U.S. POLICY

CONTAINING THE COSTS OF CLIMATE POLICY

CENTER FOR CLIMATE AND ENERGY SOLUTIONS

Center for Climate and Energy Solutions

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This policy brief outlines various options for containing costs under a cap-and-trade program to reduce greenhouse gas (GHG) emissions. Although cap and trade is generally considered a more cost-effective approach than traditional regulation, excessive allowance prices are a concern. High allowance prices could mean high compliance costs for regulated firms and high energy prices for consumers. A number of the design elements of a cap-and-trade policy including the stringency of the emission reduction targets and the distribution of allowance value will influence the cost of the policy for consumers. However, uncertainty regarding allowance prices, and in particular, short-term price volatility and persistently high prices, are of concern to stakeholders. Policy options to address these concerns include allowing facilities to bank allowances, permitting firms or the government to borrow allowances from future allocations, allowing (or expanding) the use of offsets, allowing the use of multi-year compliance periods, setting a ceiling on allowance prices, or even relaxing the cap or emission targets associated with the policy in times of high prices. Each of these options has strengths and weaknesses and their desired results must often be weighed against the reduced certainty of meeting the environmental objective. To ensure the viability of any cap-and-trade program, policymakers will likely want to include a variety of cost-containment mechanisms.

Eleven states have established carbon trading programs to reduce greenhouse gas (GHG) emissions, and other states are considering policy options. A market-based mechanism, such as cap and trade, is often at the core of these programs because it is widely believed to be the most cost-effective method to achieve the necessary reductions. Under a cap-and-trade system, a declining limit—the cap—is placed on overall GHG emissions from covered sources. The government creates allowances, typically defined as a permit to emit one ton of GHGs, equal to the level of the cap and distributes them via an auction or free of charge to covered sources. Covered firms must hold an allowance for any GHG emitted during the compliance period.

Those firms that can easily and cheaply reduce their emissions will need to purchase fewer allowances and can sell any excess allowances to those that find it relatively more expensive to make emission reductions. This provides firms with the flexibility of deciding when, where, and how emissions will be reduced. Importantly, the emergence of a market in allowances will establish a "price" for each ton of GHG emitted, providing an incentive for the development of new low- and zero-emitting technologies throughout the economy.

CONCERNS ABOUT COSTS

Policymakers and those potentially affected by climate policy have raised concerns about a cap-and-trade policy resulting in significant costs to the economy. Any program that puts a price on the emission of GHGs—an activity that was previously free of charge—will by definition make the cost of doing business in many sectors of the economy more expensive. Those sectors that produce or use carbon-intensive fuels—such as oil and natural gas—and their residential, commercial, and industrial customers will be affected.

The costs of climate policy can be estimated in a number of ways, including the compliance costs borne by those with a regulatory obligation, the price of emissions allowances themselves, and the resulting changes in energy prices and effect on gross GDP. The costs of compliance for sectors and individual firms will be influenced by their opportunities to reduce emissions and the cost of purchasing allowances. Allowance prices represent the cost of reducing an additional ton of GHG. For example, if the allowance price is $25 per ton, in theory, all emission reductions that can be made collectively for less than that amount will have already been pursued. Short-term costs will reflect the ability of firms to switch from high- to low-carbon fuels and to pursue energy-efficiency improvements. Longer-term costs will be dictated in large part by the availability of low- or zero-emitting technologies to replace high-carbon-emitting technologies.

Using cap and trade as a policy to address GHG emissions is in and of itself a cost-containment mechanism and should help lower the overall cost to society of reducing GHG emissions. Choices in the design of the program, including the stringency of the targets, the initial allocation of emission allowances, and the use of any revenues generated by the program, will also affect the costs of the policy. For example, the more stringent the reductions associated with the cap-and-trade program, the higher the overall costs of the program. The scope of offsets and availability of technologies are also important drivers. In addition, the initial distribution of allowances will likely affect the distribution of net costs across entities and the overall cost of the program. For example, providing some number of free allowances to regulated entities would decrease compliance costs to those entities, but could somewhat increase the overall macroeconomic costs of the program, compared to the case where the auction revenue was used to reduce taxes on income and savings.[1] However, if auction revenues are used for additional government expenditures, then free allocation would likely result in lower overall macroeconomic costs than auctioning.

While it is not possible to accurately predict potential costs of climate policy, a number of groups have developed models to estimate them. Model structure and assumptions vary. However, the results can be used to draw broad insights regarding the costs of various policy options and the impact of factors such as technology and availability of offsets. While these economic studies focus on mitigation costs only, such costs should be weighed against the costs of inaction, which many studies suggest are significant.[2]

The focus of this brief is to discuss the range of options proposed in an effort to reduce two types of cost uncertainty related specifically to allowance prices—short-term allowance price volatility and sustained high allowance prices.

