costs in that estimate refer to federal budgetary costs and not the effects on the U.S. economy described in this testimony. The cost estimate reports allowance prices in nominal dollars. CBO estimates that the price of allowances in nominal dollars will rise from $16 in 2012 to $26 in 2019.

sary under the cap and pushing up the price of allowances. The accumulated supply of banked allowances would enable firms to meet their requirements under the cap in succeeding periods, helping to moderate allowance prices in later years. Firms would continue to bank allowances up to the point at which the rate of increase in the price of allowances was 5.6 percent, CBO's projection of the rate of return that they would make on alternative investments.

- *Allocation.* In general, the allocation of allowances in a cap-and-trade program would not affect the allowance price. An exception to that conclusion would occur if the allowances were allocated in a manner that would tend to undo the higher prices for energy-intensive goods and services that would result from the cap-and-trade program. CBO estimated that the allowance allocation in H.R. 2454 would have a small effect on the allowance price.

- *Standards and subsidies.* In general, the imposition of some regulatory standards and the provision of subsidies to develop new technologies would reduce the price of allowances to the extent that those standards or subsidies would change the source of emissions reductions from those that would have occurred with just the cap-and-trade program alone to others that would be motivated by the standard or subsidy. CBO estimated that the standards and subsidies in H.R. 2454 (including those for energy efficiency and for electricity generation that would capture and store CO_2) would lower the allowance price by roughly 10 percent. Most of that reduction would stem from the subsidy for carbon capture and storage. (However, reductions in allowance prices stemming from standards and subsidies could lead to higher, not lower, economywide costs because—to the extent that they generated changes in emissions patterns different from those that would arise from the cap-and-trade program alone—those reductions would not all be made in the most cost-effective manner.)

Economywide Effects of the Cap-and-Trade Provisions of the ACESA

By gradually increasing the prices of fossil fuels and other goods and services associated with greenhouse-gas emissions, climate legislation—including the cap-and-trade provisions of H.R. 2454—would tend to reduce long-run risks from climate change. Such legislation would also reduce economic activity through a number of different channels, although the total effect would be modest compared with expected future growth in the economy. The key channels are:

- Shift production, investment, and employment away from industries involved in the production of carbon-based energy and energy-intensive goods and services and toward industries involved in the development and production of alternative energy sources and non-energy-intensive goods and services;

- Reduce the productivity of existing capital and labor, which are currently geared to relatively inexpensive energy;
- Reduce domestic households' income, thus tending to reduce domestic saving;
- Discourage investment by increasing the costs of producing capital goods, which is a relatively energy-intensive process;
- Reduce net inflows of capital from abroad (because lower productivity and higher production costs for capital goods in the United States would make it more attractive for investors to invest in other countries);
- Reduce the total supply of labor by raising the prices of consumer goods and thus reducing workers' real wages; and
- Interact with the distortions of economic behavior imposed by the existing tax system.

Taken together, those changes would affect the levels and composition of gross domestic product and employment and would thus influence households' economic well-being.

Effects of Emissions Restrictions on Gross Domestic Product

Researchers often report the likely effect of climate policies on the economy in terms of their projected impact on GDP. On the basis of a review of estimates by other analysts, CBO concluded that climate legislation that would significantly reduce greenhouse-gas emissions in the United States would probably reduce GDP by a modest amount compared with what it would be without the legislation. The studies reviewed by CBO yielded a wide range of estimates of losses in GDP from climate policies, but all of them concluded that, all else being equal, higher prices for emission allowances would impose greater losses in GDP. On the basis of those studies, CBO concluded that GDP losses over the entire period of the policy were likely to fall

Table 1.

Projected Changes in Gross Domestic Product in Selected Years from the Implementation of H.R. 2454

Year	Percentage Change
2020	-0.2 to -0.7
2030	-0.4 to -1.1
2040	-0.7 to -2.0
2050	-1.1 to -3.4

Source: Congressional Budget Office based on its review of other studies.

in the range of 0.01 percent to 0.03 percent per dollar of allowance price.[11] CBO then estimated losses in GDP by combining its own estimates for the prices of allowances under H.R. 2454 with the range of predicted GDP losses per dollar of allowance price.

Using that approach, CBO concluded that the cap-and-trade provisions of H.R. 2454 would reduce the projected average annual rate of growth of GDP between 2010 and 2050 by 0.03 to 0.09 percentage points, resulting in progressively larger reductions in the level of GDP over time relative to what would otherwise occur (see Table 1). To place the size of those changes into perspective, CBO projects that real GDP in the United States will grow at an average annual rate of about 2.4 percent between now and 2050 and will be roughly two and a half times as large in 2050 as it is today.

11. In a 2003 review of studies of the potential impacts of the Kyoto Protocol, CBO concluded that GDP would be reduced by 0.018 percent to 0.028 percent per dollar of allowance price (measured in 2007 dollars) for each metric ton of CO_2 equivalent, depending on how the policy was implemented. See Mark Lasky, *The Economic Costs of Reducing Emissions of Greenhouse Gases: A Survey of Economic Models,* CBO Technical Paper 2003-3 (May 2003). A more recent review of estimates of the economic effects of H.R. 2454 and similar policies found that the predictions differ considerably for the short and medium term, mainly because the studies incorporate different assessments about the rates at which important markets can be expected to adjust in response to the new policies, but the long-term predictions agree much more closely. After 2030, point estimates of the percentage losses in GDP per dollar of allowance price yield average values similar to the range implied by the 2003 CBO analysis but suggest a wider range. (The high end of that range comes from a model that assumes that the supply of labor responds very sharply to changes in wages.) The studies that CBO reviewed include Environmental Protection Agency, Office of Atmospheric Programs, "EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress" (June 23, 2009); Energy Information Administration, *Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007,* Report No. SR-OIAF/2008-1 (April 2008); Sergey Paltsev and others, *The Cost of Climate Policy in the United States* (Cambridge, Mass: MIT Joint Program on the Science and Policy of Global Change, April 2009); Warwick McKibbin and others, "Consequences of Cap and Trade" (fact sheet, Brookings Institution, 2009); and David Montgomery and others, *Impact on the Economy of the American Clean Energy and Security Act of 2009, H.R. 2454* (Washington, D.C.: CRA International, May 2009).

