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How Can One Allocation Provision Undermine a Cap-and-Trade Program? Section 3902 of the Lieberman-Warner Bill Offers a Warning about Risks in the Allowance Allocation Debate

Judson Jaffe*

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* Vice President, Analysis Group, Inc. The author served on the staff of the President's Council of Economic Advisers from 2000 to 2002. Janis Carey, Todd Schatzki, and Pavel Gavrilov of Analysis Group provided helpful comments on a prior draft and offered valuable research assistance.

Executive Summary

As the debate over the design of a federal greenhouse gas cap-and-trade program unfolds, the distribution (or allocation) of emission allowances will be one of the most difficult issues to resolve. The distributional implications of allocation decisions have long been appreciated. However, various proposals in Congress have made it increasingly clear that these decisions also could have a profound effect on how emissions are reduced under a cap-and-trade program, and could thereby have a substantial effect on the program's societal cost.

This paper describes an important exception to the conventional wisdom that allocation decisions do not affect a cap-and-trade program's societal cost. While this wisdom holds for many types of allocations, it does not apply to *conditional* allocations in which the number of allowances that a firm receives is conditioned on the firm's future operational or investment decisions.

To demonstrate this point, this paper examines an allocation provision in the draft of the Lieberman-Warner Climate Security Act of 2008 that was reported out of the Senate Environment and Public Works Committee in December 2007 (the Lieberman-Warner bill). This provision, Section 3902, would distribute allowances to new fossil-fuel-fired power plants on the basis of their future output. In so doing, it would dramatically reduce, and in certain cases reverse, some of the most important emission reduction incentives that a cap-and-trade program would create.

Section 3902's new entrant provision would counteract the incentive that a cap-and-trade program otherwise would create for firms to shift some investments in new electric generating capacity toward non-emitting renewable or nuclear plants. The provision's effects would be so significant that, for several years, the Lieberman-Warner bill's cap-and-trade program would actually create incentives for firms to invest in low-emitting fossil-fuel-fired plants instead of non-emitting renewable or nuclear plants. Section 3902's new entrant provision also would reduce the marginal cost of generation from new fossil-fuel-fired plants relative to existing plants. As a result of this provision, electricity generation from some existing plants would be economically displaced by generation from new plants even in cases where the new plants have higher emission rates and fuel costs.

An examination of Section 3902's effects highlights the need to carefully analyze the incentives that any conditional allocation provisions would create, regardless of whether those provisions are designed with the intention of creating particular incentives, or are instead designed to achieve certain distributional objectives. Otherwise, there is a real risk that much of the emission reduction measures achieved under a cap-and-trade program will be driven by allocation decisions made in the halls of Congress, rather than by the market-based incentives that a cap-and-trade program is intended to create. Such an outcome would invariably increase the cost of reducing U.S. greenhouse gas emissions.

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I. Introduction

As the debate over the design of a federal greenhouse gas cap-and-trade program unfolds, the distribution (or allocation) of emission allowances will be one of the most difficult issues to resolve. This is not surprising given what is at stake. The U.S. Environmental Protection Agency (EPA) estimated that the total annual value of allowances that would be created under the Lieberman-Warner Climate Security Act of 2008 (the Lieberman-Warner bill) could exceed $200 billion in the cap-and-trade program's first year, and would increase thereafter as the cap is tightened.[1] To date, much of the focus in the allocation debate has been on distributional implications. However, various proposals in Congress have made it increasingly clear that allocation decisions also could have a profound effect on how emissions are reduced under a cap-and-trade program, and could therefore significantly affect the program's societal cost.

This paper describes an important exception to the conventional wisdom that allocation decisions do not affect a cap-and-trade program's overall cost. While this wisdom holds for many types of allocations, it does not apply to *conditional allocations* in which the number of allowances that a firm receives is conditioned on the firm's future operational or investment decisions. As Section II explains, conditional allocations can affect the incentives that firms face under a cap-and-trade program, and can thereby affect the program's cost.

While many different conditional allocation provisions have been proposed, the draft of the Lieberman-Warner bill that was reported out of the Senate Environment and Public Works Committee in December 2007 contains one such provision that would fundamentally alter the incentives created by a cap-and-trade program.[2] Section 3902 of that bill would distribute

[1] U.S. Environmental Protection Agency (2008), *EPA Analysis of the Lieberman-Warner Climate Security Act of 2008 (S. 2191 in 110th Congress)*, March 14.
[2] Lieberman-Warner Climate Security Act of 2008, S. 2191, 110th Congress (2008), as reported out of the Senate Environment and Public Works Committee in December 2007.

allowances to new fossil-fuel-fired power plants on the basis of their future output. In so doing, it would dramatically reduce, and in certain cases reverse, some of the most important emission reduction incentives that a cap-and-trade program would create. As a result, this conditional allocation provision could significantly increase the societal cost of reducing U.S. greenhouse gas emissions. Thus, in addition to the direct relevance that an assessment of this provision has for the current allocation debate, it also offers a vivid example of the profound effect that conditional allocations can have on the cost of a cap-and-trade program. Section III of this paper explores how Section 3902's new entrant allocation provision would affect the incentives created by the Lieberman-Warner bill's cap-and-trade program. Finally, Section IV identifies the lessons that this assessment offers for the debate over allowance allocations.

