

How Regulatory Standards Can Affect a Cap-and-Trade Program for Greenhouse Gases

Some legislation considered by the current and previous Congresses has proposed combining cap-and-trade programs with various regulatory standards to reduce greenhouse-gas emissions. Greenhouse gases increase the amount of energy temporarily held in the lower atmosphere, keeping the Earth's surface warmer than it would otherwise be. Such gases include carbon dioxide, methane, nitrous oxide, and several compounds that contain fluorine and chlorine.¹ Cap-and-trade programs would place explicit restrictions on annual emissions, and producers whose activities generate greenhouse gases would be required to hold permits, called allowances, to continue to produce those emissions. The allowances would have economic value, and they would be tradable among companies and by individual people.

Some regulatory standards already exist and others have been proposed that also would affect emissions of greenhouse gases. In some cases, regulatory standards would require producers of greenhouse gases to use specific technologies, such as renewable sources for generating electricity; in others, manufacturers would have to modify the performance of their products, such as commercial furnaces, to use energy more efficiently. Such regulatory standards have been used in the past to meet various environmental goals. The Environmental Protection Agency, for example, requires some manufacturing plants to use hoods, scrubbers, or other means to capture and filter air pollutants. Similarly, the nation's corporate average fuel economy (CAFE) standards specify miles-per-gallon targets for cars and trucks, although the standards do not specify how automakers should achieve those goals. Some regulatory standards have been coupled with financial incentives to encourage the use of specific technologies or to promote particular industries. For example, current

law requires certain fuel refiners, importers, and blenders to gradually increase the amount of ethanol blended into gasoline, and the government provides tax credits for each gallon of blended fuel sold.

Over the past two decades, policymakers have established cap-and-trade (see Box 1) and other market-based programs because such programs often provide a more efficient way to reduce pollution than is possible through the imposition of regulatory standards alone. Market-based approaches rely on the interaction between producers and consumers to determine how to meet specific targets for emissions. Because policymakers do not always have enough information to tailor national regulatory standards to local circumstances, for example, or to adjust standards rapidly as market conditions change, regulatory standards do not always ensure that the least expensive solution is brought to bear on an environmental problem. Market-based approaches, in contrast, allow flexibility in the approach to meeting an environmental goal and often can achieve the same result at a lower cost.

As a result, regulatory standards combined with market-based approaches often will increase the cost of meeting an environmental goal. In particular, if standards forced large reductions in emissions in a specific industry or for a particular product that would not result from a cap-and-trade program alone, the standards would reduce the demand for allowances and depress market prices for them. Some lower-cost strategies would then not be pursued because producers would have no incentive to adopt them. The target for emission reductions might be met, but the technology or performance standard might have substituted higher-cost for lower-cost reductions that would have occurred as a result of the cap-and-trade program without the additional standards.

1. See Congressional Budget Office, *Potential Impacts of Climate Change in the United States* (May 2009).

Box 1.**Cap-and-Trade Programs in Practice**

In principle, cap-and-trade programs can minimize the cost of achieving environmental goals by providing regulated entities with flexibility in choosing how, where, and potentially when to attain mandated results. That premise has been borne out generally, and cap-and-trade programs often meet environmental goals at lower than expected cost.

The Acid Rain Program, established under the 1990 amendments to the Clean Air Act, uses a cap-and-trade program to limit emissions of sulfur dioxide from large electric power plants. That program is widely regarded as a success because it helped reduce emissions from coal-fired utilities at much less cost than had been expected.¹ In addition, in compliance with the Montreal Protocol, the United States used a cap-and-trade program to phase out production of chlorofluorocarbons and other ozone-depleting substances. That program is considered to have been relatively cost-effective, and phaseout targets were met ahead of schedule. The United States also has used a cap-and-trade program to limit emissions of lead in gasoline and to curtail emissions of nitrous oxide and volatile organic compounds.²

Cap-and-trade programs have been used by the European Union, Canada, New Zealand, and Singapore

1. See, for example, the discussion in Dallas Burtraw and Karen Palmer, *The Paparazzi Take a Look at a Living Legend: The SO₂ Cap-and-Trade Program for Power Plants in the United States*, Discussion Paper 03-15 (Washington, D.C.: Resources for the Future, April 2003), www.rff.org/documents/RFF-DP-03-15.pdf.

to limit the release of ozone-depleting compounds; the European Union achieved its phaseout ahead of schedule. Since the 1990s, Chile has had cap-and-trade programs to cut emissions of total suspended particulate matter and has used auctions for the right to operate buses and taxis as a way to alleviate traffic congestion and cut related emissions.³

Cap-and-trade programs also are used to reduce emissions of greenhouse gases in the United States and abroad. In 2005, for example, the European Union began a program to cut carbon dioxide emissions in the energy sector and in some manufacturing industries. In 2008, a coalition of 10 northeastern and mid-Atlantic states implemented a cap-and-trade program to limit carbon dioxide emissions by electric utilities. Because those programs are relatively new, it is difficult to measure their success at cost-effectively reducing emissions of greenhouse gases.