The uncertainty about the effects of H.R. 2454 on GDP is probably even greater than is expressed by that projected range of effects, even though the studies reflect a wide range of assumptions about possible future technological developments that might decrease the cost of reducing emissions, and about the degree to which people would adjust their decisions about working, saving, and investing in response to the legislation. All of the analyses that CBO reviewed characterize the economy in a very similar manner; none of them accounts for all of the possible economic effects of the legislation; and none explicitly addresses the uncertainty of its point estimates.

Unchecked increases in greenhouse-gas emissions would also probably reduce output over time, especially later in this century. Those climate-change-induced reductions in output would be moderated if actions that the United States took to reduce emissions were accompanied by similar efforts by other major emitting countries. Nonetheless, CBO concludes that the net effects on GDP of restricting emissions in the United States—combining the effects of diverting resources to reduce emissions and moderating losses in GDP by averting warming—are likely to be negative over the next few decades because most of the benefits from averting warming are expected to accrue in the second half of the 21st century and beyond.

Effects of Emissions Restrictions on Employment

By raising the prices of goods and services in proportion to the covered greenhouse-gas emissions associated with their production and consumption, climate legislation would affect the total level of employment as well as the distribution of employment among industries. Although supply-and-demand responses in many markets would influence the magnitude of industry-specific and total employment effects, a key consideration is how quickly and extensively labor markets would respond to sustained increases in energy prices. If businesses and workers treated each successive increase in energy prices as a surprise, then adjustment would be slow, and the policy would lead to slightly higher unemployment for some time. If, conversely, businesses and workers exercised foresight and acted in their self-interest, adjustment would occur more quickly, and the policy would have little effect on overall unemployment. In either case, a cap-and-trade program would have adverse effects on workers in specific industries and geographic areas; some provisions of H.R. 2454 are intended to ameliorate those effects.

Economywide Employment. The cap-and-trade program established by H.R. 2454 would probably have only a small effect on total employment in the long run, but changes induced by the program would still have costs for workers. The increases in the price of energy caused by the program would reduce workers' real wages. Total employment would be lower in the long run to the extent that some workers chose to work fewer hours or not at all—but for nearly all workers, the choice in the long run would probably be to remain in the workforce and accept the prevailing wage. Moreover, experience shows that, apart from recessionary periods, the dynamic U.S. economy provides jobs for most people who want to work.

Employment in Different Industries. The small effect on overall employment would mask a significant shift in the composition of employment over time. A cap-and-trade program for carbon dioxide emissions would reduce the number of jobs in industries that produce carbon-based energy, use energy intensively in their production processes, or produce products whose use involves energy consumption, because those industries would experience the greatest increases in costs and declines in sales. The industries that produce carbon-based energy—coal mining, oil and gas extraction, and petroleum refining—would probably suffer significant employment losses over time. Reductions also would be likely to occur in industries that use those forms of energy intensively or purchase emissions-intensive inputs to their production process from other industries, including chemicals, primary metals, minerals mining, nonmetallic mineral products, transportation, and construction. Among those industries, employment losses in chemicals and transportation services could be relatively large.

The shifts in demand caused by the policy would also create new employment opportunities in some industries. Businesses that produce the machinery necessary to generate energy without CO_2 emissions and that produce that energy—for example, electricity generated by the wind or the sun—would hire more workers. Employment would also probably increase in industry sectors that supply goods and services that use less energy in their production or that require consumers to purchase less energy when using the industry's product. In the automobile industry, for instance, employment would shift from producing vehicles that rely solely on internal-combustion engines fueled by gasoline to producing vehicles with hybrid or electric engines. The largest gains in employment would probably be in service industries.

The shift in employment between sectors of the economy would occur over a long period, as the cap on emissions became progressively more stringent and the allowance price (and, therefore, the price of emissions) became progressively higher. The experience of the U.S. economy over the last half-century in adjusting to a sustained decline in manufacturing employment provides evidence that the economy can absorb such long-term changes and maintain high levels of overall employment. From a peak of almost 20 million jobs in 1979, manufacturing employment fell to about 14 million jobs in 2007. Although manufacturing employment rose and fell with the business cycle over the period, the larger story is one of offsetting job creation and shifts of workers to other sectors of the economy. For example, from 2000 through 2007, employment in manufacturing fell by 3.5 million jobs, while nonmanufacturing private employment increased by 8.2 million jobs.[12]

12. For an analysis of the economy's adjustment to a declining demand for U.S. manufacturing, see Congressional Budget Office, *Factors Underlying the Decline in Manufacturing Employment Since 2000*, Issue Brief (December 2008).

Job turnover is always large in U.S. labor markets. In 2008, for example, employers reported that they hired about 56 million workers and that about 59 million workers left their jobs.[13] In reviewing several studies that addressed the aggregate employment effects of climate legislation, CBO found a wide range of implied estimates of annual workforce turnover—gross jobs created and gross jobs lost—and concluded that the annual churning in the workforce might range from hundreds of thousands of jobs to several million jobs depending on the year.[14] Even at the high end of that range, the churning of jobs that would be spurred by climate legislation would be small compared with what normally occurs.