SHORT-TERM ALLOWANCE PRICE VOLATILITY

Unexpected fluctuations in prices are not uncommon in cap-and-trade programs. For example, sulfur-dioxide (SO_2) permits in the U.S. Acid Rain Program, nitrogen-oxide (NO_X) trading credits in Southern California's Regional Clean Air Incentives Market (RECLAIM), and European Union allowances in the initial phase of the European Union Emission Trading Scheme (EU ETS) all experienced substantial price volatility.[3] Volatile swings in allowance prices and the uncertainty they create can mean increased financial risk to firms, consumers, and investors in markets for energy and energy-intensive goods and services.

Allowance price volatility arises from a relatively fixed supply of emission allowances created by the overall cap, combined with fluctuations in the expected demand for emission allowances. Given available options for reducing emissions, each firm's demand for allowances will be a function of its current emissions level, how many allowances it receives in any initial allocation, and the price at which it can purchase additional allowances on the market. External factors that cause fluctuations in allowance demand, and thus the price of allowances, will be driven by the weather, conditions in energy markets, the level of economic activity, and the availability of new technologies. Extreme outdoor temperatures, for example, can increase energy and fossil fuel demand, boosting the demand for emission allowances and causing an upswing in the allowance price. Similarly, relative fuel price differentials between coal and natural gas can impact fuel-switching opportunities and affect allowance demand. The interconnected nature of weather, fuels, electricity usage and GHG emissions can give rise to an increase in allowance price volatility, especially in an immature market where participants have limited historical experience.

SUSTAINED HIGH ALLOWANCE PRICES

It is widely understood that a sufficient price signal is needed to provide a continuing incentive to achieve the transition to a low-carbon economy. Sustained high allowance prices will have ripple effects throughout the economic system. For example, sustained high allowance prices may lead to a large and rapid shift in demand for lower carbon natural gas or renewables (fuel switching) in the electricity sector. At the same time, high allowance prices and expectations of sustained high prices will drive investment in existing low-carbon options and stimulate innovation in new technologies that will lower costs in the future.

High allowance prices could also increase the risk that scheduled emissions reductions under a climate policy would be halted if future policymakers are forced to decide between perceived short-term economic stability and addressing climate change. For instance, in the Regional Clean Air Incentives Market (RECLAIM) emissions market established in California in 1993 to regulate NO_X and SO_2 emissions, sustained high allowance prices resulted in companies being exempted from program requirements when prices spiked to very high levels (e.g., $45,000/ton).[4] Moreover, if firms come to expect that sustained high prices will prompt the government to provide exemptions for certain firms or sectors, there may be less investment in alternative fuels and technologies.[5]

Most cost containment options modify the cap-and-trade program to provide additional flexibility to firms in meeting their compliance obligations or expand the availability of allowances and thus lower the allowance price either as part of the basic proposal or when certain criteria are met. Policy options for addressing cost containment and their strengths and weaknesses are the focus of the rest of this brief.

COST CONTAINMENT OPTIONS: WHERE AND WHEN FLEXIBILITY

BANKING ALLOWANCES

A number of cap-and-trade programs, including California and the Regional Greenhouse Gas Initiative (RGGI), allow covered sources to bank, or hold for future use, any allowances purchased or (if applicable) received free of charge. Covered sources could also be allowed to bank offsets. Banking is likely to be used by firms if they believe that the price of allowances or offsets will be higher in the future, or that the quantity of available allowances will be lower.

Banking helps reduce short-term price volatility by adding intertemporal (timing) flexibility. Firms will want to bank allowances when the cost of reducing additional emissions, and thus the price of allowances, is believed to be low compared to future periods. If prices rise in the future, firms can use their banked allowances rather than purchasing additional allowances in the market. This boost in supply would help alleviate demand pressure in periods when fluctuations in weather, fuel prices, or economic conditions cause allowance prices to rise.

An additional strength of this approach is that it motivates early action by encouraging sources to make larger emission reductions in the near term than needed to satisfy compliance requirements, thereby advancing environmental objectives. In periods with relatively low allowance demand (e.g., a mild winter, an economic downturn, low technology costs), banking will prevent prices from falling too far, helping to alleviate volatility on the low end of the price range and preserve incentives for innovation. Over the longer term, this intertemporal flexibility results in lower economy-wide impacts because firms can optimize their reduction schedules over time.

FIRM-LEVEL BORROWING

Intertemporal flexibility is also increased by allowing firms or the program administrator to borrow allowances from the future. A number of policy proposals have contained a provision to allow covered sources to borrow allowances from future allocations to be used to cover a percentage of the current year obligations. As long as the policy includes a provision requiring the sources to pay back the borrowed allowances, the long- term environmental budget or cumulative cap can still be met. Some proposals also include a cost of borrowing (e.g., interest), either in dollars or tons.