II. The Effects of Conditional Allocations on a Cap-and-Trade's Economic Incentives

There are limitless possible approaches to allocating allowances, and different approaches will have different distributional implications. However, the conventional wisdom is that allocation decisions will not affect the incentives that firms face to reduce emissions under a cap-and-trade program, and therefore will not affect the program's societal cost.[3] Because allowances are tradable, regardless of how many allowances a firm receives, it will have the same incentive to curtail those emissions that can be reduced at a per-ton cost that is less than the price of an allowance. Allocation decisions therefore offer a valuable means of forging a political consensus, as allocations can be adjusted to gain support for a cap-and-trade program without affecting its overall cost or environmental integrity.

This conventional wisdom applies to many allocation approaches, such as those that determine a firm's allowance allocations based on its *historical* emissions, output, or production capacity. But, this wisdom does not hold for approaches that *condition* a firm's allocations on the firm's *future* operational or investment decisions. Examples of such conditional allocations

[3] For example, the first of several key findings in the National Commission on Energy Policy's influential allowance allocation report is that "[a]llocation affects the distribution of benefits and burdens among firms and industry sectors; it does not change program results or overall costs." National Commission on Energy Policy (2007), *Allocating Allowances in a Greenhouse Gas Trading System*, at viii.

(sometimes called "updating allocations") include provisions that would grant a firm more allowances if it chooses to increase its output or build a new plant, and provisions that would strip a firm of its allowance allocation if it chooses to shut down a facility. Conditional allocations give firms the opportunity to alter the number of valuable allowances that they receive by adjusting their operations or investments. As a result, such allocations can affect a firm's incentives to make particular operational changes or investments. In turn, by steering firms toward or away from certain means of reducing emissions, conditional allocations can affect how emissions are reduced under a cap-and-trade program, and can therefore affect the program's overall cost.[4]

Because the value of the overall allowance pool will be so great, conditional allocations can have profound effects even if they determine the distribution of only a small share of that allowance pool. For example, if the annual value of allowances exceeds $200 billion, a conditional allocation provision that distributes just two percent of those allowances would introduce new economic incentives whose aggregate value would exceed the fiscal year 2007 value of all federal tax incentives for renewable fuels and renewable electricity production.[5]

In some cases, conditional allocation provisions may be intentionally designed to encourage certain desirable investments. For example, the Lieberman-Warner bill would distribute "bonus allowances" in a manner that encourages the first few investments in carbon capture and storage. But, in other cases, policymakers may design conditional allocation provisions largely with an eye toward achieving certain distributional objectives. In such cases, there is a serious risk that those provisions will unintentionally introduce incentives that discourage the very actions and investments that are needed to reduce emissions cost-effectively.

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[4] Åhman et al. explore the implications of conditional allocations in the European Union's Emissions Trading Scheme. Markus Åhman, Dallas Burtraw, Joseph Kruger, and Lars Zetterberg (2007), "A Ten-Year Rule to Guide the Allocation of EU Emission Allowances," *Energy Policy* 35(3): 1718-1730.

[5] The Energy Information Administration (EIA) estimated that the value of those tax incentives was nearly $4 billion in fiscal year 2007. EIA (2008), *Federal Financial Interventions and Subsidies in Energy Markets 2007*.

A conditional allocation provision's effects depend in large part on its design. However, as the following section describes, the new entrant allocation provision in Section 3902 of the Lieberman-Warner bill offers a stunning example of just how profound those effects can be.

III. New Entrant Allocations under Section 3902 of the Lieberman-Warner Bill

Section 3902's new entrant allocation provision provides allowances to fossil-fuel-fired power plants built after 2007 on the basis of their future output.[6] Specifically, for each megawatthour (MWh) that it generates, a new fossil-fuel-fired plant would receive an amount of allowances equal to the average greenhouse gas emission rate of all fossil-fuel-fired plants that commenced operations during the five years prior to the Lieberman-Warner bill's enactment. Based on the plants that came on-line between 2003 and 2007, the average emission rate is about 0.52 metric tons per MWh.[7] Section 3901 of the Lieberman-Warner bill places a declining cap on the total number of allowances that can be distributed to fossil-fuel-fired plants under Section 3902. If the per-MWh allocation to new entrants would distribute more allowances than are set aside for fossil-fuel-fired plants, then that per-MWh allocation would be pro-rated downward accordingly. However, enough allowances are set aside such that new entrants could expect a 0.52 ton per-MWh allocation for several years following the program's implementation. Allocations in later years would depend on how much new capacity is built (and is thus entitled to the new entrant allocation), and on how heavily utilized that capacity is. Finally, allowances would not be distributed to fossil-fuel-fired plants after 2030. Figure 1 depicts the per-MWh allocation to new entrants under Section 3902, indicating how that allocation declines over time and how it depends on the amount of new fossil-fuel-fired capacity that is built.

