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The Path to Cleaner Coal

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Introduction and Summary

The Low Carbon Economy Act of 2007 (S.1766), recently introduced by Sen. Jeff Bingaman (D-NM) and six of his colleagues, provides a useful framework for spurring greenhouse gas emission reduction and will contribute to the ongoing debate in Congress on climate change legislation. The bill reflects a recognition that carbon capture and storage, CCS, technology is essential for the continued viability of coal-derived electricity in a world of growing carbon constraints. The bill sponsors offer an approach to accelerate the deployment of CCS systems that deserves careful consideration. Under this approach, plant developers would not be required to install CCS systems at new coal plants; they would instead receive "bonus allowances" as *incentives* to adopt CCS. The idea is that the market value of these bonus allowances would offset the cost differential between plants with CCS and uncontrolled coal plants with the goal of making CCS-equipped plants a cost-effective option under the bill's cap-and-trade program for coal-burning facilities.

Our recent report "Global Warming and the Future of Coal" examines an array of options for achieving the goal of widespread CCS deployment at new coal plants. It analyzes whether CCS plants would be economically sustainable under the anticipated range of CO_2 allowance prices in the early years of proposed cap-and-trade programs and concludes that CCS would not be a cost-effective compliance option under these programs. In contrast to S. 1766, our report does not propose offering utilities allowances as incentives to adopt CCS. We instead propose that Congress set an emission performance standard for new coal plants based on the effectiveness of available capture and storage technology, with a phase-in process to allow time for further testing and improvement of the technology. The performance standard would be accompanied by financial assistance to mitigate the added cost of CCS and protect against electricity price hikes.

Our report did not examine the pros and cons of using bonus allowances under a cap-and-trade program as a tool to incentivize utilities to build new plants with CCS systems. To supplement our earlier options analysis, this report will examine the CCS incentive provisions in the Low Carbon Economy Act and compare them to the emission performance approach recommended in "Global Warming and the Future of Coal." We show that the emission performance approach is more effective and less costly than the bonus allowance program proposed in the Low Carbon Economy Act for the following reasons:

- Traditional emission control programs under the Clean Air Act and other laws set higher standards of performance for new sources of pollution than existing sources of pollution. New sources have generally been required to apply the best available emission control technology and have been subject to technology-based emission limits

that supplement cap-and trade programs or other less stringent safeguards for existing sources. These stringent controls on new source emissions have made emission caps achievable by preventing emissions growth from new sources that would negate reductions from existing sources. Such new source emission standards achieved significant pollution reductions at an affordable cost, as well as sped the development and deployment of new technologies.

- Application of the most advanced control technology to new power plants should be an essential element in an overall greenhouse gas emission strategy so that emissions growth from these plants does not jeopardize sector-wide emission reduction efforts. There is broad agreement that, while further testing and development are needed, CCS is the most promising—and probably the only effective—CO_2 control technology for coal power plants.

- An emission performance standard would ensure that all new coal plants capture and sequester their emissions rather than relying on bonus allowances that may or may not be sufficient to motivate plant developers to deploy CCS systems and could either provide inadequate incentives or unjustified windfalls to utilities.

- Bonus allowances must overcome non-price barriers to building plants with CCS, including the reluctance of conservative utility executives to invest in new and uncertain technologies and the belief that second generation plants are more economical and reliable than first generation plants. As a result, the subsidies provided under a bonus allowance program would likely be considerably larger than necessary to close the cost gap between plants with and without CCS system.

- One consequence of this is that the bonus allowance set aside could become so large that it reduces the size of the auction pool and/or shrinks allowance allocations to other regulated entities. Our calculations show that the bonus allowances awarded to utilities under S. 1766 could substantially exceed the 8 percent set aside, requiring a large transfer of allowances from the auction pool to utilities and reducing the revenues derived from the auction process.

- The most likely scenario is that utilities will not sell bonus allowances in the open market but would use them to offset emissions from existing plants or even from new plants without CCS systems. This would delay reductions from the utility sector, put upward pressure on allowance prices and increase emission reduction obligations and costs for other categories of allowance holders.