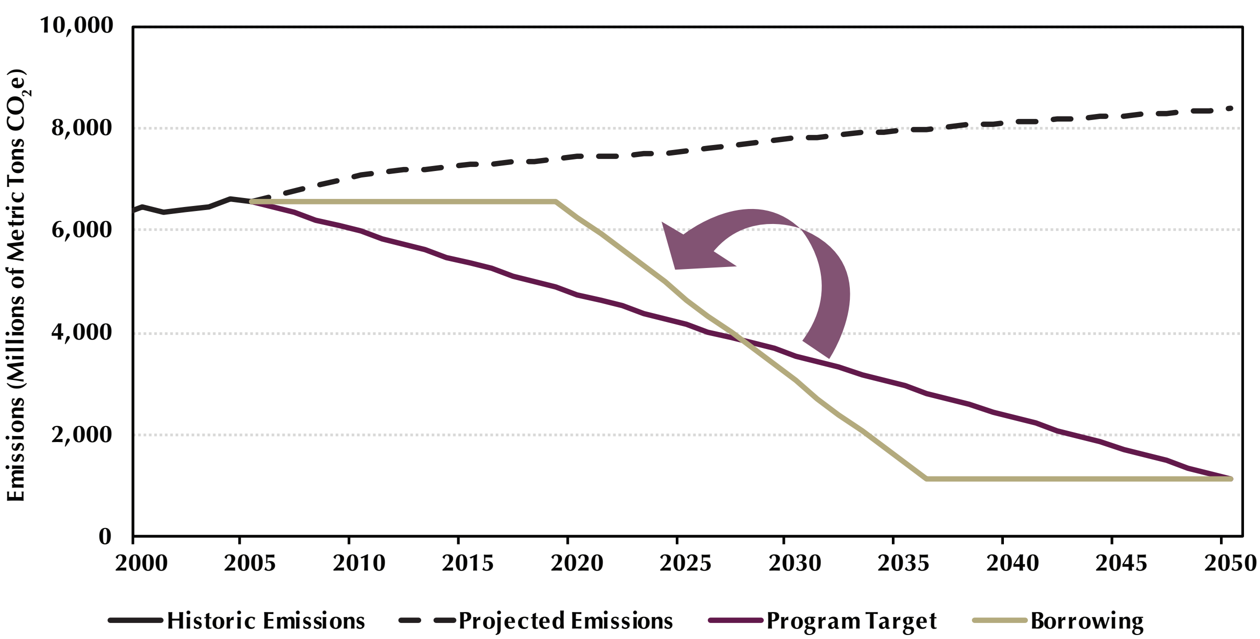
The inclusion of firm borrowing is often justified to help avoid short-term allowance price volatility (and specifically large price spikes). It allows firms greater flexibility to minimize their compliance costs and optimize their emission reductions over time. For example, if a firm intends to invest in low-carbon technology ten years in the future, borrowing allowances from that future allocation and using them for their current compliance obligation can help the firm lower its overall compliance costs. Because climate change is a long-term problem, to some extent the timing of the reductions is not a significant issue if the longer term cumulative cap remains intact.

One concern associated with allowing borrowing in a cap-and-trade program is that borrowing allowances, particularly in a situation in which the overall cap on emissions is declining, may significantly increase future allowance costs. This is of particular concern if new low-carbon technology does not come online as anticipated. A related concern is the possibility that covered sources may, through lobbying or bankruptcy, arrange for their allowance loans to be forgiven. Debt forgiveness in this context will compromise the long-term cumulative cap. Another concern with borrowing from the future (and thus delaying some emissions reduction effort) is that near-term efforts may be more beneficial to the climate than later efforts (e.g., to avoid passing certain thresholds).

ECONOMY-WIDE BORROWING

Instead of individual firms borrowing from their future allocation, the program administrator could also borrow allowances from the future. This type of borrowing is sometimes referred to as economy-wide or system-wide borrowing and involves transferring a number of allowances from future compliance periods to the current period and then releasing them into the market (through allocation or auction). In effect, this bends the targeted

FIGURE 1: System-wide Borrowing



Allowances from the future bends the targeted level of emission reductions over time (i.e., changes the shape of the reduction trajectory) by increasing the number of allowances available in the near term but reducing the number of allowances in the future.

level of reductions over time by increasing the number of available allowances in the near term but reducing the number available in the future (see **Figure 1**).

System-wide borrowing may be useful to deal with macroeconomic costs that may develop should the costs of low-carbon technology turn out to be higher than expected. If low-carbon technology is slower to materialize or turns out to be more expensive than anticipated, allowance prices could be higher than predicted and could remain so.