2. Those trading programs are described in Environmental Protection Agency, *The United States Experience with Economic Incentives for Protecting the Environment*, EPA-240-R-01-001 (January 2001); and in Barry D. Solomon, "New Directions in Emissions Trading: The Potential Contribution of New Institutional Economics," *Ecological Economics*, vol. 30, no. 3 (September 2009), pp. 371–387.

3. For more information on the various cap-and-trade programs, see Robert N. Stavins, *Experience with Market-Based Environmental Policy Instruments*, Resources Discussion Paper 01-58 (Washington, D.C.: Resources for the Future, November 2001), www.rff.org/rff/documents/rff-dp-01-58.pdf.

Market-based approaches are effective only to the extent that markets deliver accurate and timely price information and only so long as producers and consumers respond to that information. When the price mechanism falls short and appropriate price signals are not sent or received, the imposition of regulatory standards can be a more cost-effective way than a cap-and-trade program or a tax to change behavior. For example, builders and owners of rental properties might see little need to

insulate buildings or install energy-efficient appliances if utility bills are paid by tenants and if the differences in tenants' costs are not reflected in the rent that could be charged.² (Standards also might be desirable if they

2. See, for example, Scott Murtishaw and Jayant Sathaye, *Quantifying the Effect of the Principal-Agent Problem on US Residential Energy Use*, LBNL-59773 (Berkeley, Calif.: Lawrence Berkeley National Laboratory, 2006), <http://repositories.cdlib.org/lbnl/LBNL-59773>.

addressed other national priorities more effectively than market mechanisms could, even if their economic costs were higher; although such considerations are important, they lie outside the scope of this publication.)

This Congressional Budget Office (CBO) brief describes how regulatory standards can interact with a cap-and-trade program that governs emissions of greenhouse gases. It provides examples related to H.R. 2454, the American Clean Energy and Security Act of 2009, which passed the House of Representatives on June 26, 2009.

How Do Cap-and-Trade Provisions Interact with Standards for Technology and Performance?

In general, cap-and-trade programs and technology or performance standards share the same broad objective: reducing the emission of greenhouse gases or other pollutants. A cap-and-trade program places an explicit price on emissions by requiring businesses to acquire and hold emission allowances. The price of those allowances reflects the degree to which the cap requires regulated entities to reduce emissions and the cost of those reductions. If the reductions are relatively large, the resulting price is higher than a less stringent cap would produce. Restricting the supply of allowances reduces the amount of emissions and increases the price of carbon-based energy and the goods and services manufactured or delivered using that energy. In response to the resulting changes in prices for different goods and services, some technologies are likely to flourish while others could become obsolete.

As with a cap-and-trade program, standards can be expected to reduce emissions of greenhouse gases and will result in higher costs for producing some goods or diminish some desirable features of those goods, for instance, by requiring an automaker to produce a vehicle that weighs less or to cut horsepower to improve a car's energy efficiency. But standards work differently from cap-and-trade programs to reduce emissions. They often require reductions in emissions to come from specific sectors or activities, or they require the use of specific production technologies. Because cap-and-trade programs allow producers and consumers to determine how, where, and potentially when to reduce emissions, those reductions are more likely to be achieved at the lowest cost. Technology and performance standards do not allow such

flexibility, and any resulting reductions in emissions generally are more expensive. Moreover, cap-and-trade programs can respond to such changing conditions as the emergence of a new technology or a shift in demand for energy because of a change in weather patterns that could in turn be reflected in a change in allowance prices. Standards set in law generally cannot vary the same way.

If implemented in conjunction with a cap-and-trade program, technology and performance standards can affect the price of allowances and the overall economic cost of meeting specific emission targets. The effects depend critically on the stringency of the cap-and-trade program relative to that of the standards.

When Standards Are *Less* Likely to Affect Allowance Prices and Economic Costs

If a cap on greenhouse-gas emissions is relatively tight and thus relatively few allowances are available, regulated entities face relatively high prices for allowances. Prices for carbon-based energy and the goods and services that require the use of that energy increase correspondingly, providing businesses and consumers with more incentive to curtail emissions. In that case, it is less likely that separate standards will affect the price of allowances because the reductions in emissions that the standards are intended to achieve are more likely to occur as a result of the allowance prices. That is, the standards are less likely to change the way the total specified reduction in emissions is achieved. Under those circumstances, the standards might necessitate some administrative costs (for recordkeeping, reporting, and verification, for example), but they do not significantly increase the economywide cost of limiting emissions.