- These distortions of the cap-and-trade system would be avoided if an emission performance standard—and not a bonus allowance program—were the primary tool to achieve widespread deployment of CCS systems at new coal plants. While financial assistance would be available to plant developers, its purpose would be to protect consumers from undue energy price increases and not to create incentives for CCS deployment. As a result, such assistance could be precisely calibrated to reflect the carbon price differential between controlled and uncontrolled plants and could be adjusted over time as actual cost data becomes available. This would benefit energy users without providing a windfall to utilities.

Accelerating the Deployment of Carbon Capture and Sequestration Systems

What Does the Low Carbon Economy Act Propose?

The Low Carbon Economy Act would create a United States greenhouse gas cap-and-trade program that would reduce emissions to 2006 levels by 2020 and 1990 levels by 2030. Covered entities—mainly large coal-consuming facilities (primarily utilities), petroleum refineries, natural gas processing facilities, and fossil fuel importers—would need to submit allowances corresponding to the amount of CO_2 they emit or make payments into a special fund at a fixed price for each ton of CO_2 emitted. This "technology accelerator payment," or TAP, would start at $12 per metric ton of CO_2 equivalent in 2012 and increase by 5 percent per year above the rate of inflation. The TAP, which some have described as a safety valve, would provide regulated sources a cheaper alternative to purchasing allowances if the market price exceeds the TAP amount.

Emission allowances would be in part distributed by the government to the private sector for free, and in part sold at auction. The amount of auctioned allowances would become progressively larger over time and the amount of free allowances would diminish. Auction revenues would be used to fund new technologies, climate change adaptation, and assistance to low-income consumers unduly burdened by initial increases in energy prices.

Section 201(a)(1) of the Low Carbon Economy Act would require the government to set aside 8 percent of the total allowances it issues for a CCS bonus allowance program each year between 2012 and 2039. Under Section 207, facilities capturing and sequestering CO_2 would receive "bonus allowances" for each ton sequestered based on a set rate starting at 3.5 in 2012 and dropping to 1.9 in 2025 and ultimately to 0.5 in 2039. These allowances would be available for the first 10 years of the facility's operation.[1]

An Emission Performance Standard Will Better Ensure that New Coal Plants Employ CCS Systems at Lower Costs

In "Global Warming and the Future of Coal," we propose an emission performance standard which would require that new coal-fired plants deploy the best available CO_2 emission control technology—CCS—under a flexible implementation timeline. There is strong precedent for this approach under existing pollution control regimes, and it

would offer several important benefits that the bonus allowance program in S. 1766 would lack.

Traditional emission control programs under the Clean Air Act and other laws set higher standards of performance for new than for existing sources of pollution. Congress has generally required new sources of pollution, such as new coal plants, to apply the best available emission control technology, taking into account cost-effectiveness and technical feasibility. Subjecting new sources to a higher level of control has served a number of policy objectives. First, where the goal of regulation is lower overall emissions, allowing new sources to operate without the most advanced technology adds unnecessarily to the emission inventory and makes emission reduction targets more difficult to achieve. Second, it is less expensive to install state-of-the-art control technology when new facilities are being constructed than to retrofit them after they commence operation. And third, an aggressive technology-forcing standard for new sources stimulates innovation and cost-reduction, accelerating the transition of new pollution control technologies from research and development to full commercial deployment.

The two-track approach for controlling new and existing sources is well-established for conventional air pollutants emitted by power plants. The Environmental Protection Agency has adopted cap-and-trade programs for utility emissions of sulfur dioxides, nitrogen oxides and, more recently, mercury. However, these programs are backstopped by the Act's rigorous new source review provisions, which require all new facilities emitting these pollutants to meet technology-based standards reflecting the most advanced emission controls available. Based on these requirements, nearly all new power plants have installed SO_2 scrubber systems, selective catalytic reduction units for NO_x and carbon injection systems for mercury. These stringent controls on new source emissions have made emission caps achievable by preventing emissions growth from new sources that would negate reductions from existing sources.