As with firm-level borrowing, system-wide borrowing is likely to make meeting future targets more difficult. But in this case, the future targets are economy-wide, therefore meeting them will be more difficult for all market participants, rather than for a single firm. While this approach will have macro benefits in the near term, it may be seen as inequitable by those market participants that have aggressively reduced their own emissions but face stiffer future targets and higher allowance prices because of delays in achieving reductions in other sectors or firms.

DOMESTIC AND INTERNATIONAL OFFSETS

An offset represents the reduction, removal or avoidance of GHG emissions from a source not covered by the cap-and-trade program that is used to compensate for GHG emissions occurring within the program.[6] Because the impacts of climate change are independent of where emissions occur, many cap-and-trade programs allow firms facing compliance obligations to use offsets.

Offsets can provide significant cost containment if emission reductions outside of the cap are less costly than those inside the cap. For example, if it is less costly to reduce emissions from a farm than emissions from an electricity generator, allowing the farm to generate emission offsets through its reductions and sell these to the generator will allow the emission reduction goal to be met while reducing the demand for GHG allowances. This will, in turn, reduce allowance prices.

The economic benefits of including offsets in cap-and-trade programs have been demonstrated through a number of modeling exercises. Models that significantly limit the number of offsets or their types have shown higher allowance prices and GDP impacts.

A considerable challenge associated with the inclusion of offsets in a cap-and-trade program relates to the determination of what qualifies as an offset, and the related monitoring, verification, and compliance issues. While most experts agree that offsets must be real, measurable, and result in permanent emission reductions that occur in addition to what is required by law or exceeding common industry practice, ensuring that this will happen in practice requires careful policy design.[7] Even with careful design, however, offsets can still be contentious, as illustrated by the Citizens Climate Lobby and Our Children's Earth Foundation lawsuit in 2012 where the group alleged that offsets allowed for use by the California program did not result in real or additional greenhouse gas reductions. The next year, however, the San Francisco Superior Court ruled, and the California Court of Appeals upheld, that the state's program had used its experience, expertise and judgment in its assessment of offset methodologies.[8]

The use of international offsets adds another complication and can also be contentious. Some opponents are concerned by the fact that the offsets are originating in unregulated sectors outside of the country and further that ensuring the projects do what they claim is difficult to monitor. Use of accredited third-party validators and verifiers is one option that can be used to address this concern. Even addressing this concern, however, others are opposed to international offsets because their use might encourage capital flow outside of the country. It is important to remember that offsets can help ensure that program costs are kept as low as possible, and that the climate does not care where the emission results occur.

STRATEGIC ALLOWANCE RESERVE

A strategic allowance reserve—which could be constructed with a "safety valve" price level—could be constructed to provide additional allowances into the program, should price reach a specific level. A "reserve of allowances" could be built in a number of ways. It could be filled with allowances not sold at auction, with allowances borrowed from future periods, with offsets that are converted into allowances or even with current allowances that essentially expand the cap. Any or all of the above could be used to provide a reserve of allowances that would be released into the market at a specific price.

Depending on how this reserve is constructed, it could be seen as a mechanism to contain costs and to limit system-wide borrowing to some specific level. Alternatively, it could be used as an absolute price ceiling if the reserve is large enough, especially if it is filled with allowances that are in excess of the current cap.

In addition to determining how to fill the reserve, the government will also have to develop a method for distributing the reserve allowances. One option would be to hold a reserve auction in which the additional allowances are auctioned. An example of this is the "allowance price containment reserve" under the California cap-and-trade program. A percentage of allowances is held in a strategic reserve by the California Air Resource Board (CARB) in three equally-sized, fixed-price tiers: $40, $45, and $50 in 2013, and rising 5 percent annually over inflation. In 2017, the price levels are: $50.69 for Tier 1, $57.04 for Tier 2, and $63.37 for Tier 3. CARB offers a pool of allowance for sale after each quarterly auction. Notably, throughout the California cap-and-trade program, the allowance price has remained below the reserve price so no reserve sales have been held.[9]

One serious concern about an allowance reserve is that it may not contain enough allowances to actually avoid a long-term price increase. If so, competition to buy the reserve allowances would drive their price up to the market level, enriching the government but failing to reduce prices. While it would be impossible to ensure that a reserve pool would be large enough to prevent this problem without borrowing an unrealistic number of allowances from the future, it is possible that offsets could be placed in the reserve pool along with, or instead of, allowances. For example, a very large number of offsets could be available from avoided tropical deforestation or other international emission reduction efforts, and these could be used to fill a reserve pool large enough to avoid most imaginable price increases.

MULTI-YEAR COMPLIANCE DEADLINES

A multi-year compliance period would mean that firms would not have to turn in their compliance permits (allowances and offsets) yearly but instead after some number of years. Multiyear compliance allows firms to borrow fully from their future allocation but without repayment interest.