For example, in conjunction with a relatively stringent cap-and-trade program, a technology standard that required a small percentage of energy to come from renewable sources would have little effect because allowance prices would be high enough in any event to encourage the production of energy from sources that emit little carbon dioxide. In that case, the standards would not have much influence on allowance prices or economic costs beyond the federal and private spending necessary to put the standards program into effect and administer it.

When Standards Are *More* Likely to Affect Allowance Prices and Economic Costs

If a cap on emissions is less stringent, more allowances will be available, and prices for carbon-based energy and

the goods and services that require its use will not rise by as much as they would under a stricter program. That cap by itself will give businesses and consumers less incentive to reduce emissions of greenhouse gases. If regulatory standards are applied, however, a different mix of technologies and products could occur than a cap-and-trade program would produce, especially if standards are relatively more stringent and more narrowly defined. Because the total reduction in emissions would be determined by the cap, the emissions would be the same as they would be without the standards. More of the reduction would be attributable to the standards, less would be achieved through the cap-and-trade program, and allowance prices would be lower.

In the extreme, technology and performance standards could induce reductions that were sufficient to meet the cap. In that case, the allowance price would be minimal because there would be enough allowances to meet all the remaining demand for emitting greenhouse gases.

More generally, the imposition of standards would limit the flexibility that businesses and consumers have to determine the least expensive way to reduce emissions and would instead require specific actions, regardless of cost. Returning to the example of renewable-energy generation, if the cap-and-trade program was not very stringent, the relatively low price of allowances might not be sufficient to induce many energy suppliers to switch their production of energy to renewable sources. In that case, imposing a technology standard that mandated a larger percentage of energy generation from renewable sources would force more emission reductions through increased renewable-energy generation than a cap-and-trade program alone would provide. That would increase the cost of producing electricity and bring down the price of allowances because the reduction in demand for electricity that would come with more expensive energy generation would reduce electric utilities' demand for allowances. Although the overall emission reductions would be the same with or without the standard, the cost to the economy with the standard would be greater than if market forces were left to determine the least costly method of reducing emissions.

When Coupling Caps and Standards Could Result in Lower Economic Costs

Although cap-and-trade programs by themselves are more cost-effective in general, combining regulatory standards with cap-and-trade programs can yield lower costs under

some circumstances. Standards could contribute to a lower economywide cost of achieving a cap on emissions if the higher energy prices caused by the cap did not create sufficient incentives for businesses or consumers to reduce emissions cost-effectively.

Market-based approaches rely heavily on rational and knowledgeable consumers—who would choose, for example, to buy energy-efficient appliances if doing so saved money in the long run—so the conclusion that pricing emissions is the least expensive way to reduce emissions might not hold when consumers do not act in their apparent self-interest. Some analysts assert, for example, that many consumers should be spending more on appliances today because doing so will reduce their energy bills in the future, given current energy prices.³ Analysts do not have a full understanding of consumers' responses to higher prices for energy, but some suggest that consumers might not always act in their own interest because they fear losses more than they anticipate gains, because they lack or cannot process the information necessary to make the best choice over longer periods, or because they use decisionmaking criteria that undervalue efficiency as a product attribute. If so, consumers might not respond as much to higher energy prices induced by a cap-and-trade program as would be optimal in terms of reducing carbon emissions at the lowest overall cost. In that case, some sorts of performance standards might help a cap-and-trade system to lower the cost of reducing emissions.

Caps and Standards in the American Clean Energy and Security Act

H.R. 2454 would establish two cap-and-trade programs for 2012 to 2050: One would reduce emissions of carbon dioxide and several other greenhouse gases (carbon dioxide alone accounts for 85 percent of all U.S. greenhouse-gas emissions); the other, smaller, program would govern the production and use of hydrofluorocarbons, a class of particularly damaging greenhouse gases.

Under the first program, the government would limit emissions of greenhouse gases in the sectors of the economy that are subject to the cap by requiring regulated

3. See, for example, Kenneth Gillingham, Richard G. Newell, and Karen Palmer, "Energy Efficiency Economics and Policy," *Annual Review of Resource Economics*, Vol. 1 (October 2009), pp. 597–620.

entities to hold emission allowances and by issuing only a limited number of those allowances. The regulated entities would be permitted to trade allowances or to bank them for future use. In addition, by offsetting their excess emissions with reductions in emissions of greenhouse gases internationally or in sectors of the U.S. economy that would be exempted from the cap, the regulated entities could emit more than the amount covered by the allowances they held.