The challenge of lowering overall emissions of greenhouse gases will be immeasurably more difficult if, in response to electricity demand growth, a new generation of coal-fired power plants is built which does not control CO_2 emissions. As "Global Warming and the Future of Coal" shows, the construction of 145 gigawatts, GW, of new coal generation capacity between now and 2030 could add 790 million metric tons of CO_2 to current U.S. CO_2-equivalent emissions of 7.15 million metric tons.[2] This would mean an 11 percent *increase* in emissions as compared to the *reductions* of 20, 50 and even 80 percent targeted between now and 2050 under the major legislative proposals. The emission stream from these new plants would remain constant over their entire operating life of 60 years to 70 years, requiring progressively deeper reductions from elsewhere in the economy to achieve a declining emission cap.

Application of the most advanced control technology to new power plants should be an essential element in an overall greenhouse gas emission strategy so that emissions growth from these plants does not jeopardize sector-wide emission reduction efforts. There is broad agreement that, while further testing and

development are needed, CCS is the most promising—and probably the only effective—CO_2 control technology for coal power plants since it is capable of 85 percent to 100 percent emissions capture and storage. Without a higher standard of control for new than existing coal plants, however, widespread CCS deployment would be unlikely. The estimated cost of CCS is in the range of $24 to $30 per ton for Integrated Gasification Combined Cycle plants, and in the range of $40 to $51 per ton for Supercritical Pulverized Coal Plants.[3] This is well above the 2012 TAP of $12 per ton under the Low Carbon Economy Act and likely above the escalating TAP levels in subsequent years with the 5 percent annual increase. It is also above the projected carbon price that, according to the Environmental Protection Agency, would likely prevail until 2030 under the McCain-Lieberman cap-and-trade bill.[4] As a result, CCS systems would not be cost-competitive with conventional coal generation technology for at least two decades and perhaps longer.

This "cost gap" could be bridged by special CO_2 performance standards for new coal plants akin to new source review requirements for conventional pollutants. Our report proposes "emission performance standards," which would require new plants to capture CO_2 emissions at the level achievable by the best performing CCS technology and then to store the captured CO_2. By contrast, the Low Carbon Economy Act takes the tack of setting aside bonus allowances to incentivize developers to build these plants while allowing continued construction of conventional uncontrolled coal plants.[5]

An emission performance standard coupled with financial assistance to protect consumers from electricity price hikes is a more certain and cost-effective tool to ensure that new coal plants will employ CCS systems than a bonus allowance program. An emission performance standard would send a clear signal to plant developers that CCS systems are a required feature of all new coal plants. This would also spur innovation and cost-reduction by technology vendors and utilities who would now have a powerful motivation to seek low cost and reliable CCS solutions. Under an incentive-based approach, by contrast, plant developers would have a range of choices and would be able to weigh several factors when deciding whether CCS-equipped plants represent the most economic option for new coal generation. Many of these factors are impossible to predict and control in advance, and therefore a system of bonus allowances could in practice create either insufficient or excessive incentives for investing in plants with CCS systems.

For example, if the market price of CO_2 is lower than anticipated, bonus allowances would offset a smaller share of the cost premium for a CCS-equipped plant and utilities would need to spend less to purchase allowances to cover the emissions of uncontrolled plants. This could tip the balance in favor of conventional coal generation technology. The same outcome would occur if conventional coal plants are less costly or more efficient than anticipated or, conversely, if plants with CCS are more costly to build or operate.

Bonus allowances must overcome non-price barriers to building plants with CCS, including the reluctance of conservative utility executives to invest in new and uncertain technologies, the lower operational and financial risks of building conventional coal plants and the belief

that second generation plants are more economical and reliable than first generation plants. If bonus allowances are insufficient to overcome these perceived risks, developers might opt for conventional plants even though their nominal costs are no lower than those of plants with CCS systems. The subsidies provided under a bonus allowance program would therefore likely need to be considerably larger than necessary to simply close the cost gap between plants with and without CCS system. And even with a substantial premium, there is no guarantee that plant developers would choose the CCS path.

The unpredictability of a bonus allowance program could also result in incentives that are more costly than necessary to spur investments in CCS, even considering the need to overcome non-price barriers such as technology risks. For example, if the market price of CO_2 is higher than expected, the value of bonus allowances could be greater than anticipated, resulting in a windfall to the plant developer over and above the incremental costs of building a CCS plant, even with a risk premium.[6] Similarly, the high price of allowances coupled with the lower cost of coal compared to alternative fuels could spur construction of more CCS plants than anticipated, with the demand for allowances outstripping the allowance set aside.