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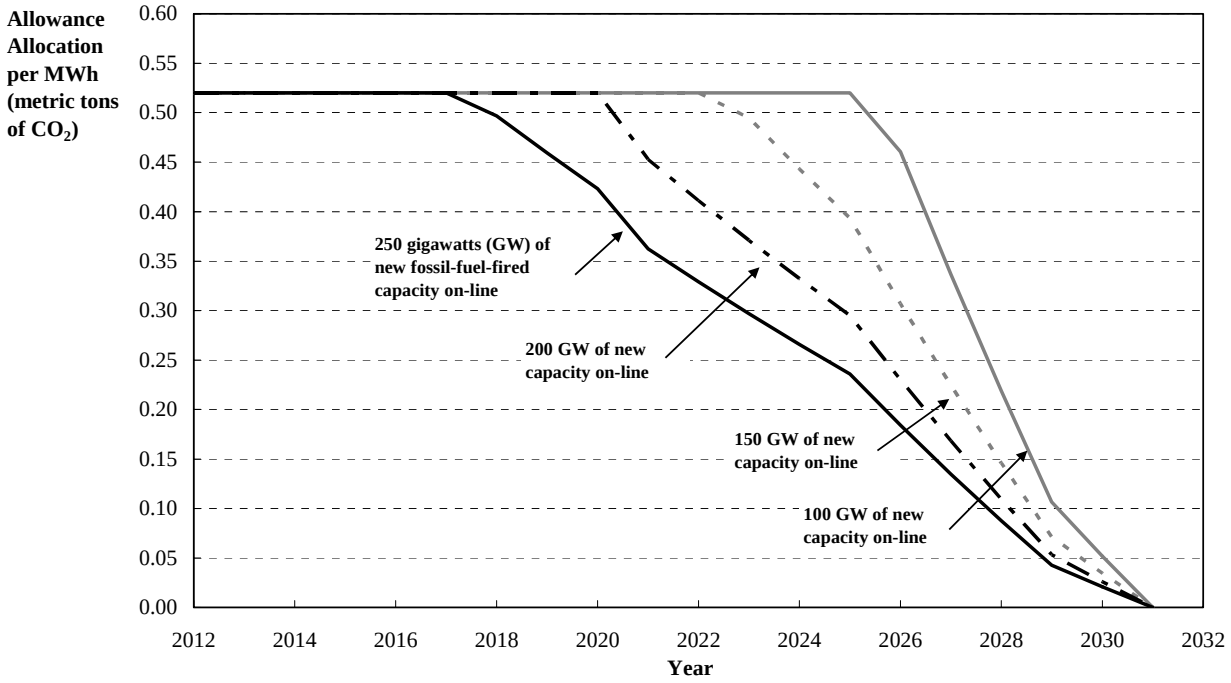
[6] Lieberman-Warner Climate Security Act of 2008, S. 2191, 110th Congress, § 3902 (2008), as reported out of the Senate Environment and Public Works Committee in December 2007.

[7] The rates of individual plants vary from as low as 0.3 tons per MWh for combined cycle gas plants to more than 1.0 ton per MWh for coal plants. This estimate was calculated as the capacity-weighted average 2007 carbon dioxide emission rate of those generating units that came on-line from 2003 and 2007. This calculation was performed using Platts BaseCase data for the first three quarters of 2007. Fourth quarter data were unavailable. Section 3902 states that the per-MWh allocation will be "the average greenhouse gas emission rate of all fossil fuel-fired electric power generating facilities that commenced operations during the 5 years preceding the date of enactment of this Act." Section 3902 does not state how this average should be calculated, and different methods would yield different average rates. Some alternative calculations yield average rates ranging from 0.46 to 0.54.

Figure 1. Per-MWh Allocations to New Entrant Fossil-Fuel-Fired Plants under Section 3902 of the Lieberman-Warner Bill as a Function of the Amount of Capacity that is Built



Sources: Lieberman-Warner Climate Security Act of 2008, S. 2191, 110th Congress, § 3902 (2008), as reported out of the Senate Environment and Public Works Committee in December 2007; and Platts BaseCase data.
Notes: The maximum per-MWh allocation of 0.52 tons is calculated as described in footnote 7. Allocation calculations assume an average capacity utilization factor of 85% for new plants. If the actual utilization factor is lower, per-MWh allocations will remain at the maximum level longer, and will be higher in each year in which allocations are pro-rated downward (until allocations are fully phased out in 2031).