An advantage of allowing multiple years for compliance rather than a single year is that firms can optimize their reduction schedule and minimize their compliance costs over time. A disadvantage of this approach, however, is that firms can put off taking action. Furthermore, it may reduce market liquidity if the compliance window is too long and may cause a scenario where large numbers of buyers are in the market for allowances at the same time, perhaps right as the compliance deadline looms. The result could be a rather large temporary spike in the price of allowances.

Staggering the deadlines for compliance such that some firms turn in their allowances one month and others turn in their allowances in a different month can help avoid the previous issue of having all buyers looking for allowances at the same time.

An alternative structure for multiyear compliance and/or firm level borrowing is to have overlapping compliance periods like those currently used in the EU ETS trading program. In this program, allocation occurs in January but the compliance deadline is in March. Also, firms can use their allocation for the upcoming year for the previous year's compliance.

EXTENDED COMPLIANCE PERIOD

The government could also start with a shorter compliance period but extend this deadline if allowance prices reach a certain specified level. For example, the compliance period might be changed from 1 year to 5 years, although reporting could still be required every year. This option helps to relieve the short-term demand pressure for allowances. This longer compliance window allows firms the flexibility of having more time to manage their compliance obligation without having to borrow and may provide additional time for low carbon capital stock turnover.

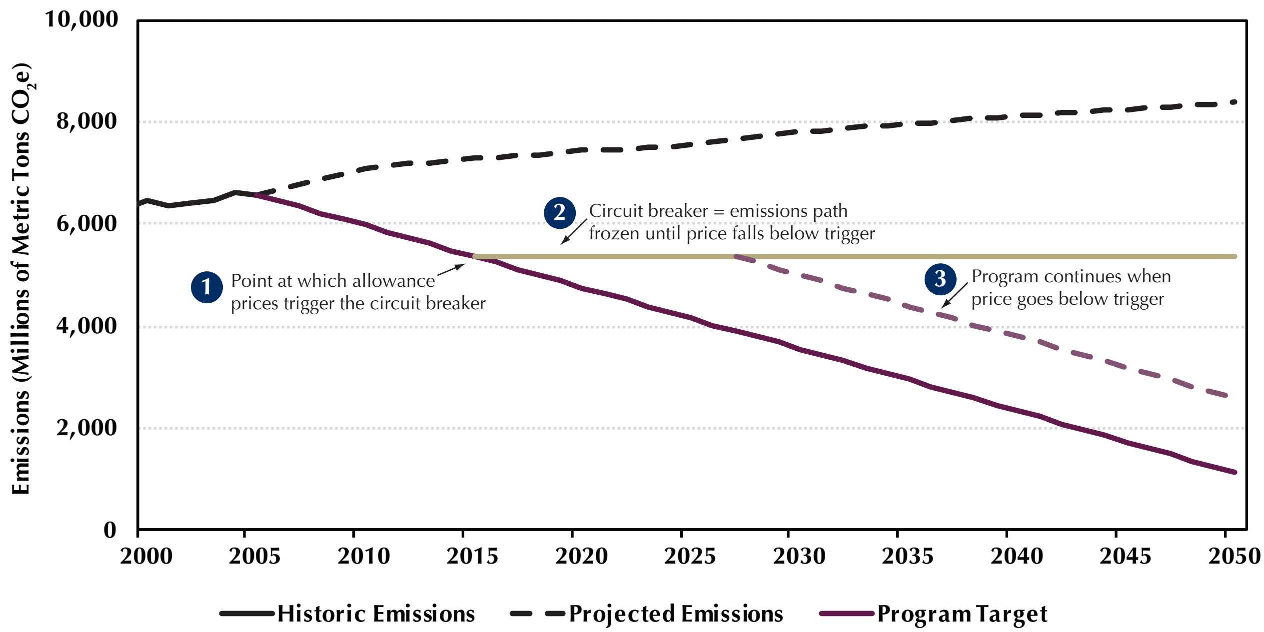
As with other options set to trigger when allowance prices reach a certain level, this option complicates the regulatory certainty for firms. And if a firm procrastinates in terms of meeting its reduction obligations, this extension may only serve to make compliance that much more difficult in future years.

RELAXED TARGETS (CIRCUIT BREAKER)

Sustained high allowance prices can also be addressed by simply adjusting a program's target level or timeline of reductions should allowance prices reach some specific level. This option has been called the "circuit breaker option" and is similar in many respects to the price ceiling approach discussed in the next section.

With the circuit breaker approach, the scheduled decline in the cap's targets and timelines is delayed or cancelled if the price of allowances rises too high. The cap is essentially frozen as long as the allowance prices remain above a known price.