Unintended and Adverse Consequences of the Low Carbon Economy Act

In addition to the inherent uncertainty in using bonus allowances to incentivize widespread CCS deployment, the bonus allowance provisions proposed in the Low Carbon Economy Act are likely to have a series of unintended consequences that could adversely affect the operation of the cap and trade system and make it more difficult and costly to achieve the bill's emission reduction targets. These consequences would not occur under an emission performance approach.

The number of bonus allowances awarded to utilities may substantially exceed the allowance set aside in the bill, which would require a large transfer of allowances from the auction pool to utilities and undermine the benefits of the auction process. Although the precise operation of the bonus allowance program in the bill is difficult to forecast, a calculation using realistic "worst case" assumptions illustrates the potential for "overcompensating" utilities who invest in CCS and diverting an excessive number of allowances from the auction pool.

According to the bill's sponsors, "the bonus allowance set aside can support the development of up to 150 GWs of advanced coal with carbon capture and storage by 2030."[7] The bill's sponsors are presumably assuming that these GWs represent new generation plants rather than retrofits of existing plants.[8] A one GW Supercritical Pulverized Coal plant using the latest technology produces around 5.4 million metric tons of CO_2 annually. Thus, 150 GWs of new generation without CCS would produce 810 million metric tons per year or 8.1 billion tons over a 10 year period.

The following table calculates the number of bonus allowances that new plant developers would be awarded if 25 percent of the expected 150 GWs of new plants with CCS begin operating—for example, capturing and sequestering 90 percent of their CO_2 emissions—in each of the years 2015, 2020, 2025, and 2030:[9]

TABLE 1: NUMBER OF ALLOWANCES PER YEAR ALLOCATED TO FACILITIES WITH CCS

YEAR	TONS SEQUESTERED/ MILLIONS[10]	BONUS MULTIPLIER	NUMBER OF BONUS ALLOWANCES/MILLIONS
2015	182	3.5	637
2020	364.5	2.9	1,057
2025	546.5	1.9	1038.4
2030	728.5	0.9	655.7

Key: 1 allowance = 1 ton of CO_2 emissions

For each of these representative years, total bonus allowances awarded would be greater than the 8 percent set aside of 510 million metric tons in 2017—and double the size of the set aside in 2020 and 2025.[11] Under Section 207(a) (5), the shortfall would be made up by taking allowances out of the auction pool and transferring them to the bonus allowance program. Because the overall allowance pool would become smaller as the cap declines, the expanded set aside would represent a rising percentage of total allowances available, as shown in Table 2:[12]

The value of bonus allowances could exceed the incremental costs of building new plants with CCS and provide windfall revenues to utilities. What would allowances be worth to utilities and would they confer economic benefits beyond those required to subsidize the added costs of CCS? The background documents for S. 1766 indicate that, assuming a carbon price of $10 per ton in 2017, 3.5 bonus allowances would be worth $35.[13] However, another scenario consistent with the views of some analysts is that the actual carbon price

TABLE 2: PERCENT OF TOTAL ALLOWANCES IN SET ASIDE FOR FACILITIES WITH CCS

YEAR	TOTAL ALLOWANCES TO ALL SECTORS (IN BILLIONS)	TOTAL BONUS ALLOWANCES (IN MILLIONS)	PERCENT OF TOTAL ALLOWANCES
2015	6.533	637	9.75%
2020	6.188	1057	17.08%
2025	5.732	1038.4	18.00%
2030	4.819	655.7	13.60%

The diversion of allowances from the auction pool to the CCS set aside program would necessarily reduce the revenues to the government derived from the allowance auction and thus the funding available for supporting new technologies, climate change adaptation, and assistance to low-income consumers unduly burdened by initial increases in energy prices.

under the bill will equal the TAP, which is set at $12 per ton in 2012 and rises by 5 percent above the rate of inflation annually. Assuming a modest inflation rate of 2 percent per year, the TAP would rise by 7 percent per year. By 2017, the TAP could therefore rise by between 35 and 40 percent, or up to $16 to $17 per ton.[14] The value per ton of 3.5 allowances would

then be $56 to $60 per ton in 2017—well above the projected $30-$35 per ton price necessary to make CCS competitive.[15]

