Economic and Environmental Implications of Allowance Allocation Benchmark Choices

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An important issue in the design of any cap-and-trade system is how to allocate emission allowances that are used to comply with the program's aggregate cap on emissions. Decisions about allowance allocations can have consequences for the policy's cost of achieving emission reductions, the environmental benefits achieved by the program, and the distribution of economic impacts.

California's Air Resources Board (ARB) has proposed to allocate a portion of allowances through an updating output-based mechanism to help reduce the interstate and international competitiveness impacts of the climate policy during the transition to a cap-and-trade system. The most important feature of this mechanism is that it allocates a fixed number of allowances for each unit of an industrial sector's output.[1] This mechanism is recognized as one approach to addressing emission leakage and its associated economic consequences.[2] By providing free allowances in proportion to a facility's production levels, an updating output-based allocation can offset the incremental cost imposed on facilities from the cap-and-trade system and thus eliminate any competitive advantage provided to out-of-state producers that might cause production – and its associated emissions – to shift out-of-state.

An important decision in the design of an updating output based allocation mechanism is the choice of an emissions benchmark, which – in effect – determines the number of emission allowances allocated for each unit of output. Two common alternatives for a benchmark are the industry-average emission rate and a lower emission rate that reflects a "best practice" or "best-in-class" facility. In the design of California's cap-and-trade program, ARB has proposed to use a "best-practice" approach, in which each sector's emission benchmark will be set equal to the greater of (1) 90% of the industry average or (2) the emission rate of the most efficient – or "best-in-class" – facility.

In discussions that have taken place regarding this benchmark choice, a number of misconceptions have arisen regarding the impacts of this choice on economic and environmental outcomes. This brief report seeks to provide a clearer conceptual understanding of these impacts, and to provide estimates of the associated shifts in expenditures for a sub-set of affected sectors.

Economic and Environmental Consequences of Benchmark Choice

With an updating output-based allocation, varying the magnitude of the emission benchmark effectively changes the magnitude of the carbon price faced by individual producers. This can be seen in Figure 1, which shows the emission rate for a set of hypothetical facilities in a hypothetical industry. Without free allocations, producers face the full carbon cost of production, which may lead to a number of market responses, including higher prices (and potentially an associated reduction in demand), and substitution of out-of-state for in-state production – that is,

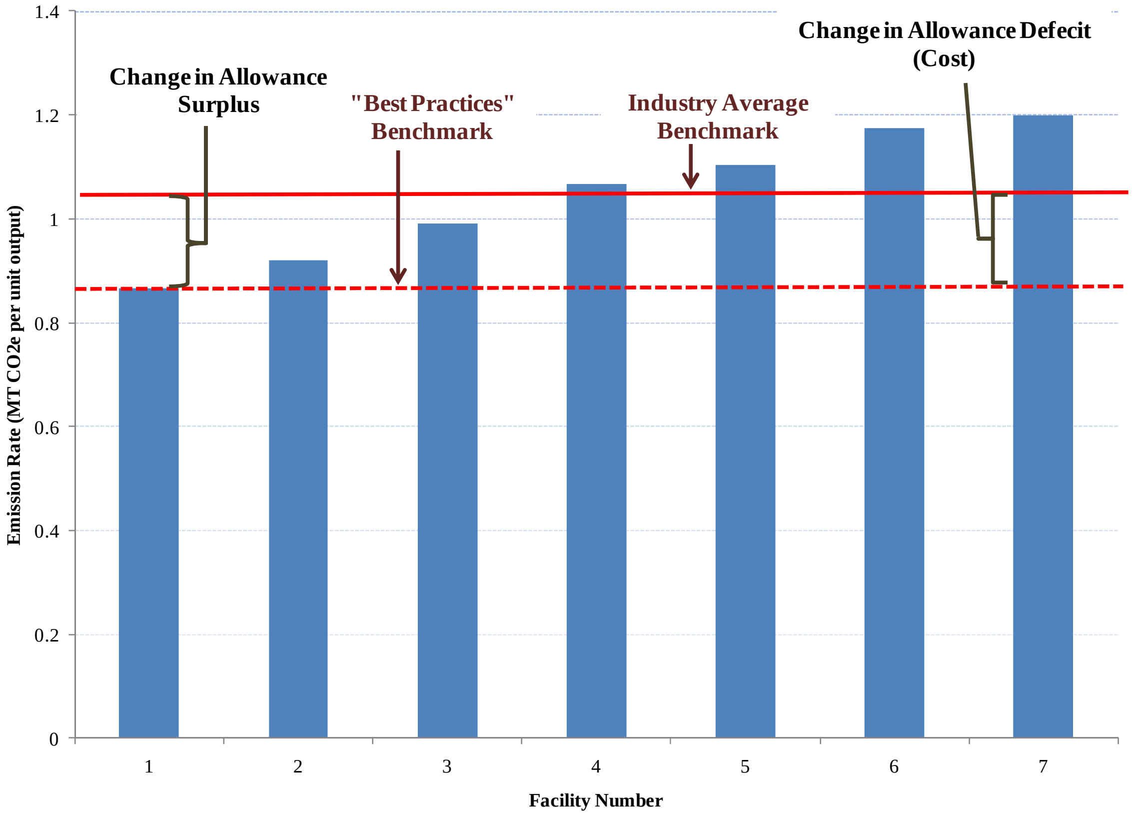
[1] As we discuss below, under ARB's proposal, allowances would be allocated to the petroleum refinery sector using a variation on this approach.