FIGURE 2: Illustration of the Circuit Breaker Option



Under a circuit break approach, the scheduled decline of the program's emission cap and timelines is (1) delayed or cancelled if the allowance price rises above a "trigger' price. (2) The cap is essentially frozen as long as the allowance price remains above the trigger price. (3) The program's emission cap and timelines resume once the allownace price falls below the trigger price.

See **Figure 2** for a hypothetical example of a circuit breaker and the effect it could have on emission targets.

Although it is likely that the price acceleration will be slowed or even reversed, prices may still rise beyond the price that triggered the circuit breaker. As a result, there is no price certainty, nor is there environmental certainty. To date, no program has used this approach for cost containment.

COST CONTAINMENT OPTIONS: PROVIDING INCREASED PRICE CERTAINTY

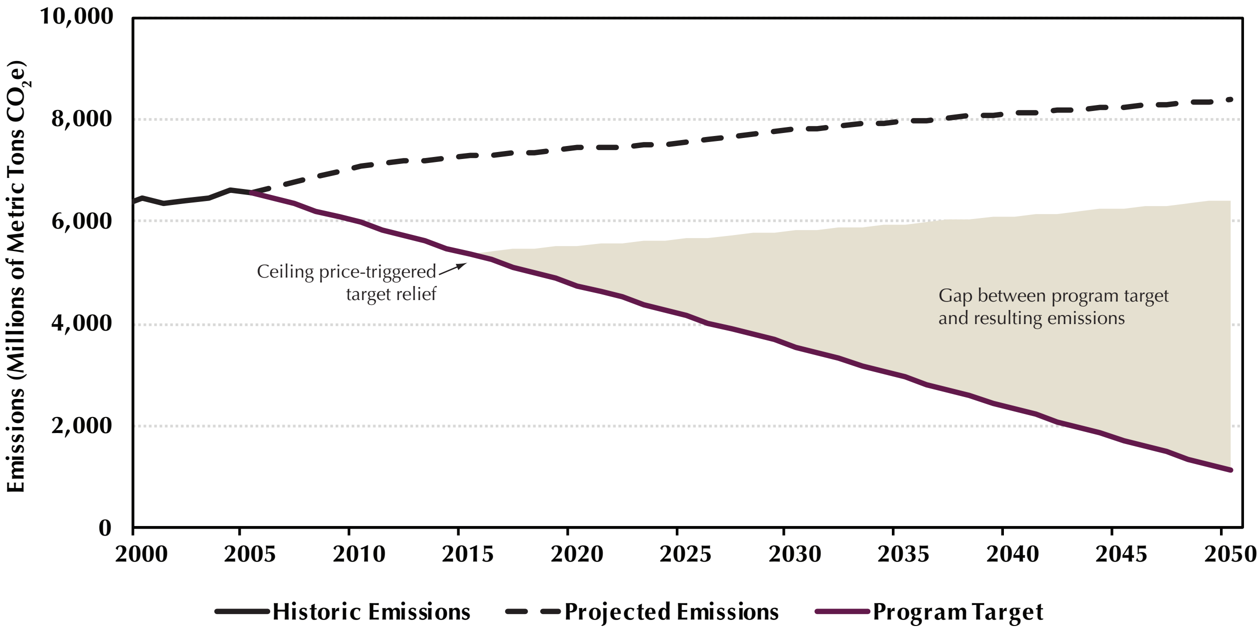
Cap and trade sets a limit or fixed cap on the quantity of emissions each period, while allowing market forces to determine the price of emission allowances. This quantity-based approach is helpful in ensuring that environmental objectives are met. However, while it achieves greater emissions certainty, it creates uncertainty about the price of allowances and the ultimate cost of compliance. A number of programs have been designed to include more cost certainty into a cap-and-trade program.

PRICE CEILING

One way to provide price certainty is to have a ceiling on allowance prices. When the allowance price hits this specified level, the government could sell additional allowances at this price or firms could simply pay into a fund without having to acquire allowances. Either way, once the allowance price reaches the level of the price ceiling, the cap-and-trade program would behave like a tax on emissions.

While it provides more cost certainty because it ensures that the price of allowances never exceeds the

FIGURE 3: Potential Effect of a Price Ceiling on Emission Reductions



Under a pricing ceiling, allowances are released (or firms could pay into a fund) to maintain a "maximum" price, which could result in emissions increasing from the program target trajectory.

specified threshold, this option may result in emission levels that exceed the program's capped level. **Figure 3** shows an example of a price ceiling and its potential effect on meeting the program targets.

Depending on the level at which the price ceiling is set, firms may choose to simply pay into a fund or obtain the additional government-issued allowances rather than make additional reductions. This could have a significant effect on the emission targets. If the price ceiling is set too low, this option could also significantly reduce the incentives for low-carbon technology innovation. As with determining the appropriate tax level to motivate the necessary technological change, determining the appropriate level at which to set the price ceiling will be challenging.

