Key Issues Facing California's GHG Cap-and-Trade System for 2021-2030

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Executive Summary

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California's Greenhouse Gas (GHG) cap-and-trade program is a key element of the suite of policies the State has adopted to achieve its climate policy goals. The passage of AB 398 (California Global Warming Solutions Act of 2006: market-based compliance mechanisms) extended the use of the cap-and-trade program for the 2021-2030 period, while also specifying modifications of the program's "cost containment" structure and directing CARB to "[e]valuate and address concerns related to overallocation in [ARB's] determination of the allowances available for years 2021 to 2030." The changes being considered by CARB will not only affect the program's stringency, but also its performance by affecting the ability of the "cost containment" structure to mitigate allowance price volatility and the risk of suddenly escalating allowance prices.

This white paper addresses key design issues that were identified by the legislature in AB 398 and have been identified by CARB in its "Preliminary Concepts" white paper, including:

1. Price levels for the Price Ceiling and Price Containment Points;
2. Allocation of allowances between the auction budgets, Price Containment Points, and Price Ceiling;
3. "Overallocation" of GHG allowances; and
4. The program's administrative and operational rules, including: (1) procedures for distributing allowances to the market from the Price Ceiling or Price Containment Points; (2) procedures for using allowances once distributed; and (3) banking rules.

Price Levels for the Price Ceiling and Price Containment Points

CARB must establish specific price levels for the Price Ceiling and Price Containment Points. When setting the price for the Price Ceiling, there are a number of considerations that are relevant and useful from an economic perspective, including the estimated social cost of carbon, the risk of emission

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leakage, linkages with other cap-and-trade systems and/or other types of climate policy instruments in other jurisdictions, and continuity with prior market rules:

- **The social cost of carbon reflects the estimated damages that an additional ton of GHG emissions will have on society, and thus is a key economic consideration in setting the Price Ceiling.** Setting the Price Ceiling above the social cost of carbon creates incentives for covered sources to undertake abatement of GHG emissions that is more costly than the damages these emissions create. CARB should rely on reliable estimates of the social cost of carbon that are based on sound scientific methods. A widely respected benchmark was developed by the United States Government's Interagency Working Group ("IWG") on the Social Cost of Greenhouse Gases. The IWG estimated the social cost of carbon to be $25 to $115 per metric ton for the year 2030, with a central tendency of about $79 per metric ton.[2]
- **A lower Price Ceiling limits emission and economic leakage, all else equal.** Leakage will rise with higher allowance prices, as economic activity shifts outside of California to avoid GHG cap-and-trade compliance costs. With this shift in economic activity, environmental benefits are diminished and economic impacts are larger.
- **A high Price Ceiling may have positive or negative implications for linkage with other GHG cap-and-trade systems (or other types of climate policy instruments in other jurisdictions).** Linkage can lower the cost of achieving California's GHG goals. One risk of linkage, however, is that shocks to allowance demand or supply in one system will diffuse to linked systems. A Price Ceiling can mitigate this risk by limiting price spikes. However, the choice of Price Ceiling (and price floor) also needs to be consistent with policy objectives in other regions.
- **Continuity in market design is important for investor confidence needed for cost-effective investments in low-GHG technologies.** Thus, changes to program design should be minimized, and program design decisions, including Price Ceiling levels, should be chosen with long-term implications in mind. However, it will be unwise to defer rule changes that meaningfully improve program performance, unless absolutely necessary.

The costs of existing efforts to reduce emissions are not a useful guide for the Price Ceiling. The value of environmental policies reflects the benefits they create, not the cost of achieving those benefits. Thus, conceptually, the social cost of carbon provides a better benchmark for a limit on the price of carbon emissions. Further confounding matters, many (if not all) programs in CARB's Scoping Plan are pursued to achieve multiple benefits, not solely GHG emission reductions. Thus, any metric of cost that attributes costs to only GHG emission reductions will overstate the true cost of GHG abatement. More broadly, the fact that CARB has adopted a policy with high costs (potentially affecting only a small portion of California's economic activity) does not mean that it makes sense to impose this cost on the entire California economy (and might even imply that this policy should not be pursued in the first place.)