[2] Stavins, Borck, Schatzki, *Options for Addressing Leakage in California's Climate Policy*, February 2010.

leakage. Such leakage can arise due to increased flow of goods into California from out-of-state producers (i.e., greater imports) or through reduced supply of goods to out-of-state consumers by California producers (i.e., reduced exports.)

An ordinary free allocation of allowances that is fixed at some historical baseline – typically characterized as "grandfathering" – does not ameliorate the reduction in competitiveness due to imposition of carbon constraints. Because this approach to allocation is not tied to production levels, it has no effect on marginal costs of production, which are what determines competitiveness and comparative advantage. In contrast with this approach, an updating output-based allocation can address the reduction in competitiveness due to the environmental constraint, because the allocation is tied to production levels and so affects marginal production decisions. Thus, using this approach, production costs can be returned to levels comparable to those that would have prevailed absent the environmental constraint, thereby addressing competitiveness impacts, while still maintaining the environmental constraint and the benefits of environmental protection.

Figure 1
Emission Rate and Allowance Benchmarks for a Hypothetical Industry



By contract, when allowances are allocated using an updating output-based allocation, producers receive allowances for each unit of output, which can offset the allowance costs associated with production process emissions. However, the choice of benchmark determines what share of this cost is actually offset. Within this framework, the economic and environmental implications of lowering the benchmark from the industry-average benchmark to a 90% of industry-average benchmark can be examined.

First, lowering the benchmark may raise market prices to consumers for products from industry, since, shown in Figure 1, the carbon cost imposed on all producers increases with a lower benchmark. The magnitude of these price responses depends on industry-specific characteristics of supply and demand for the particular product. [3]

Second, lowering the benchmark may result in emission leakage and economic (jobs) leakage. The increase in carbon cost to in-state producers will give out-of-state producers a cost advantage that may cause a shift in current production or future investment. Leakage would cause in-state economic impacts and reduce the cap-and-trade system's environmental effectiveness. As with price effects that arise from an increase in costs, the extent to which leakage arises would depend upon particular market circumstances.

Third, lowering the benchmark may reduce the overall cost of achieving emission reductions. Without free allocations, output prices would better reflect the underlying cost of carbon, which might lead consumers to substitute lower-carbon goods and services for higher-carbon goods and services, thus lowering the cost of achieving emission reductions. These cost impacts could affect prices to consumers for goods and services outside of industry. ARB has acknowledged that this a "necessary tradeoff in order to minimize leakage to the extent feasible as required by AB 32."[4] But, the benchmark decision does not affect incentives to reduce carbon emissions including increased energy efficiency of operations; with an updating output-based allocation, producers have the incentive to invest in emission reductions since they are able to capture the cost savings from these investments.