H.R. 2454 also would amend current, and establish new, federal standards for energy efficiency in industrial processes and consumer products. Those standards would mandate the use of specific technologies in production and require manufacturers to certify that their products met scheduled targets for improved energy efficiency.

Standards That Would Probably Have Little Effect on Allowance Prices or Economic Costs

In its estimate of the federal budgetary impact of H.R. 2454, CBO concluded that some of the act's new or amended standards probably would not affect the price of allowances for emissions of greenhouse gases but could impose small additional costs on society.⁴ Those standards involve technology or energy-efficiency goals that CBO expects would be met by private responses to the higher energy prices stemming from the cap-and-trade program even in the absence of the standards. In those cases, the standards would not further constrain the behavior of businesses or consumers. The standards would not generate reductions in emissions in excess of those specified by the cap, and they would not affect the direct economic cost of controlling emissions.

As an example, H.R. 2454 would require electric utilities to supply a specific percentage of their markets with power generated from qualifying renewable sources, to purchase renewable-energy credits, or to make payments to the states in which they operate. In its cost estimate, CBO projected that the pricing of allowances in the cap-and-trade program would provide a sufficiently strong incentive to generate enough electricity from renewable sources to satisfy the federal standard. That is, electricity suppliers, in the aggregate, would turn to those fuels and sources as a consequence of the market incentives provided by the cap on emissions, even without the renewable-source standard. Correspondingly, the

provision requiring the use of renewable fuels or energy sources probably would not affect the behavior of electric utilities or the price of allowances. However, small administrative costs would be incurred in the public and private sectors to implement the standards and verify compliance.

There were insufficient data for CBO to determine for the remaining standards proposed in H.R. 2454 whether the pricing of allowances would by itself lead to the use of the specified technologies or targets for energy efficiency or whether meeting the standards would require additional changes in technology and production. For example, it is not clear that businesses would demand energy-efficient furnaces because of higher energy prices resulting from a cap-and-trade program or whether such furnaces would be produced only because of the performance standards specified in H.R. 2454. Similarly, it is unclear whether rising energy prices would lead consumers to demand outdoor lighting fixtures that met the progressively tighter performance standards for energy efficiency specified in H.R. 2454.

In those and other cases, CBO incorporated no effects of the standards in its estimation of the price of allowances. If, in fact, the standards forced technological changes that would not otherwise occur because of the overall cap on emissions, then the standards would lead to a lower price of allowances than CBO estimated but result in a generally higher cost to the economy.⁵

Standards That Would Affect Allowance Prices and Economic Costs

Although new regulatory standards might not affect allowance prices, some existing standards could reduce the prices of allowances and increase the overall economic costs of the proposed program to reduce emissions of greenhouse gases. Whether new or existing, regulatory standards that force reductions in emissions in particular industries beyond those that would occur as a result of the cap-and-trade program would lower the price of allowances but increase the economic costs of meeting the cap.

4. See Congressional Budget Office, cost estimate for H.R. 2454, the American Clean Energy and Security Act of 2009 (June 5, 2009).

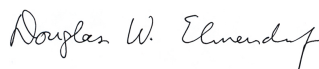
5. Looking beyond standards, H.R. 2454 also includes other provisions, such as tax incentives for the development and adoption of technologies to capture and store carbon in the generation of electricity. CBO estimated that those incentives probably would reduce the price of allowances and increase the economic cost of reducing emissions.

For example, over time CAFE standards will produce reductions in greenhouse gases emitted to the atmosphere. Consequently, fewer reductions from all other sectors would be necessary to meet any given cap, and the price of allowances under H.R. 2454 would be lower than the price of those allowances in the absence of CAFE standards. Barring substantial increases in gasoline prices, however, meeting tighter CAFE standards to curtail emissions would be more costly to society than other strategies (such as generating electricity from natural gas instead of coal) that could be encompassed by a cap-and-trade program.⁶ Moreover, the total reduction in emissions would be the same because it would be

determined by the cap. Therefore, identical emission reductions would cost the economy more when produced by the combination of CAFE standards and a cap-and-trade program than by a cap-and-trade program alone. Whether CAFE standards are justified by other national priorities is a subject that lies beyond the scope of this brief.

6. See Congressional Budget Office, *Climate-Change Policy and CO₂ Emissions from Passenger Vehicles*, Issue Brief (October 6, 2008), and *The Economic Costs of Fuel Economy Standards Versus a Gasoline Tax* (December 2003).

This brief was prepared by Rob Johansson. It, along with CBO's other work on climate change, appears on the agency's Web site (www.cbo.gov).



Douglas W. Elmendorf
Director