The process of shifting employment can have substantial costs for the workers, families, and communities involved. For example, one-quarter of the workers who were displaced from their jobs in 2003—that is, workers who were permanently separated from their jobs because their employers closed or moved, there was insufficient work for them to do, or their positions were abolished—and who were subsequently reemployed were jobless for 27 weeks or more.[15] Finding a new job might require substantial worker flexibility. Some workers would need to migrate to new geographic areas. An earlier study indicated that in states whose industries were hit by significant adverse shocks between 1950 and 1990, the rate of unemployment generally decreased only when workers moved to different states, a process that often took more than five years to unfold.[16] And some workers might need to acquire new skills more suited to the employment opportunities available to them.

Moreover, some workers would never find the new employment they were seeking. Some might end up working fewer hours than they might prefer. And some might leave the labor force entirely. Almost half of the unemployment spells completed in 2003 ended with the individuals leaving the labor force rather than becoming

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13. See Department of Labor, Bureau of Labor Statistics, *Job Openings and Labor Turnover: January 2009*, USDL 09-0245 (March 10, 2009), Tables 11 to 14.

14. CBO reviewed a number of studies that addressed the effects of policies like those that H.R. 2454 would put in place, including David Kreutzer and others, *The Economic Consequences of Waxman-Markey: An Analysis of the American Clean Energy and Security Act of 2009*, CDA09-04 (Washington, D.C.: The Heritage Foundation, August 5, 2009); McKibbin and others, "Consequences of Cap and Trade"; Environmental Protection Agency, Office of Atmospheric Programs, "EPA Analysis of the American Clean Energy and Security Act of 2009 H.R. 2454 in the 111th Congress"; Montgomery and others, *Impact on the Economy of the American Clean Energy and Security Act of 2009 (H.R. 2454)*; Energy Information Administration, *Energy Market and Economic Impacts of S. 2191, the Lieberman-Warner Climate Security Act of 2007;* Paltsev and others, *The Cost of Climate Policy in the United States;* and Mun S. Ho, Richard Morgenstern, and Jhih-Shyang Shih, *Impact of Carbon Price Policies on U.S. Industry*, Discussion Paper 08-37 (Washington, D.C.: Resources for the Future, November 2008).

15. Data for people who lost jobs in 2003 are from Congressional Budget Office, *Long-Term Unemployment* (October 2007), p. 11.

16. Oliver Jean Blanchard and Lawrence F. Katz, "Regional Evolutions," *Brookings Papers on Economic Activity,* no. 1 (1992).

employed.[17] Women, less-educated workers, and older workers who lose their jobs appear to be more likely to leave the labor force than men, more-educated workers, and younger workers who lose their jobs.[18] Some workers leaving the labor force, especially older or less-educated workers, might opt to seek disability payments that they would not have claimed otherwise.

Even workers who find new jobs might suffer permanent adverse effects. For example, reductions in employment that occur rapidly in particular geographic areas or industries could lead to significant reductions in the lifetime earnings of some affected workers. Even 15 to 20 years later, men who separated from their stable jobs in a mass layoff during the 1982 recession had annual earnings that were 20 percent lower than similar workers who did not experience such a job loss.[19]

Provisions of H.R. 2454 Intended to Ameliorate Those Employment Effects. Some provisions of the bill—those that would subsidize the development and deployment of technologies that reduced emissions or that would subsidize production by specific industries and firms—would dampen the effects of the policy on employment in industries and areas where they are expected to be most severe.

- Selected provisions of the bill would subsidize petroleum refiners through 2026 and trade-exposed, energy-intensive industries—those in which domestic firms compete with foreign firms that do not bear the cost of complying with comparable policies to control emissions—through 2035. Those subsidies would be linked to output, causing the firms receiving them to produce more than they otherwise would under the cap-and-trade system and in doing so employ more people (although that process also dampens the reallocation of output and employment to industries that produce fewer carbon emissions).

- The bill also includes measures that would decrease the negative effects of the cap-and-trade system on output and employment in the coal mining and processing industries. Those provisions would establish and provide funding for the Carbon Storage Research Corporation. That entity would, in the 15 years after enactment of the bill, support the development of technologies to capture and store carbon, potentially enabling coal-fired plants to generate electricity without releasing greenhouse gases into the atmosphere. Through 2050, utilities or merchant generators that invested in and operated plants that used those technologies to generate electricity would be paid subsidies to offset the higher costs of that technology.

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17. See Randy Ilg, "Analyzing CPS Data Using Gross Flows," *Monthly Labor Review* (September 2005), pp. 10–18.

18. Henry Farber, "What Do We Know About Job Loss in the United States? Evidence from the Displaced Workers Survey, 1984-2004," *Economic Perspectives* (2005), pp. 13-28.

19. Till von Wachter, Jae Song, and Joyce Manchester, *Long-Term Earnings Losses Due to Mass Layoffs During the 1982 Recession: An Analysis Using U.S. Administrative Data from 1974 to 2004* (April 2009), www.columbia.edu/~vw2112/papers/mass_layoffs_1982.pdf.

Those subsidies would increase demand for coal and boost output and employment in the coal industry relative to what would occur under the emissions restrictions in the legislation but without those subsidies.

- The bill also would establish the Climate Change Worker Adjustment Assistance program and provide funding of $4.1 billion through 2019 for that program. That program would aim to cushion the effects of the emissions-control policies on workers who lost their job as a consequence of the policy. It also would seek to complement the flexibility evident in U.S. labor markets by providing job training and assisting workers searching for employment.

The Overall Burden on Households

Households' well-being depends on the amount and composition of goods and services they consume as well as how much time they have for nonmarket household activities including leisure. Policies to restrict emissions could affect all elements of households' well-being, and the legislation's overall burden would be determined by the value that people place on those various elements. For example, if people found products and activities that were not greenhouse-gas-intensive to be good substitutes for ones that were, they would be more willing to switch between them. As a result, they would find rising prices for greenhouse-gas-intensive products and activities less burdensome than if there were no good substitutes for them.