The incentives for CCS arguably do not need to cover the full cost of a new plant with CCS to be effective; they need only to cover the differential between the market price of CO_2 allowances and the cost per ton of capturing and sequestering emissions because uncontrolled coal plants would need to purchase allowances at that price to cover their emissions. Because the market price of an allowance in this example will rise to $17 per ton in 2017, the cost differential between CCS and uncontrolled plants would be $18 per ton (assuming a cost per ton for CCS of $35). A single bonus allowance worth $17 per ton would be sufficient to close this gap. The additional 2.5 allowances would be a windfall, although perhaps necessary at least in part to overcome the "technology risk" premium for CCS.

Following this formula, the total dollar value of the CCS incentive allowances per year would be as shown in Table 3:[16]

to calculate their total dollar value to a developer planning a 1 GW facility with CCS. For various years between 2015 and 2030, this amount is as shown in Table 4 (on page 9).

For a CCS plant beginning operation in 2015, around $2.5 billion would be generated from bonus allowances over 10 years. This would represent over 80 percent of the total cost of building the facility—assuming that a 1 GW new generation plant with CCS would cost $3 billion in 2015.

Utilities Would Likely Use Bonus Allowances to Avoid Reducing Emissions from Existing and New Plants. What would utilities do with the bonus allowances they receive? One possibility is to sell these allowances at the market price, using the proceeds to cover the incremental cost of building and operating a new plant with CCS. However, a utility's first priority is likely to be ensuring that it has enough allowances to offset emissions from existing plants or from new plants constructed without CCS

TABLE 3: AGGREGATE VALUE OF BONUS ALLOWANCES

YEAR	TOTAL BONUS ALLOWANCES/MILLIONS	TECHNOLOGY ACCELERATOR PAYMENT/$	TOTAL VALUE OF ALLOWANCES AND CREDITS/$ BILLIONS
2015	637	$13.74	$8.75
2020	1,057	$19.27	$20.37
2025	1,038.4	$27.03	$28.07
2030	655.7	$37.91	$24.90

In short, bonus allowances would be worth in the range of $240 billion for the 10- year period between 2020 and 2030.

Another way of looking at the economic significance of the bonus allowances is

systems. Where a utility needs allowances to offset emissions from existing plants or from new plants without CCS, there would be no reason to sell bonus allowances that could be used for that purpose since they would then have to be replaced

TABLE 4: VALUE OF ALLOWANCES FOR 1 GW OF CAPACITY IN 2015

YEAR	NUMBER OF METRIC TONS CAPTURED	BONUS ALLOWANCE MULTIPLIER	TOTAL NUMBER OF ALLOWANCES/ MILLIONS[17]	VALUE OF ONE ALLOWANCE	TOTAL VALUE IN MILLIONS
2015	4,860	3.5	17	$13.74	$233.72
2020	4,860	2.9	14.1	$19.27	$271.71
2025	4,860	1.9	9.2	$27.03	$248.68
2030	4,860	0.9	4.4	$37.91	$166.80

on a one-to -one- basis with allowances purchased on the open market. Thus, unless the value of the bonus allowances exceeded the cost to the utility of actually reducing emissions at its existing plants,[18] the utility will likely keep bonus allowances for internal use and only sell the bonus allowances after all its internal needs have been satisfied. This could have a significant effect on the availability of allowances to other sectors of the economy. For example, with a bonus allowance rate of 3.5, a utility could offset 20 percent of the emissions at 15.75 GW of coal plants in return for building a 1 GW plant with CCS.[19] This would allow existing plants to continue operating at current levels without reducing or otherwise offsetting their emissions even though the cap under the bill would decline by 28 percent between 2012 and 2030. The burden of reducing emissions to meet the cap would therefore fall disproportionately on other regulated entities.