COMPLIANCE PENALTY

Another method for providing more specific price or cost certainty within the cap-and-trade program is to establish a penalty price for noncompliance. As long as the penalty is only a price and does not require payback of emissions exceeding compliance, this penalty can be set so as to provide an upper bound on allowance prices. If allowance prices rise above the penalty, firms would have the incentive to pay the penalty rather than buy additional allowances or make further emission reductions.

In order to distinguish this option from a pure price ceiling, penalties often include a requirement to pay back those tons not in compliance. A number of existing emission market programs contain a compliance penalty with this provision, including the U.S. Acid Rain Program, with a penalty of $2,000 per ton of excess SO_2 or NO_X, set in 1990 and adjusted annually for inflation. The EU ETS Phase II penalty of 100 euros per ton of CO_2, set in 2013, is also adjusted annually for inflation.[10] All of these programs require a firm to replace the excess tons in addition to paying the penalty on each ton over their compliance obligation.

BOX 1: Cost Containment Benefits of Complementary Policies

Many believe that a cap-and-trade policy is not the only policy needed to reduce GHG emissions.

Additional policies address information barriers and other market failures that inhibit technology development and deployment. Some sources and product users may not efficiently be covered by a cap-and-trade policy. While complementary policies have their own associated costs, they may contribute to a reduction in the costs of meeting the emission targets of the climate policy. Policies to encourage energy efficiency, like rebates, tax credits, accelerated depreciation, and consumer dividends will promote lower energy use, address other market failures and can help meet the emissions cap.

IMPLEMENTATION OPTIONS

PRICE-TRIGGERED MECHANISMS

A number of cost-containment policies discussed in this brief—offsets, banking, borrowing, etc.—can be included in the overall design of a cap-and-trade program and operate as options that can be used at any time. Having them always available has a number of advantages, including providing program transparency, automation, and a degree of certainty for investment and planning purposes.

However, some of those policies could be used or expanded if the price of allowances reaches a certain level. In other words, they are “triggered” by a specific allowance price. For example, in the original RGGI program design, 3.3 percent of a firm’s compliance obligation could be fulfilled using offsets, and if the allowance price exceeded a certain threshold, this percentage could be expanded to 5 percent, and, if it reached an even higher threshold, 10 percent.

Although these triggered mechanisms may provide additional flexibility in dealing with allowance price uncertainty, this approach can increase program complexity, reduce predictability, and add administrative costs. RGGI removed this mechanism in its 2012 Program Review.[11] Programs that choose this option also need to consider the price level at which such triggers would take effect. A level too low would result in a continuous option (calling into question the usefulness of a triggered approach), and a level too high would limit its cost-containment benefits. Further, some have argued that an explicit price should not be included in the proposal, but rather a price range, to minimize potential gaming of the system. If a specific price is known ahead of time, market participants may be able to adjust their behavior to trigger the mechanism.

LINKAGE TO OTHER CAP-AND-TRADE PROGRAMS

Connecting programs so that each accepts allowances or offset credits issued by the other trading program can also help contain the costs of the program by expanding the potential for lower cost abatement options and reducing the potential for allowance price volatility. Larger markets tend to have lower overall costs because of the increased flexibility system to choose the least-cost emission reductions and the greater number of allowances in the combined. Linking programs is both environmentally and economically important. Linkage can minimize costs while expanding GHG mitigation and technology transfer opportunities.

A potential downside of linkage is that reductions occur outside of the program jurisdiction, and the ancillary benefits from reducing GHG emissions (e.g., reduced criteria air pollution) happen elsewhere. Another potential complication of linkage is ensuring that the environmental stringency of both programs is equivalent. A price ceiling in one program which results in emissions exceeding the capped level of emissions, will have environmental as well as economic implications on a linked program. Similarly, offsets with less rigorous oversight that are traded into a linked program could reduce the environmental benefits in the other program. Few program design features would prohibit linkage, but careful review and program adaptation may be necessary.

KEY DESIGN QUESTIONS

There are a number of policy options that can help reduce allowance price volatility and control costs in a cap-and-trade program. First and foremost, a program that includes multiple sectors as well as access to offsets (both domestic and international) is a fundamental design choice that will minimize program costs. With such a program, however, there are other policy options that can be used. Each will have different implications, both for the functioning of the carbon market and for the ability of the program to meet its environmental objectives. Policymakers should consider a number of questions in devising an approach to limiting costs in a cap-and-trade program:

- What type of costs (and whose costs) are the target of the proposed cost-containment mechanism?
- Will the cost containment mechanism result in a significant delay or even the inability to meet the program's emission reduction targets?
- How much of a dampening effect will the cost-containment policy have on incentives to invest in low carbon technologies?
- If borrowing is allowed—how much and from what time period? Also, how quickly do borrowed allowances need to be paid back, and will an "interest" payment be required?
- If a strategic reserve is used—how large should it be and how should it be "filled"?
- If choosing a triggered approach to any of the mechanisms, how will the trigger price(s) be determined?
- Will the trigger price be explicit in the policy proposal?
- Do the cost containment options increase the potential for gaming and market manipulation?
- Is there an option to link the program to other programs?