Some of those components of well-being—mainly the consumption of marketed goods and services—are included in GDP, but other components are not. Conversely, some components of GDP, such as exports and investment, do not directly affect households' well-being in the same way that consumption does, although they support jobs and provide for the future. A substantial proportion of projected GDP impacts are due to declines in investment, mainly from the increased costs of producing energy-intensive capital goods. Declines in investment translate only gradually into reduced household consumption. As another example, if the policies caused output and real wages to fall, the burden of lower consumption might be partly offset if people also chose to supply less labor and instead devoted more time to valuable nonpaid activities not included in GDP, such as childrearing, production within the home, and leisure activities.

Measuring the overall burden of policies like those embodied in H.R. 2454 requires estimates not only of supply and demand responses in many markets but also of households' valuation of activities that take place outside markets. Such estimates are difficult to obtain and very uncertain. Only two of the analyses of H.R. 2454 reviewed by CBO provide estimates of the overall burden, and the results differ

considerably, reflecting differences in assumptions about households' behavior.[20] On the basis of those estimates and of estimates of the burden of other types of policies such as tax shifts and trade liberalization, CBO concludes that the overall burden of H.R. 2454 is likely to be smaller than the projected loss in GDP.

CBO developed an estimate of households' loss in purchasing power as a rough indication of the direct effect that the cap-and-trade program established in H.R. 2454 would have on households. That loss in purchasing power equals the costs of complying with the policy minus the compensation that would be received as a result of the policy.[21] Compliance costs include the cost of purchasing allowances and offsets, and of reducing emissions—costs that businesses would generally pass along to households in the form of higher prices. Compensation includes the free allocation of allowances, receipt of proceeds from the sale of allowances, and profits earned from producing offsets; much of that compensation would be passed to households from businesses and governments.

Although CBO's measure of the loss in purchasing power provides an estimate of the direct effect of the cap-and-trade program on households, it ignores some channels of influence on economic activity and households' well-being that cannot be readily quantified. Some of the omitted channels lead CBO's measure to overstate households' true burden, and some lead CBO's measure to understate the burden. The latest research in this area does not reach a clear conclusion about the relative magnitude of those channels, but it appears that CBO's measure of the loss in purchasing power probably understates to a small degree the true burden of the cap-and-trade program.

On the one hand, in keeping with the standard procedures followed by CBO, the Office of Management and Budget, and the Congressional Budget Committees in identifying federal budgetary costs, CBO estimated the price path for allowances that

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20. Some models—including one that provides an estimate of the burden—assume that households are very willing to work less and to shift their consumption away from goods and services that become relatively more expensive. Such models conclude that cap-and-trade policies to reduce carbon dioxide emissions would have a larger effect on GDP (because households would provide less labor to produce goods and services and would save less as well) but would impose only a small overall burden (because households could easily substitute relatively cheaper goods and services for more expensive ones and substitute household production or leisure for work). Much empirical work suggests that the supply of labor is significantly less flexible than those models assume, and CBO's own models and analyses in other areas generally assume less flexibility. By contrast, models that assume that households are relatively inflexible about shifting their consumption of goods, services, and leisure generally (including the other model in CBO's review that provides an estimate of the burden) conclude that policies would have smaller effects on GDP but larger effects on the overall burden (although still somewhat smaller than the GDP effects). Those estimates of the burden do not include any value people place on averting climate change by reducing emissions.

21. Once the compensation received by U.S. households is deducted from the compliance costs, the remaining loss in purchasing power stems from the cost of reducing emissions and producing domestic offsets, expenditures on international offsets, and the value of allowances that would be directed overseas.

would reduce emissions to the levels defined by the annual caps without accounting for the effect that the policy might have on GDP. Because the program would reduce GDP (and thus lessen the overall demand for energy), the allowance price required to meet the cap would be slightly lower than CBO's estimate. A lower allowance price, in turn, would lead to a smaller loss in purchasing power. CBO's estimate of the loss in purchasing power, therefore, is slightly larger than would be the case if the agency had accounted for the potential decline in GDP when it estimated the price of allowances. In addition, CBO's measure ignores ways in which the program might interact with distortions of economic behavior (and, thus, costs ultimately imposed on households) generated by the existing tax system. Some of those interactions would tend to reduce overall economic costs. For example, the existing incentive for overconsumption of housing from the mortgage interest deduction might be countered to some extent by higher energy prices, as housing is energy intensive.

On the other hand, CBO's estimate of the loss of purchasing power does not capture all of the ways in which the cap-and-trade program could impose costs on households. There would be transition costs of lost earnings by workers who would become temporarily unemployed or underemployed during the adjustment to higher prices for energy from fossil fuels. There would also be indirect effects on household consumption relative to what would happen in the absence of the cap-and-trade program. The premature obsolescence of existing long-lived capital, such as coal-fired power plants that would no longer generate as much electricity, would reduce household wealth a little (through shareholders' losses) and in turn reduce consumption. Both lower household wealth and higher costs of producing energy-intensive capital goods would reduce domestic saving and investment, leading to slightly lower economic growth and household consumption. Finally, some interactions of the cap-and-trade program with existing taxes could tend to add to economic costs. For example, the increase in prices for fossil fuel energy and energy-intensive goods and services would tend to aggravate distortions in the labor market caused by existing taxes on earnings.

The loss in purchasing power would rise over time as the cap became more stringent and larger amounts of resources were dedicated to cutting emissions—for example, by generating electricity from natural gas rather than coal or by improving energy efficiency. As a share of GDP, the aggregate loss of purchasing power would be 0.1 percent in 2012 and 0.8 percent in 2050, CBO estimates, and would average 0.4 percent over the entire 2012–2050 period. Measured at the projected 2010 level of income, the average per-household loss in purchasing power would be $90 in 2012 and $925 in 2050 and would average about $455 per U.S. household per year over the 2012–2050 period.