Under Section 3902, fossil-fuel-fired plants that commenced operation before 2008 (existing plants) would receive those allowances set aside for fossil-fuel-fired plants under Section 3901 that remain after the requirements of Section 3902's new entrant provision are met. Thus, if the per-MWh new entrant allocation would exhaust all of the allowances set aside for fossil-fuel-fired plants in a given year, existing plants would not receive any allowances in that year. If allowances remain after the new entrant provision's requirements are met, an existing plant would receive a share of those allowances that is equal to its share of historical electricity sector greenhouse gas emissions.

Two important features of Section 3902's new entrant provision cause it to significantly alter the emission reduction incentives that a cap-and-trade program would create. First, the provision gives allowances to firms if they choose to build fossil-fuel-fired plants but not if they choose to build renewable or nuclear plants, which do not receive allowances under the

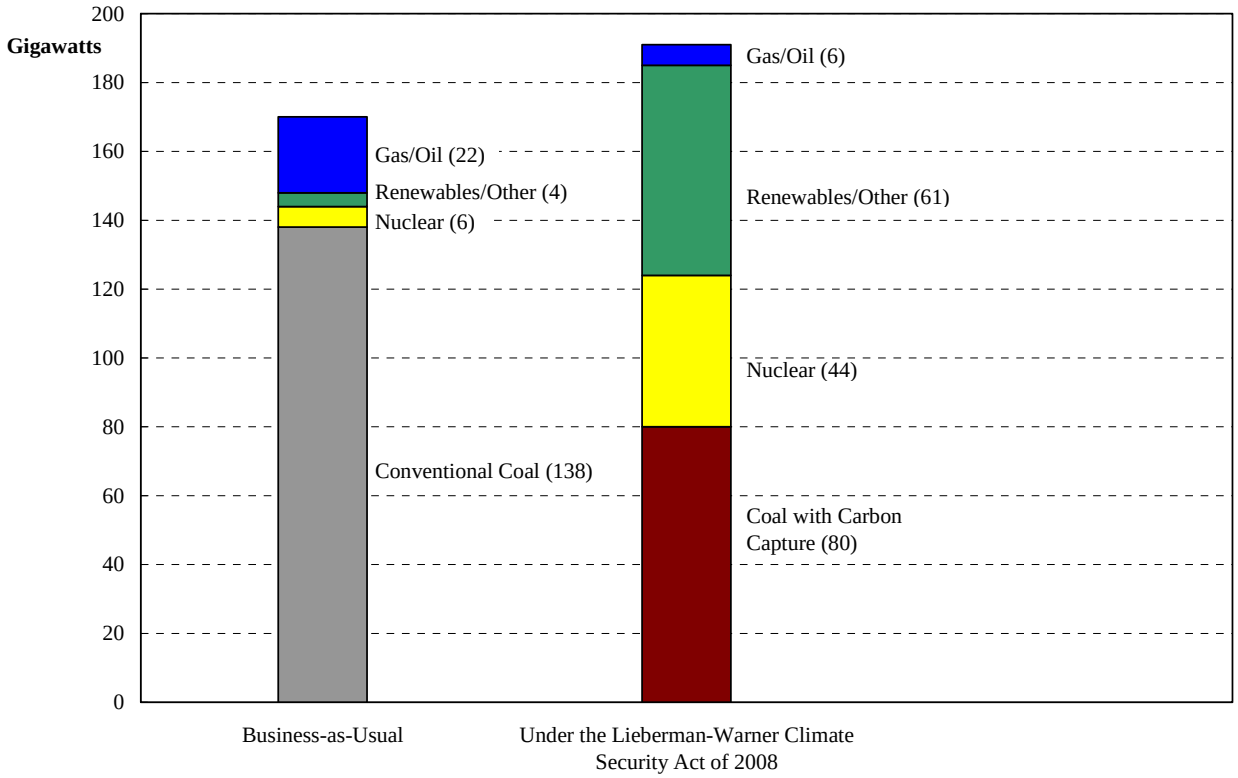
Lieberman-Warner bill. Second, the new entrant provision grants a specified number of allowances for *each* MWh that a new fossil-fuel-fired plant generates. So, the more electricity a new plant generates in each future year, the more allowances it receives in that year. By contrast, the number of allowances that an existing plant receives under Section 3902 does not depend on its future output. These two features dramatically alter the incentives that firms would face when considering investments in new generating capacity. In addition, once new capacity investments are made, the new entrant provision's second feature would significantly affect how new and existing plants are dispatched to meet electricity demand. Together, these two effects — which are described below — will increase the cost of achieving emission reductions in the electricity sector, and could even diminish the amount of reductions achieved in that sector.