Finally, benchmark decisions have distributional consequences. For example, reducing the benchmark below the industry average will increase government revenues, benefitting the public sector at the expense of the private sector. The benefits from additional government revenues would depend largely upon the particular uses chosen by legislators and government administrators. While the shift in benchmark would allow the government to create benefits, it would do this by imposing costs on consumers and businesses. In particular, costs to consumers would rise due to higher goods prices, and economic activity within the state, including employment and profits to business owners, would decline.

Thus, shifting the benchmark used to determine the quantity of allowances for industry assistance would result in a mix of economic and environmental consequences. As shown by Figure 1, the impacts to industry will vary across facilities, with facilities with lower emission rates facing impacts greater than those at the industry average.[5]

Concerns about Windfall Profits

One alleged advantage of a best practices benchmark is that it could diminish "inappropriate overcompensation" to industry due to the allocation of free allowances. These concerns stem, in

[3] For example, recent research suggests that increases in the costs of gasoline supply (as with a state gasoline taxes) are largely passed through to consumers. Marion, Justin and Erich Muehlegger, "Fuel Tax Incidence and Supply Conditions," March 2010. Note that this circumstance reflects a uniform cost across all producers and sellers, whereas California's cap-and-trade system will impose costs on in-state but not out-of-state producers.

[4] Air Resources Board, Appendix J, Allowance Allocation, p. J-9, July 2011.

[5] ARB staff argues that the ability to arbitrage emission allowances for emission offsets offers an opportunity to further lower their compliance costs. This logic is flawed, since any difference in market prices between allowances and offsets would reflect additional costs faced by those that use offsets. Such costs could include risks that offsets are invalidated at a future date or greater administrative costs.

part, from the experience of the European Union Emission Trading Scheme (EU ETS), of which some researchers have found that industry received excess or "windfall" profits as a consequence of the way in which allowances were allocated.[6] ARB and other stakeholders hope that policies aiming to achieve other public policy goals, such as mitigating leakage, do not inadvertently boost industry profitability at the public's expense.[7]

To understand these issues, it is important to recognize, first, that the imposition of any regulation on an economic sector can result in winners and losers within an industry due to differences in the impact of the new regulations on individual companies. In the context of a cap-and-trade system, the profitability of individual producers may rise or fall due to pre-existing differences in facility emission rates that create differences in compliance costs across facilities. For example, as shown in Figure 1, because compliance costs will vary across facilities, more efficient producers may see benefits if market prices rise more than the cost increase they face. By contrast, less efficient producers likely would see losses since the change in their costs would likely exceed any increase in prices.[8] (Appendix A provides a more detailed discussion and graphical illustration of this point.)

However, because an updating output-based allocation imposes a uniform cost on all facilities regardless of the benchmark choice, increasing or decreasing the benchmark will likely lead to (partially or fully) offsetting effects with potentially little inter-industry change in profits. On the one hand, lowering the benchmark would raise producers' costs, thus lowering profits; on the other hand, market prices would also likely rise in response to the higher costs.[9] Consequently, profits to individual facilities would likely remain unchanged (aside from any potential impacts due to leakage). (See Appendix A.)

Consider the case in which the benchmark is set at the industry-average emission rate, as shown in Figure 1. In this case, Facility 7 receives insufficient allowances per unit of output, while Facility 1 receives surplus allowances for each unit of output. Because Facility 1 receives surplus allowances, some have argued that the benchmark should be set at its emission rate so that it will not receive any "excess" allowances.[10] However, while shifting the benchmark to this lower "best practices" benchmark may eliminate any surplus allowances to Facility 1, the lower benchmark will also impose a greater (marginal) carbon cost on the industry, which would likely lead to higher prices. Thus, the price response hinders any effort to eliminate the "surplus" to Facility 1. While a higher benchmark may raise industry profitability by increasing its competitiveness compared with out-of-state industry, it would likely do little to change the mix of winners and losers among in-state producers.

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[6] For example, *see* de Bruyn, Sander, et al., "Does the energy intensive industry obtain windfall profits through the EU ETS? An econometric analysis for products from the refineries, iron and steel, and chemical sectors," CE Delft, April 2010.