Effects on Households in Different Income Groups

Estimates of the average loss in purchasing power per household do not reveal the range of effects that the program would have on households in different circumstances, including their income level, sectors of the economy in which they work, and

regions of the country in which they live. CBO does not have the capability to estimate effects by region or by sector of employment, but the agency does estimate effects on households of different income levels.

Specifically, CBO estimated the effects of the cap-and-trade program established by H.R. 2454 on households in each fifth of the population arrayed by income (and adjusted for household size) on the basis of the provisions of the program as defined for both 2020 and 2050. The loss in purchasing power that would be faced by households at each point in the income distribution would depend on the amount of compliance costs they would bear minus the amount of offsetting real income they would receive as a result of the policy. To show the burden of the loss in purchasing power that households would experience, CBO presents those losses as shares of after-tax income.

Avenues by Which Households Would Incur Costs and Receive Compensation

Estimating the effects of the cap-and-trade program on households in different income brackets entails accounting for the various means by which households would bear compliance costs and receive compensation in their various roles as consumers, workers, shareholders, taxpayers, and recipients of government services.

Compliance Costs. CBO assumed that businesses would pass the costs of acquiring emissions allowances, purchasing domestic and international offset credits, and reducing emissions on to their customers through higher prices for goods and services. (That assumption, which is standard in distributional analyses, stems from the fact that the price of an item in the long run generally reflects the incremental cost of producing that item.) CBO estimated price increases for categories of goods and services using a model of the U.S. economy that relates final prices of goods to the costs of production inputs. Households and governments would bear those costs through their consumption of goods and services. Households account for the bulk of total spending, and they would bear an estimated 87 percent of the compliance costs. Those costs were allocated among households on the basis of their consumption of those goods and services as reported in the Consumer Expenditure Survey from the Bureau of Labor Statistics.[22]

The federal government and state and local governments would bear the remainder of compliance costs (an estimated 13 percent) through their spending on goods and ser-

22. The database for the analysis was constructed by statistically matching income information from the Statistics of Income data (from the Internal Revenue Service), households' characteristics from the Current Population Survey (reported by the Census Bureau), and data on households' expenditures from the Consumer Expenditure Survey (from the Bureau of Labor Statistics). The data are from 2006, the latest year for which information from all three sources was available, and thus reflect the patterns of income and consumption in that year. The data were extrapolated to 2010 levels using the estimated overall growth in population and income. For the purposes of this analysis, CBO allocated the cost of reducing all of the gases covered in the cap-and-trade program among households and governments on the basis of their contributions to emissions of carbon dioxide, which constitute more than 85 percent of greenhouse gases.

vices. CBO did not distribute governmental costs across households because their incidence was unclear. If governments chose to increase taxes across the board, the cost would fall on households in proportion to their share of federal, state, and local taxes. In contrast, if governments chose to cover the additional expenses by cutting back on the services they provide, the cost would fall on households that no longer received those services.

Emissions Allowances. Under H.R. 2454, the distribution of allowances would change between 2020 and 2050, which would alter the distribution of the loss in purchasing power across households.

In 2020, the government would issue most of the allowances at no cost to private entities, state governments, or the federal government. More specifically:

- 15 percent of the value of the allowances would be set aside for an energy rebate program for households whose gross income does not exceed 150 percent of the federal poverty level or that are receiving benefits through the Supplemental Nutrition Assistance Program, the Medicare Part D low-income subsidy, the Supplemental Security Income program, or other low-income assistance, and for an expansion in the earned income tax credit payable to individuals without qualifying children;

- 16 percent of the value of the allowances would be given to companies that distribute electricity and natural gas, with instructions to pass those benefits on to their residential customers;

- 29 percent of the value of the allowances would be given to those same distributors of electricity and natural gas, with instructions to pass the value on to their commercial and industrial customers;

- 15 percent of the value of the allowances would be given to what are termed trade-exposed, energy-intensive industries—which would be less able to pass their compliance costs on to their customers than would other industries facing less international competition—and oil refiners;

- 18 percent of the value of the allowances would be directed to the federal government and to state governments to spend within the United States (not including the amount used to fund the energy rebate and tax credit). For example, the bill would direct a portion of the value to be spent encouraging the development of particular technologies (such as electricity generation that includes the capture and storage of carbon dioxide) and improvements in energy efficiency; and

- 7 percent of the allowance value would be spent overseas, to fund efforts to prevent deforestation in developing countries, encourage the adoption of more efficient technologies, and assist those countries in adapting to climate change.

The allocation of allowances under the 2050 provisions of the ACESA is quite different from that in 2020, with a much larger fraction of the allowance value flowing directly to households:

- 15 percent of the value of the allowances would continue to be used to fund the energy rebate program and the expansion in the earned income tax credit;
- 54 percent of the allowance value would be used to fund a Climate Change Consumer Refund Account and would be paid on a per capita basis;
- 21 percent of the value would be directed to federal and state governments (not counting the shares allocated for household rebates, tax credits, and refunds) to be spent on various objectives, including encouraging investments in clean energy technology, increasing energy efficiency, facilitating adaptation, and protecting wildlife; and
- 10 percent of the value would be spent overseas to fund efforts to prevent deforestation in developing countries, encourage the adoption of more efficient technologies, and assist those countries in adapting to climate change.

For the allowances given to local distributors of electricity or national gas with instructions to pass the benefits on to their residential customers, CBO assumed that the value of those allowances would be received by those households. For the allowances given to those local distributors with instructions to pass the benefits on to their commercial and industrial customers, CBO assumed that the value of those allowances would be received by shareholders, because that allocation of allowances would not generally reduce the cost of producing an incremental unit of output and thus would not generally be passed through to households in the form of lower prices.[23] For the allowances given to trade-exposed industries and oil refiners, CBO assumed that the value would be passed through in the form of lower prices for customers.[24] With the exception of the allowances used to fund household rebates, refunds, or tax credits, CBO lacked sufficient information to distribute the value of allowances that were given to federal or state governments to spend within the United States. CBO also did not distribute among U.S. households the value of allowances that would be spent overseas.