A. Section 3902's effect on electric generating capacity investment decisions

By requiring firms to surrender valuable allowances for each ton of their greenhouse gas emissions, a cap-and-trade program increases the cost of operating existing and new coal, natural gas, and oil-fired power plants in proportion to their emissions intensity. By contrast, it has no impact on the cost of operating non-emitting renewable or nuclear plants. Thus, a cap-and-trade program introduces incentives to shift new capacity investments toward lower and non-emitting capacity.

Low-emitting fossil-fuel-fired plants (such as coal plants with carbon capture) are expected to play a significant role in meeting future electricity needs. However, many analyses also have found that a shift in some new capacity investments toward non-emitting plants can make a substantial contribution to cost-effectively reducing U.S. greenhouse gas emissions. For example, Figure 2 depicts EPA's projections of new capacity investments that would occur with and without the Lieberman-Warner cap-and-trade program. EPA projects that the program would cause firms to displace investments that they would otherwise make in conventional fossil-fuel-fired plants with increased investments in renewable and nuclear plants, and with new investments in advanced coal plants with carbon capture.

Figure 2. EPA Projections of Cumulative New Electric Generating Capacity Investments through 2025 with and without the Lieberman-Warner Climate Security Act of 2008 (These projections do not account for the Section 3902 new entrant allocations)



Source: U.S. EPA (2008), *EPA Analysis of the Lieberman-Warner Climate Security Act of 2008 (S. 2191 in 110th Congress)*, March 14.

However, EPA's analysis fails to account for Section 3902's new entrant allocation provision. This provision would dramatically reduce, and in some cases reverse, the incentive that a cap-and-trade program would create to shift new capacity investments away from fossil-fuel-fired plants toward renewable and nuclear plants.

With or without Section 3902, firms considering investing in new fossil-fuel-fired plants would account for the fact that they would need to surrender allowances to cover the emissions associated with each MWh that they generate from such plants. However, as a result of Section 3902, those firms also would account for the fact that they would receive more than half an allowance for each MWh that they generate from such plants — an entitlement that they would not enjoy if they instead invested in renewable or nuclear plants.[8] Thus, Section 3902 would

[8] The estimated allocation is based on the calculation described in footnote 7.

reduce the *effective* allowance requirement associated with generating electricity from new fossil-fuel-fired plants.

As a result of Section 3902, the net allowance requirement for each MWh of generation from a new conventional coal-fired plant would be less than half of the allowance requirement without Section 3902. While a new conventional coal plant's emission rate will vary depending on the specific plant, the Energy Information Administration (EIA) estimates that a typical plant would have to surrender 0.83 allowances per MWh to cover its emissions.[9] Therefore, a new conventional coal plant that receives 0.52 allowances per MWh under Section 3902 would face a net allowance requirement of just 0.31 allowances per MWh (see Figure 3). In effect, from the standpoint of its net allowance requirement per MWh, a new conventional coal plant would be treated as if it were *less* emissions-intensive than some of the most efficient existing combined cycle gas plants. Thus, Section 3902's new entrant provision would significantly increase the allowance price that would be necessary to encourage a shift away from new investments in conventional coal-fired generation toward investments in non-emitting generation.

Section 3902's effect on the net allowance requirement for new natural gas power plants would be even more perverse. EIA estimates that a typical new combined cycle gas plant would have to surrender 0.38 allowances per MWh to cover its emissions.[10] Therefore, a typical new combined cycle gas plant that receives 0.52 allowances per MWh of generation under Section 3902 would, on net, *accumulate* 0.14 allowances with every MWh that it generates (see Figure 3). Thus, whereas a cap-and-trade program should increase the cost of gas-fired generation relative to the cost of generation from renewable and nuclear plants, because of Section 3902, the Lieberman-Warner cap-and-trade program would do precisely the opposite for at least a decade after it is implemented.