[7] For example, Air Resources Board, Appendix J, Allowance Allocation, pp. J-8 to J-9, July 2011.

[8] As shown in the Appendix, changes in market prices will depend upon how costs change for the marginal facility that sets market prices. This facility could be a facility with a low emission rate, in which case all producers would face losses; or, this marginal facility could have a high emission rate, in which case all producers would see gains.

[9] The extent to which new costs are passed through to consumers will depend upon market conditions of supply and demand.

[10] Air Resources Board, Appendix A to 2nd 15-day Cap-and-Trade Regulatory Text: Refinery Allocation Methodology, September, 2011.

Some have supported their concerns about windfall profits by pointing to the experience of the EU ETS.[11] However, the experience in the EU ETS provides a poor example for California because of important policy differences between these programs that mitigate concerns about windfalls. While California's program would use updating output-based allocations, the EU ETS allocated allowances to industry using a very different mechanism that allows industry to benefit from *both* higher output prices and the value of free allowances.[12] The industry-wide windfalls that potentially arise under the grandfathering approach are qualitatively different than the inter-industry changes in profitability (and potential gains to certain producers) under the updating output-based approach proposed for California by ARB. This approach is designed to avoid raising output prices and to provide allowances as a means of addressing the cost of complying with the cap-and-trade system. Given these differences in policy design, the experience with allowance allocations in the EU is irrelevant to the California system. Thus, aside from addressing issues related to leakage, providing industry with allowances through an updating output-based allocation is unlikely to lead to any industry-wide windfalls of concern in the EU.[13]

Implications of ARB's Benchmark Decisions

ARB faces a decision regarding how it will allocate allowances to businesses for the purposes of industry assistance. To consider the consequences of this decision, we have estimated the additional expenditures that would be faced by industry in California due to the decision to use a benchmark based on a "best-practices" emission rate rather than the industry-average emission rate. Our analysis considers all sectors for which ARB's documentation allows the difference in the "best-practices" and industry-average benchmarks to be calculated. These sectors are listed in Table 1, along with the ARB's proposed benchmark emission rate, the benchmark units, and total emissions

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[11] Union of Concerned Scientists, "Re: Comments on Proposed (15-day) Revisions to AB 32 Cap-and-Trade Regulation," August 11, 2011;

[12] In the EU ETS, industry receives a fixed quantity of allowances regardless of actual production. Consequently, the cap-and-trade system imposes a marginal cost for each unit of output, thus increasing prices. In fact, research suggests that allowances costs were passed through to consumers, in spite of free allowances. By contrast, because ARB's proposal would allocate allowances *in proportion to output*, the cost of the cap-and-trade program is diminished (depending on the size of the allocation per unit output). There are tradeoffs involved in the different approaches taken in the EU and California. The EU program compensates industry, but does not provide incentives that would avoid leakage or shifts in production to producers outside the cap. The California system is designed to prevent emission leakage, but does not alter consumers purchasing decisions through internalizing carbon costs into the price of goods and services.

[13] The allowance allocation approach proposed by ARB for the refinery sector differs somewhat from the approach proposed for other sectors. While allowances to other sectors will be based upon product output, the refining industry would receive allowances based on both actual GHG emissions and a facility-specific energy efficiency index. Under this approach, allowances would be allocated in proportion to output, although the number of allowances received for each unit of output would vary across facilities. As noted by ARB, this allocation approach has been proposed to reduce the wide variation in impacts that would have occurred under a strict output-based benchmark. The alternative approach is designed to achieve two effects. First, it is designed to reduce the "surplus" allowances received by the facilities with the lowest emission rate. Second, it is designed to reduce the allowance deficit faced by the facilities with the highest emission rate, which would thus be faced with the greatest leakage risk.

in 2007 and 2008.[14] These sectors represent about 75% of the total industry emissions that would be covered by the industry assistance program. For each of these sectors, the allocation benchmark equals 90% of the industry's average emission rate.