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23. All increased profits, net of taxes, were allocated to households according to their holdings of equities, which were estimated from the Federal Reserve's Survey of Consumer Finances for 2004. Those holdings include equity held through mutual funds and private pension accounts.

24. That approach was used to account for CBO's inability to distribute the initial cost of the cap among such firms. The cost of the emissions cap would tend to fall on workers and shareholders in those industries; correspondingly, the relief aimed at those industries (which would be linked to their level of production) would tend to offset costs that workers and shareholders in those industries would otherwise incur. Because of data limitations, CBO assumed for this analysis that the cost of complying with the cap would lead to price increases for those industries. Correspondingly, CBO reflected the value of allowances allocated to those industries as offsetting price decreases.

Domestic Offset Credits. Covered entities would purchase domestic offset credits to comply with the cap under both the 2020 and 2050 provisions of ACESA. Spending on domestic offsets would rise over time because the increase in the price of allowances would make it cost-effective for firms to comply by purchasing increasingly costly offsets. Suppliers of domestic offset credits would experience increases in net income—the gross income received from selling the offsets minus the costs incurred to generate them.[25]

Additional Financial Transfers and Costs That Would Affect Households. The cap-and-trade program under H.R. 2454 would result in some additional transfers of income—and additional costs—that are not reflected in the gross compliance costs, the disposition of the allowance value, or the net income from domestic offset production. Households would receive additional income in three ways:

- *The value of the rebates and tax credits for low-income households in excess of the 15 percent of the allowance value that the bill would set aside to pay for them.*[26] That amount would add to the sums received by households but would also increase the cost to the government.

- *Increases in government benefit payments that are pegged to the consumer price index, such as Social Security benefits.* Under the assumption that the costs of compliance would be passed through to consumers in the form of higher prices and that the Federal Reserve would not act to offset those price increases, the rise in the consumer price index would trigger increased cost-of-living adjustments in benefits from certain government programs. The increase in those transfer payments would help offset the higher expenditures for the households that received them but would also impose a cost on the federal government.

- *Reduced federal income taxes.* Because the federal income tax system is largely indexed to the consumer price index, an increase in consumer prices with no increase in nominal income would reduce households' federal income tax payments. That effect would increase households' after-tax income but would also add to the federal deficit.

Because each of those transfers of income would have equal and offsetting costs (increased Social Security benefits would ultimately need to be paid for by higher taxes or reductions in other government spending, for example), they would neither

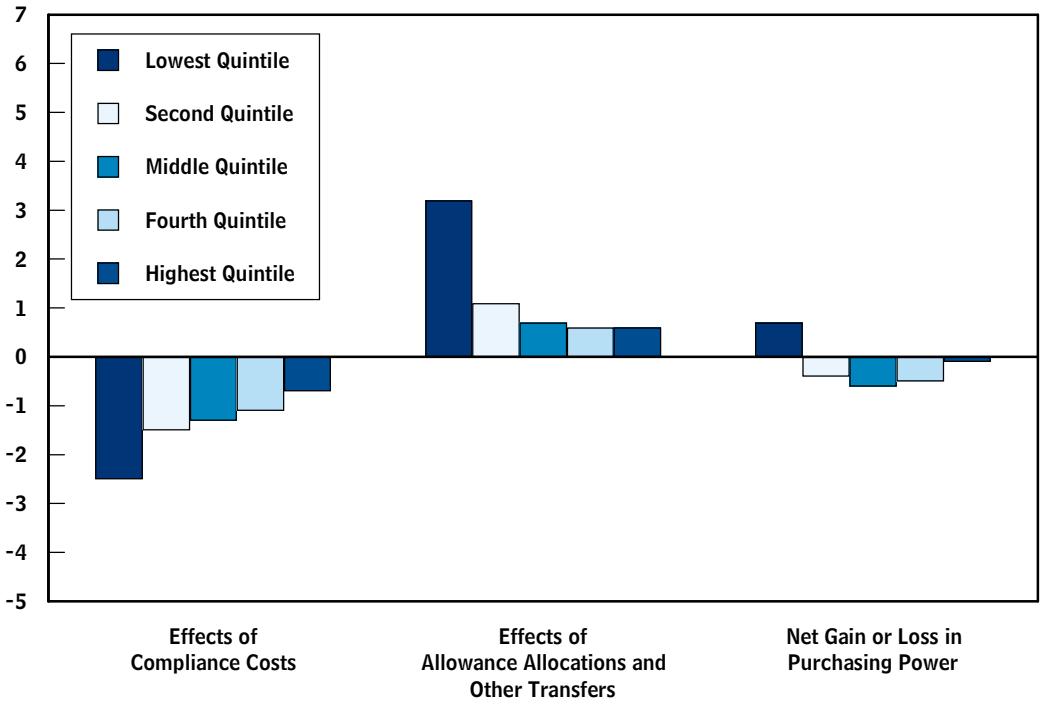
25. Like other profits, increased after-tax net income by providers of domestic offsets was allocated to households according to their holdings of equities, which were estimated from the Federal Reserve's Survey of Consumer Finances for 2004. Those holdings include equity held through mutual funds and private pension accounts.

26. Estimates of the low-income rebates and tax credits were made by CBO and the staff of the Joint Committee on Taxation, respectively.

Figure 1.

Average Gain or Loss in Households' Purchasing Power from the Greenhouse-Gas Cap-and-Trade Program in H.R. 2454, by Level of Income: 2020 Policy Measured at 2010 Levels of Income

(Effects as a percentage of after-tax income)



Source: Congressional Budget Office.

add to nor reduce the loss in purchasing power associated with the policy. However, because CBO was able to distribute the benefits associated with the transfers but lacked sufficient information to distribute the costs, the transfers do affect the estimated distribution of the loss in purchasing power described below.