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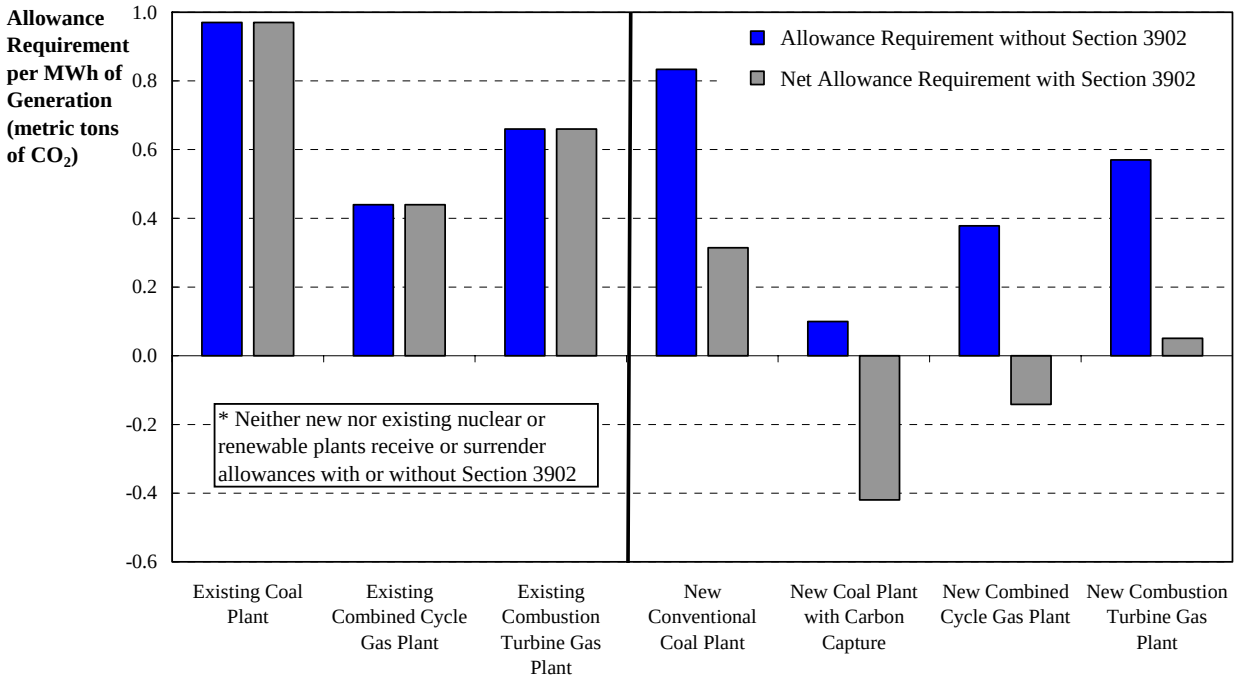
[9] This estimate is based on the assumed heat rate in 2006 for a scrubbed new coal unit and the carbon dioxide emission factor for coal, which are respectively presented in Tables 2 and 39 of EIA (2007), *Assumptions to the Annual Energy Outlook 2007*. The only coal unit that came on-line in 2007 for which 2007 emissions data are available had a slightly higher rate of 0.89. Platts BaseCase data.

[10] This estimate is based on the assumed heat rate in 2006 for a new conventional combined cycle gas unit and the emission factor for natural gas presented in EIA (2007). The combined cycle gas units that came on-line in 2007 for which 2007 emissions data are available had rates ranging from 0.37 to 0.46. Platts BaseCase data.

Figure 3. Allowance Requirement per MWh of Generation from Existing and New Fossil-Fuel-Fired Power Plants with and without Section 3902 of the Lieberman-Warner Bill



Sources: Platts BaseCase data (for existing plant heat rates); EIA (2007), *Assumptions to the Annual Energy Outlook 2007* (for new plant heat rates and fossil fuel emission factors); and Massachusetts Institute of Technology (2007), *The Future of Coal: Options for a Carbon-Constrained World* (for the emission rate from a new coal plant with carbon capture).
Notes: These values represent typical requirements for each plant type. Actual requirements depend on plant-specific circumstances. The residual emission rate for a coal plant with carbon capture assumes a 90% removal efficiency. Net allowance requirements for new plants are based on plants receiving 0.52 metric tons of allowances per MWh of generation under Section 3902.

A cap-and-trade program with the Section 3902 new entrant allocation provision would reduce the cost of generating electricity from new combined cycle gas units for several years. However, firms considering investments in new generating capacity would account for the fact that those allocations would be gradually phased out over time. Nonetheless, for some investments in combined cycle gas plants, the present value of the near-term benefits from those new entrant allocations may exceed the expected allowance costs that would begin to be incurred as those allocations are phased out. That is, Section 3902's effects may be so significant that, in the initial years of the Lieberman-Warner bill's cap-and-trade program, the program could actually *reduce* the present value cost of building and operating combined cycle gas plants. As a result, the program could actually create an incentive for firms to invest in those plants instead of renewable or nuclear plants.[11] Moreover, because of Section 3902, an even more perverse

[11] For example, straight-forward calculations demonstrate that the present value of allowance costs associated with operating a new combined cycle gas plant would be negative over the twenty-year time horizon from 2012 to 2031 if

outcome would be possible. If the Lieberman-Warner bill's cap-and-trade program does create a net incentive to invest in gas-fired plants instead of non-emitting plants in the initial years of the program, that incentive could actually increase if the allowance price turns out to be higher than expected. Of course, a cap-and-trade program should be sending precisely the opposite signal when the allowance price increases.