Table 2 reports estimates of the impact of the benchmark choice in terms of total GHG allowance expenditures for 2013. Impacts for other sectors are not reported because the difference between the "best-practices" and industry-average benchmarks is not known. For 2013, total GHG allowance expenditures would rise by an estimated $51 million if allowance prices are $10 per MT CO_2e, and $274 million if allowance prices are $54 per MT CO_2e (the price for the highest tier of the allowance reserve.) Our analysis does not evaluate the likelihood or extent to which leakage or price increases would occur given current market conditions or the magnitude of the adjustment to expenditures that would occur given the benchmark alternatives considered.[15] Table 3 reports the impact on expenditures for the first compliance period, 2013 and 2014. Over this period, total GHG allowance expenditures would rise by an estimated $101 million if allowance prices are $10 per MT CO_2e, and $543 million if allowance prices are $54 per MT CO_2e.

Conclusion

California's Air Resources Board is in the final stages of the design of its GHG cap-and-trade system. One of the final issues it must resolve is how to allocate emission allowances for industry assistance, including the decision about the number of allowances to provide for each unit of industry output. Decisions about whether to set the benchmark at the industry-average emission rate or at a more stringent "best-practices" rate have potential implications for economic and environmental outcomes. While using the "best-practices" benchmark could raise the prices consumers pay for products from industry and lead to emissions leakage and economic leakage, it could also lower the cost of achieving emission reductions. However, experience from the Europe's Union Emission Trading Scheme, where concerns about "windfall" profits has arisen as a concern, is not relevant to California given differences in the approaches taken to allocating emissions. For sectors representing about 75% of total California industry emissions, additional expenditures would be about $101 million if allowance prices are $10 per MT CO_2e, and $543 million if allowance prices are $54 per MT CO_2e (the price for the highest tier of the allowance reserve in 2013) over the two-year first compliance period (2013-2014). Our analysis does not consider the extent to which leakage, price or cost effects would occur as a consequence of the benchmark choice.

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[14] ARB indicates that the benchmarks for Hydrogen and Cement Production will be based on a "best-in-class" estimate that is less than 10%, but does not report the industry-average emission rate. For all other sectors, ARB does not report whether the proposed benchmark reflects 90% of the industry average, or the "best-in-class" rate. Air Resources Board, Appendix B: Development of Product Benchmarks for Allowance Allocation, July 2011.

[15] Among other factors, the magnitude of any leakage or price effects would depend upon the size of these adjustments relative to each industry's overall cost structure. For an example of such an assessment, *see* Houser, Trevor et al., "Leveling the Carbon Playing Field, International Competition and US Policy Design," Peterson Institute for International Economics, World Resources Institute, Washington, D.C., May 2008.

Table 1
Emissions and Allocation Benchmarks for Selected Industries Receiving Industrial Assistance

			2007		2008	
Sector	**Benchmark**	**Benchmark Unit**	**Emissions (MMT CO2e)**	**Percent**	**Emissions (MMT CO2e)**	**Percent**
Crude Petroleum and Natural Gas Extraction						
Thermal EOR	0.0654	Barrel of Crude (Thermal EOR)	8.08	11.5%	8.35	11.9%
Non-Thermal	0.01	Barrel of Crude (Non-thermal)	7.67	10.9%	7.92	11.3%
Petroleum Refineries	0.0465	Barrel of Primary Refinery Products	36.01	51.4%	35.60	50.6%
Glass Container Manufacturing	0.264	Short Ton of Container Glass Pulled	0.44	0.6%	0.32	0.5%
Other Sectors			17.88	25.5%	18.13	25.8%

Notes:
Includes industries for which ARB has indicated that the benchmark for free allocations is based on 90% of the industry-average emission rates. The estimate of total emissions for the Other Sector receiving Industrial Assistance reflect an effort to match industry categories in the Cap-and-Trade rule, as identified by NAICS codes, with GHG emissions from the 2008 California Emissions Inventory, which organizes emissions through a multi-level industry designations.
EOR is Enhanced Oil Recovery.