Effects of the Policy's Provisions in 2020

CBO estimates that households in the lowest income quintile in 2020 would see an average *gain* in purchasing power of 0.7 percent of after-tax income, or about $125 measured at 2010 income levels. Households in the highest income quintile would see a *loss* in purchasing power of 0.1 percent of after-tax income, or about $165 at 2010 income levels (see Figure 1 and Table 2), and households in the middle quintile would experience a loss in purchasing power equivalent to 0.6 percent of after-tax income, or about $310 at 2010 income levels.

Although households in the lowest income quintile would experience a net gain in purchasing power in 2020 under the provisions of H.R. 2454, they would experience

Table 2.

Average Gain or Loss in Households' Purchasing Power from the Greenhouse-Gas Cap-and-Trade Program in H.R. 2454: 2020 Policy Measured at 2010 Levels of Income

	Effects of Compliance Costs	Effects of Allowance Allocations and Other Transfers	Net Gain or Loss in Purchasing Power
	Average Dollar Gain or Loss per Household		
Lowest Quintile	-430	555	125
Second Quintile	-560	410	-150
Middle Quintile	-685	375	-310
Fourth Quintile	-825	455	-375
Highest Quintile	-1,400	1,235	-165
Unallocated	-120 [a]	130 [b]	10
All Households	-900	740	-160
	Gain or Loss as a Percentage of After-Tax Income		
Lowest Quintile	-2.5	3.2	0.7
Second Quintile	-1.5	1.1	-0.4
Middle Quintile	-1.3	0.7	-0.6
Fourth Quintile	-1.1	0.6	-0.5
Highest Quintile	-0.7	0.6	-0.1
Unallocated	-0.2 [a]	0.2 [b]	0
All Households	-1.2	1.0	-0.2

Source: Congressional Budget Office.

Note: The figures are 2010 levels based on the 2006 distribution of income and expenditures. Households are ranked by adjusted household income. Each quintile contains an equal number of people. Households with negative income are excluded from the bottom quintile but are included in the total. The loss from compliance costs is distributed to households on the basis of their carbon consumption.

a. Unallocated compliance costs reflect the governments' share of carbon consumption.

b. CBO did not allocate allowances for which the recipients were unspecified (for example, allowances given to the government to distribute for energy-efficiency improvements). Unallocated gains and losses from other transfers are the net government cost of funding transfers in excess of the allowances allocated for that purpose. On net, the unallocated allowances and unfunded transfers increase purchasing power for the 2020 policy because the unallocated allowances are greater than the unfunded transfers.

the largest financial burden prior to compensation. The price increases triggered by the compliance costs would cause a loss in purchasing power of 2.5 percent of after-tax income for households in the lowest quintile, compared with 0.7 percent of after-tax income for households in the highest quintile. Although the dollar increase in out-of-pocket expenditures stemming from the compliance costs would be substantially larger for high-income households ($1,400) than for low-income households ($430), it would impose a larger proportional burden on low-income households because

those households consume a larger fraction of their income and because energy-intensive goods and services make up a larger share of expenditures by low-income households.

In estimating households' loss of purchasing power, CBO lacked sufficient information to allocate across households in different income brackets the benefits of some proposed government spending programs. In addition, the agency was not able to allocate across households the 13 percent of compliance costs that would be borne by the government as well as other expenditures that the federal government would face as a result of the policy and that would not be funded by revenue from the allowances. The government could finance those expenditures in various ways, including increasing taxes or reducing other spending, which could have very different effects on households at different points in the income spectrum. In 2020, the aggregate amounts of benefits and costs that CBO was not able to allocate across households roughly canceled each other out. As a result, the loss in purchasing power that CBO allocated across households in different income brackets was nearly the same as the average loss in purchasing power experienced by all households in aggregate (0.2 percent of after-tax income, or $160 per household when measured at 2010 income levels).[27]

Effects of the Policy's Provisions in 2050

The cap-and-trade program in H.R. 2454 would have different impacts across households in 2050 than in 2020. CBO estimates that households in the lowest income quintile in 2050 would see an average increase in purchasing power equal to 2.1 percent of their after-tax income, or $355 measured at 2010 income levels (see Table 3 and Figure 2). Households in the highest income quintile would see a loss in purchasing power of 0.7 percent of after-tax income, or about $1,360 measured at 2010 income levels, and households in the middle quintile would have a loss in purchasing power of 1.1 percent of after-tax income, or about $590 at 2010 levels.

In 2050, the aggregate amount of costs that CBO was unable to allocate across households would exceed the aggregate amount of unallocated benefits. In particular, the magnitude of the rebates and tax credits for low-income households in 2050 would be significantly larger than the 15 percent of the allowance value set aside to pay for them. In addition, more revenue would be required to fund the increases in indexed benefits (such as Social Security income) that would be triggered by higher prices. As a result, the loss in purchasing power allocated across households in different income

27. That average loss in purchasing power in 2020 is slightly lower than the $175 reported in CBO's June 2009 analysis (and which CBO referred to as "net economywide cost") because of refinements in CBO's methodology and subsequent changes in legislative provisions. In addition, the allocation of the loss in purchasing power across households is different than in the June 19th analysis because the final version of the bill targeted more relief at households in the lowest income quintile. For more information, see Congressional Budget Office, "The Estimated Costs to Households from the Cap-and-Trade Provisions of H.R. 2454," letter to the Honorable Dave Camp (June 19, 2009).

Table 3.