The reallocation of allowances from the auction pool to the CCS set- aside program could adversely disrupt operation of the cap-and-trade program and increase costs for other categories of allowance holders. Whenever allowances are removed from the general allowance pool and set aside to support a particular industry sector or technology, it can distort the forces of supply and demand under a market trading system.[20]

In this instance, a large portion of the allowance pool—18 percent in the peak year—would be transferred to the electric utility sector, substantially increasing the number of allowances guaranteed to this sector outside the auction process.[21] Although these allowances could prevent future emissions from up to 150 GW of new coal plants, they would not in themselves *reduce* existing emissions unless utilities also replace existing plants.[22] Thus, other regulated entities would need the same number of allowances to cover their emissions but would have access to fewer allowances from either the free industry allocation or the auction process. The result would be upward pressure on allowance prices, since fewer allowances are available, and larger costs to non-utility allowance holders who would need to purchase allowances from utilities or make investments to reduce their emissions.

As a consequence, there will be an increasing likelihood that the actual cost of allowances will exceed the TAP limits, with TAP payments substituting for actual emission reductions. This problem would only become more acute as the cap declines from 2006 levels in 2020 to 1990 levels in 2030. With utilities cushioned from reducing their emissions by bonus allowances and other sectors required to make correspondingly deeper reductions, the difficulty of achieving the overall emission caps would greatly increase.

Many utilities would receive direct financial assistance in addition to bonus allowances, increasing the windfall they receive over and above the incremental costs of constructing and operating plants with CCS systems. The Low Carbon Economy Act would provide financial incentives for constructing new coal plants with CCS systems in additional to bonus allowances. Part of the proceeds from allowance auctions would be dedicated to up to $25 billion per year in technology development and adaptation assistance. Of the amounts deposited in the new Energy Technology Deployment Fund, 45 percent would be used for a zero- or low-carbon energies technology program for which coal plants with CCS would be eligible. Another 28 percent would be used to carry out an advanced coal and sequestration technologies program that would be limited to coal plant demonstration projects employing CCS systems. Under the latter program, an eligible plant could receive either a loan guarantee, a grant for up to 50 percent of project costs, or production payments of no more than 1.5 cents per kilowatt hour of electricity output for a 10- year period. Up to 20 GW of new coal capacity would be eligible for this assistance.

Since the Low Carbon Economy Act's CCS bonus allowance program would be more than sufficient to eliminate the cost differential between new coal plants with CCS and those without it, an additional program of financial assistance for plants with CCS would be redundant and simply confer additional financial benefits on plant owners.

Conclusion

Why an Emission Performance Standard Is the Best Approach

"Global Warming and the Future of Coal" argues that, without emission controls, the added CO_2 emitted from new coal plants will make it much more difficult to achieve substantial net greenhouse gas emission reductions in the United States, particularly with a long-term emission reduction target of 80 percent by 2050—the amount that many scientists consider necessary to stabilize greenhouse gas levels in the atmosphere. Like the authors of the Low Carbon Economy Act and many others, we propose the widespread deployment of CCS systems at new coal plants to prevent the bulk of these plants' emissions from being released into the atmosphere.

The report also concludes that, at least in their initial stages, cap-and-trade programs are not likely to create a carbon price high enough to eliminate the cost differential between new coal plants with CCS and those without it. As a result, new coal plant developers are unlikely to capture and sequester their emissions. We, therefore, recommend adopting an emission performance standard for all new coal plants pegged to the capture efficiency of available technology. This new standard would be phased in over an eight- year period from the date of plant construction.[23] Recognizing the added cost of building new plants with CCS systems, we further propose a package of financial assistance for these plants that would prevent significant electricity price increases. The logical source of revenues for this program would be the proceeds of allowance auctions; in the absence of an auction, other sources might be tapped, including a national "wires' charge" on retail electricity sales.

Under our proposal, existing power plants would be subject to a cap-and-trade program, with declining caps over time, as in the Low Carbon Economy Act and other proposed climate change bills. The exclusion of new plants from the cap-and-trade program, coupled with a high standard of performance for these plants, would reduce the risk that emission increases from new sources would offset reductions from existing sources and slow progress toward achievement of the overall cap.