Sources:
Air Resources Board, Cap-and-Trade Regulation, Appendix B: Development of Product Benchmarks for Allowance Allocation, July 2011; Air Resources Board, Greenhouse Gas Emission Inventory Data, Third Edition, 2000-2008, May 12, 2010.

Table 2
Impact of Allowance Benchmark Choice on Annual (2013) GHG Allowance Expenditures
Industry-average Benchmark versus 90% Industry Benchmark
($ Million)

	Allowance Price ($ per MTCO2e)			
Sector	**$10**	**$25**	**$43**	**$54**
Crude Petroleum and Natural Gas Extraction				
Thermal EOR	8.1	20.1	34.5	43.1
Non-Thermal	7.6	19.1	32.7	40.9
Petroleum Refineries	35.1	87.8	150.3	187.9
Glass Container Manufacturing	0.4	0.9	1.6	2.0
Total	51.2	128.0	219.1	273.9

Note:
Incremental expenditures are based average of total emissions for 2007 and 2008.
Estimates reflect the reduction in allowances received through ARB's allowance allocations to industry assistance regardless of whether a producer would receive a surplus or deficit of allowances under either benchmark.
Allowance prices of $43 and $54 per MT CO_2e reflect the cost of allowances from the first and third tiers of the Allowance Reserve in 2013, assuming an annual inflation of 2%.

Sources:
Air Resources Board, Cap-and-Trade Regulation, Appendix B: Development of Product Benchmarks for Allowance Allocation, July 2011; Air Resources Board, Greenhouse Gas Emission Inventory Data, Third Edition, 2000-2008, May 12, 2010.

Table 3
Impact of Allowance Benchmark Choice on GHG Allowance Expenditures During the First Compliance Period (2013-2014)
Industry-average Benchmark versus 90% Industry Benchmark
($ Million)

	Allowance Price ($ per MTCO2e)			
Sector	**$10**	**$25**	**$43**	**$54**
Crude Petroleum and Natural Gas Extraction				
Thermal EOR	16.0	39.9	68.3	85.4
Non-Thermal	15.2	37.9	64.9	81.1
Petroleum Refineries	69.6	174.0	297.9	372.3
Glass Container Manufacturing	0.7	1.8	3.2	4.0
Total	101.5	253.6	434.2	542.8

Note:
Incremental expenditures are based average of total emissions for 2007 and 2008.
Estimates reflect the reduction in allowances received through ARB's allowance allocations to industry assistance regardless of whether a producer would receive a surplus or deficit of allowances under either benchmark.
Allowance prices of $43 and $54 per MT CO_2e reflect the cost of allowances from the first and third tiers of the Allowance Reserve in 2013, assuming an annual inflation of 2%.

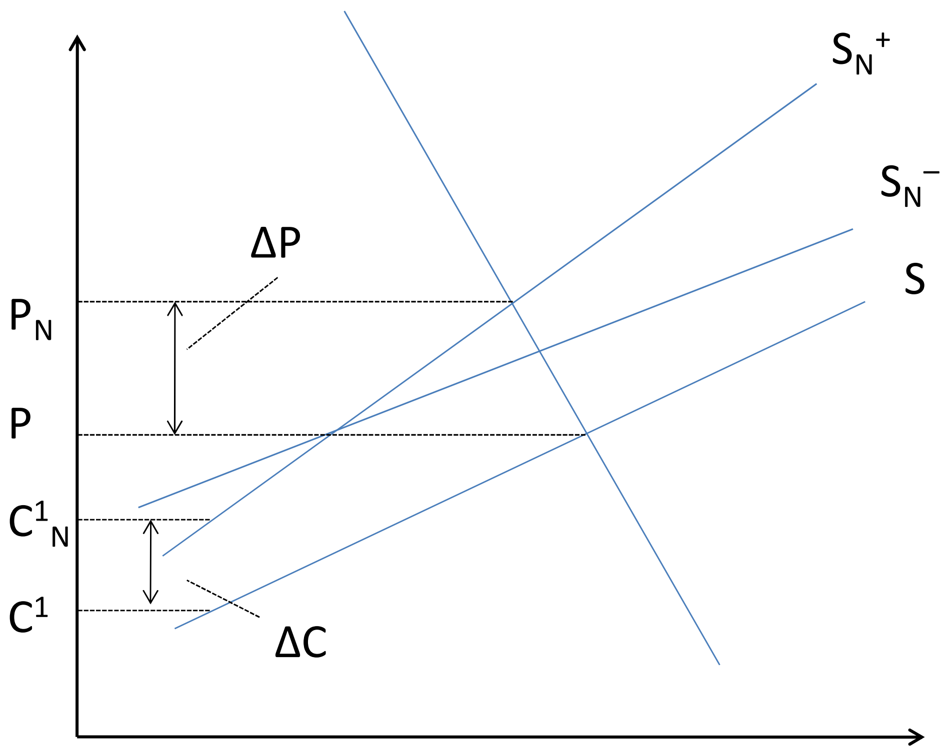
Sources:
Air Resources Board, Cap-and-Trade Regulation, Appendix B: Development of Product Benchmarks for Allowance Allocation, July 2011; Air Resources Board, Greenhouse Gas Emission Inventory Data, Third Edition, 2000-2008, May 12, 2010.