Average Gain or Loss in Households' Purchasing Power from the Greenhouse-Gas Cap-and-Trade Program in H.R. 2454: 2050 Policy Measured at 2010 Levels of Income

	Effects of Compliance Costs	Effects of Allowance Allocations and Other Transfers	Net Gain or Loss in Purchasing Power
	Average Dollar Gain or Loss per Household		
Lowest Quintile	-675	1,030	355
Second Quintile	-880	580	-300
Middle Quintile	-1,075	485	-590
Fourth Quintile	-1,295	500	-795
Highest Quintile	-2,190	830	-1,360
Unallocated	-190 [a]	-200 [b]	-390
All Households	-1,410	485	-925
	Gain or Loss as a Percentage of After-Tax Income		
Lowest Quintile	-3.9	6.0	2.1
Second Quintile	-2.4	1.6	-0.8
Middle Quintile	-2.0	0.9	-1.1
Fourth Quintile	-1.7	0.7	-1.0
Highest Quintile	-1.1	0.4	-0.7
Unallocated	-0.3 [a]	-0.3 [b]	-0.5
All Households	-1.9	0.6	-1.2

Source: Congressional Budget Office.

Note: The figures are 2010 levels based on the 2006 distribution of income and expenditures. Households are ranked by adjusted household income. Each quintile contains an equal number of people. Households with negative income are excluded from the bottom quintile but are included in the total. The loss from compliance costs is distributed to households on the basis of their carbon consumption.

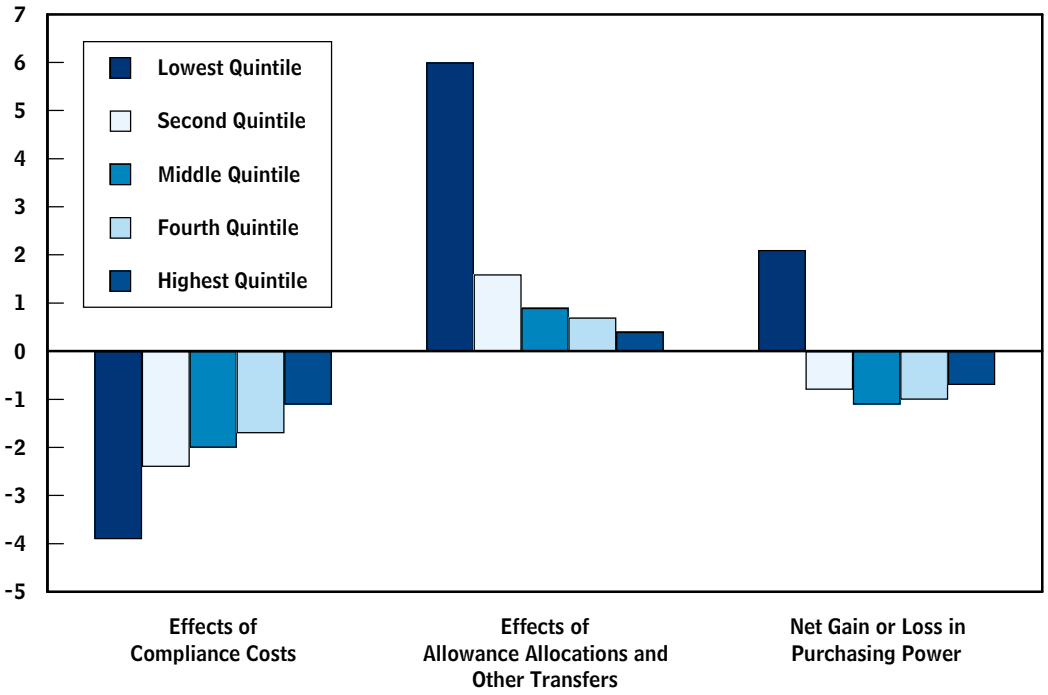
a. Unallocated compliance costs reflect the governments' share of carbon consumption.

b. CBO did not allocate allowances for which the recipients were unspecified (for example, allowances given to the government to distribute for energy-efficiency improvements). Unallocated gains and losses from other transfers are the net government cost of funding transfers in excess of the allowances allocated for that purpose. On net, the unallocated allowances and unfunded transfers decrease purchasing power for the 2050 policy because the unallocated allowances are less than the unfunded transfers.

Figure 2.

Average Gain or Loss in Households' Purchasing Power from the Greenhouse-Gas Cap-and-Trade Program in H.R. 2454, by Level of Income: 2050 Policy Measured at 2010 Levels of Income

(Effects as a percentage of after-tax income)



Source: Congressional Budget Office.

brackets is only about 60 percent of the estimated aggregate loss in purchasing power (1.2 percent of after-tax income, or $925 per household when measured against 2010 income levels).

Comparison of the Effects of the 2020 and 2050 Policy Provisions

The 2020 and 2050 policy provisions and the losses in purchasing power associated with them have some similarities and some differences.

First, the loss in purchasing power stemming from both the 2020 and 2050 policy provisions would impose the largest burden (measured as a fraction of after-tax income) on households in the middle and next-to-highest income quintiles (see Figures 1 and 2).

Second, the amount of compensation received by households in the lowest income quintile would be substantially higher in 2050 than in 2020. Households in the bottom quintile would receive greater relief in 2050 because they would continue to

receive protection in their loss of purchasing power through the low-income rebate and tax credit provisions and would also receive refunds through the Climate Change Consumer Refund Account. If the low-income rebates and tax credits that households received were reduced to account for the Climate Change Refunds that they would also receive, the net gain by the average household in the lowest quintile would be about $135.

Third, the ultimate beneficiaries of the value of the allowances would be more certain in 2050 than in 2020 because most of the allowances in 2020 would be distributed to households via private entities or government programs designed to promote new technologies or energy efficiency. As a result, CBO had to make assumptions as to how the allowances given to private entities would ultimately accrue to households. In contrast, most of the allowance value in 2050 would flow to households directly via rebates from the federal government.