Finally, because of Section 3902, new coal plants with carbon capture also would enjoy a net gain of allowances with each MWh that they generate. A Massachusetts Institute of Technology study found that, if a coal plant can capture and store 90 percent of its carbon dioxide (CO_2) emissions, its residual emission rate would be between 0.09 to 0.14 metric tons per MWh.[12] Therefore, a new coal plant with carbon capture would have to surrender allowances to cover its residual emissions. However, if it also receives 0.52 allowances per MWh under Section 3902, it would enjoy a net gain of 0.38 to 0.43 allowances with each MWh that it generates. At an allowance price of $30 per ton of CO_2, this translates into a gain of 1.1 to 1.3 cents per kilowatthour. As a result, for more than a decade following the Lieberman-Warner cap-and-trade program's implementation, that program would significantly reduce the cost of operating coal plants with carbon capture.

Although the new entrant allocations would be gradually phased out, because of the new entrant provision, the Lieberman-Warner bill's cap-and-trade program would reduce the present value cost of new investments in coal plants with carbon capture for several years after the program's implementation.[13] Thus, for several years after its implementation, the cap-and-trade program would encourage firms to invest in coal plants with carbon capture instead of non-emitting renewable or nuclear plants, despite the fact that the coal plants would have residual

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one uses the following assumptions: a 0.38 ton per MWh emission rate for the new plant; the new-entrant allocation schedule from Figure 1 associated with 150 gigawatts of new fossil-fuel-fired capacity coming on-line; EPA's "core" projections of allowance prices under the Lieberman-Warner bill from its IGEM model; and a 7 percent real discount rate. Of course, the values for all of these inputs are highly uncertain and will be influenced by firms' responses to Section 3902. The intent here is simply to show that the new entrant allocation provision is designed in such a way that this outcome is possible.

[12] Massachusetts Institute of Technology (2007), *The Future of Coal: Options for a Carbon-Constrained World.*

[13] The bill's effect on a plant's present value cost would depend in part on how quickly such a plant could come on-line after 2012, the start of the Lieberman-Warner bill's cap-and-trade program.

emissions. Here again, this incentive would increase if the allowance price turns out to be higher than expected. Moreover, this incentive would be additive on top of the incentive for initial investments in carbon capture that would be introduced by the Lieberman-Warner bill's "bonus allowances" provision.[14]

In summary, even with an aggressive cap-and-trade program in place, low-emitting fossil-fuel-fired plants (such as coal plants with carbon capture) will almost certainly play a substantial role in meeting our future electricity needs. At the same time, many believe there is a significant potential to cost-effectively reduce U.S. greenhouse gas emissions by shifting some investments in new electric generating capacity toward non-emitting renewable and nuclear plants. Yet, the new entrant allocation provision in Section 3902 of the Lieberman-Warner bill would dramatically reduce, and in some cases reverse, the incentive that a cap-and-trade program would otherwise create for firms to invest in non-emitting plants.

B. Section 3902's effect on the dispatch of capacity to meet electricity demand

In addition to distorting investment decisions, Section 3902 would severely distort the dispatch of generating capacity to meet electricity demand once new generating capacity is in place. This is the case because, as a result of Section 3902, the net allowance requirement for each MWh of generation from a new fossil-fuel-fired plant would be significantly lower than that for an existing plant with an identical emissions profile.

For example, a combined cycle gas plant with a heat rate of 7,200 British thermal units per kilowatthour (Btu/kWh) emits approximately 0.38 metric tons of CO_2 per MWh of generation. Therefore, both existing and new gas units with that heat rate would have to surrender 0.38 metric tons of allowances per MWh of generation. Yet, unlike an existing unit, a

[14] Sections 3601 to 3605 of the Lieberman-Warner bill establish a "Bonus Allowance Account" containing 4 percent of the total pool of allowances created under the cap-and-trade program from 2012 to 2030. Allowances from the Account would be distributed to those firms that are the first to deploy carbon capture and storage. EPA estimated that the Account would be sufficiently large to distribute allowances to the first 10 gigawatts of generating capacity with carbon capture. These plants would receive as many as 4.5 allowances for each ton of emission reductions that they achieve through carbon capture and storage during the first ten years of their operation. EPA's analysis indicates that, for a plant that commences operation in 2015, the value of its bonus allocation during the ten-year period could, on average, be 10 cents for every kilowatthour that it generates during that period. U.S. EPA (2008).

new gas unit also would receive 0.52 metric tons of allowances for each additional MWh that it generates. Thus, the new plant would enjoy a net *gain* of 0.14 allowances with each MWh that it generates, reducing its marginal cost of electricity generation both in absolute terms and relative to an identical existing plant.