Appendix: Analysis of Economic Consequences of Allowance Allocation Benchmark Options

In this appendix, we briefly consider the impact of allowance allocation choices on producer profitability. To better understand inter-industry effects, we assume there is no out-of-state industry so that leakage effects are not an issue. Consequently, this analysis eliminates a potentially important source of lost economic activity for the state.

As with any economic regulation, the change in marginal costs from a cap-and-trade system may vary across producers within an industry. Given these differential cost impacts, the change in the industry supply curve as a result of the new regulation will depend on the nature of the industry's costs and the nature of the new regulation. As shown in Figure A1, if the marginal costs of the new regulation are positively correlated with existing production (marginal) costs, the supply curve will become steeper (see line, S_N^+). Under these conditions, the change in costs to the marginal producer is greater than the cost impact on infra-marginal producers, and the increase in equilibrium prices due to the regulation may exceed increases in costs to infra-marginal producers, thus increasing profits to these producers (i.e., $\Delta P > \Delta C_1$). Consequently, because of the industry's price response to new regulations and the differential cost impacts across producers, not only will new regulations have uneven economic impacts across producers, but some producers may be economically advantaged by new regulation.[16]

Figure A1
Graphical Analysis of the Impact of a New Regulation on the Industry Supply Curve



[16] If some producers face capital constraints (i.e., constraints on their ability to finance new investment), new regulations may also benefit more financially able producers if their financial positions allow them to undertake investments required by new regulations that less financially able competitors cannot undertake.

By contrast, when the costs of the new regulation are negatively correlated with existing marginal production costs, then the supply curve becomes flatter (see line, S_N-). In this case, while equilibrium prices will increase, all producers will be disadvantaged by the policy because increases in costs will exceed increases in prices, although impacts to infra-marginal producers will exceed those of marginal producers.

Two types of approaches are typically considered to allocate free allowances to producers. Under one approach, often referred to as grandfathering, producers receive a fixed quantity of allowances that is independent of actual operations during the period when regulations are in place. Under this approach, the free allocations effectively provide a one-time payment, but do not change marginal production costs, since producers receive the same quantity of allowances irrespective of their production activities. Consequently, supply curves remain unchanged regardless of the quantity of allowances received, and prices remain unchanged from levels represented in Figure 1.

With an updating output-based allocation, producers receive a quantity of allowances for each unit of output. Because allowances are allocated in proportion to output, the free allocation effectively lowers the cost of complying with the cap-and-trade system. When the quantity of allowances allocated per unit of output is the same for all producers, the supply curve simply shifts horizontally depending upon the size of the allocation. Thus, as shown in Figure A2, while updating output-based allocations confer free allowances to producers, prices also adjust downward (from P_N to P_A) in response to the reduction in costs (ΔC). Because of these offsetting effects, profits are similar to levels that would have prevailed absent the policy; moreover, the "windfall" that potentially occurs under grandfathering would not occur because of these offsetting effects.

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Figure A2
Graphical Analysis of the Impact of Fixed Benchmark Choice