This approach is simpler, cheaper, and more effective than the bonus allowance program in the Low Carbon Economy Act because:

- An emission performance standard would assure that all new coal plants capture and sequester their emissions rather than relying on bonus allowances that may or may not be sufficient to motivate plant developers to deploy CCS systems and could either

provide inadequate incentives or unjustified windfalls to utilities. By adopting a clear mandate to install CCS systems at new coal plants after an appropriate phase-in period, Congress would send a strong signal that CCS is the preferred technology path. This would accelerate improvements in the technology and reductions in cost.

- Since bonus allowances would not be awarded to utilities under the emission performance approach, there would be no possibility that utilities employing CCS would earn excess allowances that reduce the size of the auction pool and/or shrink allowance allocations to other covered entities without corresponding emission reductions. This would assure that the revenues from auctions are sufficient for their intended purposes of technology development, adaptation assistance, and protection for low income people from higher energy prices. In addition, the allowances available to other regulated entities would not be reduced, thus avoiding upward pressure on allowance prices.

- Under the emissions performance approach, utilities that build *new* plants with CCS would not be able to avoid or defer emission reductions at *existing* plants by using surplus allowances to cover their emissions. Since new plants would be subject to a separate emissions performance standard, the emission caps would apply only to existing plants, with appropriate reduction targets to incentivize plant owners to retire these plants, increase efficiency, or offset emissions. This would assure that utilities are diligent in pursuing reductions from the existing power plant fleet.

- Financial assistance would be provided to developers of new plants with CCS under both the Low Carbon Economy Act and our proposal. However, the purpose of this assistance under the emissions performance approach would not be to *incentivize* the construction of these plants, but rather to prevent consumers from experiencing undue energy price increases because of the greater cost of producing electricity at CCS-equipped plants as compared to uncontrolled facilities. Since this assistance would not seek to reward developers of CCS plants and would not take the form of allowances of inherently uncertain value, it would not need to include a premium to overcome non-price barriers to CCS, including technology risks. Instead, the level of support could be precisely calibrated to reflect the carbon price differential between controlled and uncontrolled plants and could be adjusted over time as actual cost data becomes available. We propose allowing new CCS plants to recover 20 percent of total construction costs, with the level of recovery declining by 2 percent per year as the cost-effectiveness of the technology increases.[24] This is substantially less than the effective value of bonus allowances that would be awarded under S. 1766. We welcome further analysis comparing this approach to others,[25] with the premise that the goal of cost recovery is not to reward utilities for building plants with CCS systems but to minimize adverse economic impacts on consumers.

Endnotes

1 Under Section 302, the facility would also receive "sequestration credits" equal to the total tons sequestered on a one-to-one basis; the allocation rate for these allowances would not change over time and they would be available for an unlimited duration. Although the materials accompanying the bill suggest that these sequestration credits would increase the total number of allowances provided to plant developers, Committee staff and its consultants informed us that these credits would simply be used to offset the facility's pre-capture emissions and would have no independent market value.

2 S. 1766 does not regulate all U.S. GHG emissions, so its cap is somewhat smaller than total emissions—for example, 6,653 million metric tons of CO_2 equivalent in 2012.

3 Ken Berlin and Robert M. Sussman, "*Global Warming and the Future of Coal,*" (Washington: Center for American Progress, 2007) at 17-18. S. 1766 assumes a somewhat higher cost per ton of $35 for new plants with CCS (perhaps because it did not differentiate between IGCC and SCPC units).

4 EPA Analysis of The Climate Stewardship and Innovation Act of 2007, at 3 ("In this analysis, while CCS is available starting in 2015, carbon allowance prices rise to a high enough level to make CCS cost-competitive in [about] 2030 and it is rapidly deployed thereafter").

5 Under Section 202(c), emission rate criteria would be set for new coal plants that commence operation after December. 31, 2006, "based on the lowest economically achievable carbon dioxide per kilowatt hour emission rate for a facility of that type." We assume that these criteria would reflect the operation of conventional coal generation technology without CCS.

6 This would not occur under S. 1766 because the TAP would set an upper limit on the price of allowances but could occur under other bills that lack a similar "safety valve."

7 Fact sheet entitled "Bonus Allowances for Carbon Capture and Storage."

8 The Department of Energy projects that around 150 GW of new coal capacity will be built in the United States by 2030. CCS retrofits of existing plants are definitely desirable but are believed to pose cost and technical challenges.