As the above example demonstrates, because of Section 3902's new entrant provision, the net operating costs of new fossil-fuel-fired plants would be lower than that of otherwise identical existing plants. Worse yet, because of Section 3902's new entrant provision, less efficient, higher emitting new entrants would have lower operating costs than some more efficient, lower emitting existing plants. For example, at a natural gas price of $7 per million Btu and an allowance price of $30 per ton of CO_2, despite consuming more natural gas and emitting more per MWh of generation, a new gas-fired unit with a heat rate as high as 9,000 Btu/kWh would have a lower net operating cost (accounting for fuel and net allowance costs) than an existing gas-fired unit with a heat rate of 7,200 Btu/kWh.[15] Thus, in this example, as a result of Section 3902, a new gas-fired unit would displace an existing unit in the dispatch order despite having higher fuel costs and emitting 25 percent more CO_2 per MWh. This would lead to an *increase* in natural gas use and electricity sector emissions. Moreover, as the allowance price increases, so too would this distortion. At an allowance price of $45 per ton of CO_2, despite emitting 35 percent more CO_2 per MWh, a new unit with a heat rate of nearly 9,700 Btu/kWh would displace an existing unit with a heat rate of 7,200 Btu/kWh.

In addition to the perverse effects that it would have on societal costs and electricity sector emissions, Section 3902's new entrant provision also would adversely affect the profitability of existing plants. It could thereby cause the inefficient premature retirement of some existing plants. As illustrated above, new plants may displace existing plants in the dispatch order even in cases where the displaced plants are more efficient and less emissions-intensive. Moreover, because their net allowance requirement per MWh of generation would be

[15] In this and the following example it is assumed that Section 3902 would grant the new unit 0.52 allowances per MWh, and that all variable operating costs other than fuel and allowance costs are the same for the two units.

lower than that of identical existing plants, new plants would be willing to generate electricity at lower prices than would identical existing plants. This would reduce the market price of electricity that all plants receive for their power. As a result of these two effects, existing plants' revenues and profitability would be much lower than if new entrants did not receive free allowances for each MWh that they generate.

IV. Policy Lessons and Conclusion

As has been demonstrated above, the new entrant provision in Section 3902 of the Lieberman-Warner bill introduces profoundly distortionary incentives that undermine much of what a cap-and-trade system is intended to achieve. Indeed, its effects are so problematic that it is hard to imagine that the new entrant provision will be maintained in its current form once those effects are better understood. Therefore, it is also important to consider the broader lessons that emerge from examining this provision.

An examination of Section 3902 makes clear that great care must be taken in deciding how to allocate allowances under a cap-and-trade system. Any allocation provision that conditions firms' allocations on their future investment or operational decisions can introduce powerful and potentially undesirable incentives. While Section 3902 offers an extreme example of how conditional allocation provisions can create unintended negative consequences, the Lieberman-Warner bill contains other conditional allocation provisions that also will discourage potentially cost-effective means of reducing emissions. For example, Section 3901 of the bill would strip existing power plants (and other facilities) of their future allocations if they shut down. While intuitively appealing, this provision would actually discourage a firm from shutting down an inefficient power plant. This is because, by shutting down, the firm would lose a valuable claim on future allowance allocations. If that claim is sufficiently large, it would be economically rational for a firm to continue operating the plant even if its costs of electricity generation exceed its revenues from electricity sales.[16]

[16] *See* Åhman et al. (2007).

Given the incentives that they can introduce, conditional allocations should be avoided wherever possible, unless they are intentionally designed to encourage particular investments or emission reduction measures. In fact, even when a conditional allocation provision is *intended* to create a particular incentive, if it is not carefully designed, the nature and magnitude of the resulting incentive may be far different than anticipated. For example, an economic argument can be made for encouraging the initial deployment of coal plants with carbon capture. However, if this is done by allocating "bonus allowances," in designing those allocations, consideration needs to be given to the desired magnitude of the resulting incentive.[17] EPA's analysis of the Lieberman-Warner bill indicates that, on average, the value of the bill's carbon capture bonus allowances could amount to as much as 10 cents for every kilowatthour that the initial recipients of those allowances generate over a ten-year period.[18] This begs the question of whether a similar level of investment in carbon capture could be encouraged with a lesser bonus allocation. Moreover, these carbon capture bonus allowances offer an example of how it is important to consider the full set of incentives created by conditional allocations. As a result of the carbon capture bonus allowances, all else equal, the higher is the allowance price the more firms will be willing to invest in carbon capture even if there are less costly opportunities to invest in new non-emitting renewable or nuclear capacity.

In the end, the lessons that emerge from examining Section 3902 point strongly toward the need to carefully examine the incentives created by any conditional allocations that may be employed in a cap-and-trade program. Otherwise, there is a real risk that much of the emission reduction measures achieved under a cap-and-trade program will be driven by allocation decisions made in the halls of Congress, rather than by the market-based incentives that a cap-and-trade program is intended to create. Such an outcome would invariably increase the cost of reducing our national greenhouse gas emissions.

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[17] The magnitude of the incentive created by allocating bonus allowances will depend on how many allowances are awarded to firms that make the initial investments in carbon capture, and on the allowance price itself, which is subject to significant uncertainty.

[18] See footnote 14.