END NOTES

* This brief is an update to *Containing the Costs of Climate Policy*, Congressional Policy Brief Series (Arlington, VA: Center for Climate and Energy Solutions, 2008).

1 Providing free allowances to those entities with a compliance obligation can serve to compensate them for their additional control costs and ease the transition to the new program. Taking into account relevant sector characteristics, such as those that are exposed to trade or competitiveness impacts, will help to lessen the cost to these industries. Although this approach does not have a significant impact on the overall efficiency of the compliance market, it will raise distributional and equity concerns, as well as concerns over possible windfall gains as a result of the free allocation. In addition, giving allowances out for free forgoes the opportunity to use allowance auction revenues to reduce distortionary taxes elsewhere in the economy, which is believed to improve overall economic efficiency.

2 U.S. Billion-Dollar Weather and Climate Disasters, NOAA National Centers for Environmental Information, accessed June 22, 2017, https://www.ncdc.noaa.gov/billions; The Risky Business Project, *Risky Business: The Economic Risks of Climate Change in the United States* (New York, NY: The Risky Business Project, 2014), http://riskybusiness.org/report/national; Center for Integrative Environmental Research (CIER), *The U.S. Economic Impacts of Climate Change and the Costs of Inaction* (College Park, MD: University of Maryland, 2007), http://cier.umd.edu/climateadaptation; Okmyung Bin et al., *Measuring the Impacts of Climate Change on North Carolina Coastal Resources* (Washington, DC: National Commission on Energy Policy, 2007), http://econ.appstate.edu/papers/climate/NC-NCEP%20final%20report.031507.pdf; and Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2014: Impacts, Adaptation, and Vulnerability* (Cambridge, UK: Cambridge University Press, 2014), http://www.ipcc.ch.

3 A. Denny Ellerman and Paul L. Joskow, *The European Union's Emissions Trading System in Perspective* (Arlington, VA: Center for Climate and Energy Solutions, 2008), https://www.c2es.org/publications/european-union-emissions-trading-system.

4 A. Denny Ellerman, Paul L. Joskow, and David Harrison, Jr., *Emissions Trading in the U.S.—Experience, Lessons and Considerations for Greenhouse Gases* (Arlington, VA: Center for Climate and Energy Solutions, 2003), https://www.c2es.org/publications/emissions-trading-us-experience-lessons-and-considerations-greenhouse-gases.

5 Alexander Farrell and Lester Lave, "Emission Trading and Public Health" *Annual Review of Public Health* 25 (April 2004): 119–138, https://doi.org/10.1146/annurev.publhealth.25.102802.124348.

6 For more information see Center for Climate and Energy Solutions, *Ensuring Offset Quality: Integrating High Quality Greenhouse Gas Offsets Into North American Cap-and-Trade Policy* (Arlington, VA: Center for Climate and Energy Solutions, 2008), https://www.c2es.org/publications/ensuring-offset-quality.

7 Ibid.

8 *Citizens Climate Lobby and Our Children's Earth Foundation v. California Air Resources Board*, 2015 Calif. App, http://www.courts.ca.gov/opinions/archive/A138830.PDF.

9 California Air Resource Board, *2017 Annual Allowance Price Containment Reserve Notice* (Sacramento, CA: California Environmental Protection Agency, 2016), https://www.arb.ca.gov/cc/capandtrade/reservesale/2017_reserve_sale_apcr_notice.pdf.

10 U.S. Environmental Protection Agency, "Penalties for excess emissions of sulfur dioxide and nitrogen oxides," Code of Federal Regulations, title 40, sec. 77.6 (2016), https://www.gpo.gov/fdsys/pkg/CFR-2016-title40-vol18/xml/CFR-2016-title40-vol18-sec77-6.xml; and European Commission, *EU ETS Handbook* (Brussels, Belgium: European Union, 2015), https://ec.europa.eu/clima/sites/clima/files/docs/ets_handbook_en.pdf.

11 Regional Greenhouse Gas Initiative, *Summary of RGGI Model Rule Changes* (New York City, NY: Regional Greenhouse Gas Initiative, 2013), https://www.rggi.org/docs/ProgramReview/_FinalProgramReviewMaterials/Model_Rule_Summary.pdf.

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