9 Only tons actually captured and sequestered would give rise to allowances. It is hoped that capture effectiveness will eventually exceed 90 percent, but we have assumed 90 percent as a conservative number.

10 The tons sequestered column was calculated by assuming that 90 percent of the 810 million metric tons of CO_2 produced by 150 GW of plants are captured and that, for example, in 2015, 25 percent of those plants are in operation. Thus 810x.90x.25 = !82.

11 Assuming a cap of approximately 6.4 metric tons in 2017, 8 percent would equal 510 million tons.

12 New coal plants would also get allowances under Section 202 as part of the allocation set aside for "new entrants." This allocation is 8 percent of the total allowance given to each industry sector. Initially, 54 percent of total industry allowances (1.9 billion tons) are allocated to the electric power generating sector. We estimate that the new entrant set aside for the utility sector would total 152 million allowances in 2012, declining to lower amounts as the industry allocation declines and the allowance pool increases in later years. A portion of these allowances would presumably go to new coal plants with CCS.

13 Fact sheet entitled "Bonus Allowances for Carbon Capture and Storage."

14 To determine the technology accelerator payment after 2012, we assumed a modest 2 percent inflation rate and compounded the resulting 7 percent increase per year, assuming two years of compounding prior to 2015 and five years of compounding for each subsequent year.

15 This is true even after adjusting for inflation. With a 2 percent annual inflation rate over five years from 2012-2017, the per ton cost of CCS would increase from the high-end projection of $35 to $38.64 in 2017.

16 Again, we assume that 25 percent of the expected 150 GWs of new plants with CCS begin operating in each of the years 2015, 2020, 2025, and 2030, and that 90 percent of their CO_2 emissions are captured and sequestered.

17 The total number of allowances was calculated by multiplying the number of metric tons captured (first column of the table) by the bonus allowance multiplier (second column).

18 This is unlikely for two reasons. First, there are no current technologies that enable substantial reductions without retrofitting coal plants to capture and sequester their emissions, and the cost of CCS retrofits would likely be greater than the value of the bonus allowances (see footnote 3 and accompanying text). Second, since there are currently no effective emission reduction technologies available for existing coal plants, the only way to reduce emissions is plant closure. Closure, however, is not as cost effective an option as obtaining allowances at many plants as shown by the expectation that, at least for many years, most coal plant operators will purchase such allowances, rather than close their plants, and then increase the cost of electricity to finance allowance purchases.

19 The allowances for one new CCS plant, assuming 90 percent capture and sequestration, equal 90 percent of the plant's potential emissions. These allowances could offset 20 percent of the emissions from 4.5 plants (90 percent divided by 20 percent). The 15.75 total is reached by multiplying 4.5 by the number of bonus allowances, which is 3.5 in this example.

20 In addition to the set-aside for CCS plants, S. 1766 contains set-asides for the coal mining industry and for energy-intensive manufacturing sectors.

21 Coal-fired utilities would be allocated 29 percent of total allowances in 2012 (54 percent of the total industry allocation of 53 percent) but the utility allocation would decline to 18 percent in 2025 (54 percent of the total industry allocation of 35 percent). Thus, the CCS bonus allowances awarded to utilities in that year would basically double the sector's share of total allowances.

22 It is likely that most if not all of the new plants would be used to meet projected increases in demand for electricity, which according to EIA will be approximately 40 percent by 2030. EIA estimates that only 3.6 GW of coal power plants will be decommissioned by 2035. See "Global Warming and the Future of Coal", at 6-7.

23 For example, it would require that all new coal plants built after 2008 be able to capture their emissions by 2013 and to sequester them fully by 2016.

24 Assuming that 80 GW of new coal capacity would be eligible for cost-recovery, our report calculates the cost of this program at $36 billion over 10 years. See "Global Warming and the Future of Coal" at 45.

25 Additional subsidies might be necessary to cover operating costs if these costs sufficiently exceed the cost of power from a plant that does not capture and sequester but which must buy allowances. This subsidy might take the form of a $/kW hour production tax credit that is adjusted over time.

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