"Shadow prices" on carbon used by private corporations for internal decision-making are even more problematic as a basis for setting the Price Ceiling. Private corporations adopt these shadow

[2] This estimate varies with the choice of discount rate used to convert future damages into present value terms, as well as other factors.

prices for multiple reasons, many of which are unrelated to the true social cost of carbon. Moreover, the specific shadow prices chosen by private corporations vary widely, from less than $0 per $MTCO_2e$ to more than $800 per $MTCO_2e$, and many other companies have adopted no shadow price at all.

When deciding on price levels for the Price Containment Points, it is important to keep in mind their underlying purpose. The Price Containment Points will contain allowances taken from the allowance budgets to help "contain costs" if there is a surge in demand for allowances. Under volatile market conditions, the Price Containment Points can mitigate allowance price volatility, provide the market with additional time for price discovery, and allow market participants more time to adjust investment and operational decisions. These benefits may be particularly important for California's system given the risk of volatile allowance prices identified by some research (Borenstein et al., 2017.)

All else equal, evenly distributing the Price Containment Points throughout the range between the price floor and Price Ceiling will most effectively mitigate price volatility, including the risk of large, sudden increases in price. To the extent that CARB is making decisions about the disposition of allowances (e.g., allowances already allocated for a 2021-2030 allowance reserve prior to recent legislation), adding these to the Price Containment Points would provide a greater buffer against volatile prices than placing these in the Price Ceiling.

"Overallocation" of Allowances

The "overallocation" issue has emerged due to a combination of factors including banked allowances from the 2013-2020 period that could be used to achieve compliance in 2021-2030. Some stakeholders have raised the concern that the bank of allowances could jeopardize achievement of the program's "intended" goals, while others have raised concerns about legal compliance with California's legislative statutes. We make several observations about this, setting aside issues related to GHG cap-and-trade's underlying stringency, which may be a central thrust of many stakeholder's focus.

First, no regulatory mechanism can "guarantee" compliance with a particular environmental target. While proposed remedies can increase the *likelihood* that total emissions are at or below a particular target in a particular year, they cannot enable CARB meet some bright line with certainty.

Second, the "overallocation" debate reflects, in part, a concern that actual emissions may exceed particular *annual* targets, rather than a concern about cumulative targets. A shift in focus away from cumulative emission targets and toward annual targets would be both costly and inconsistent with the underlying science of the climate problem. Climate impacts reflect cumulative rather than annual emissions, and GHG policies that are designed to reflect this flexibility lower costs by allowing emission reductions to occur when they are less costly and increase environmental benefits by allowing early reduction in emissions. Moreover, allowance banking does not imply that emissions will exceed certain annual targets, particularly because market participants are likely to maintain a bank of allowances to mitigate against economic risks (rather than expend the entire bank to achieve compliance in particular years).

Third, empirical analysis suggests that there is a meaningful possibility that market conditions will tighten substantially; Borenstein et al. find a 1-in-3 chance that allowance prices will rise to a value of $85 per $MTCO_2e$ without any changes to allowance budgets. Proposals to eliminate allowances from allowance budgets (or other accounts and reserves) would increase the likelihood that this occurs. The risk of such price increases will remain as California's climate targets increase in stringency over time, thus providing an on-going incentive for market participants to maintain a sizable bank of allowances.

Allocation, Holding, and Use of Price Ceiling and Price Containment Point Allowances

CARB faces multiple administrative decisions related to the allocation, holding, and use of allowances from the Price Ceiling and Price Containment Points. Initial discussions propose many restrictions on the timing, holding, and use of these allowances.

When designing administrative rules for the Price Ceiling, some rules may simplify the program's operation without sacrificing performance. Because the Price Ceiling ensures a supply of allowances sufficient for companies to comply, the timing of sales and constraints on holding and use of allowances is less critical.

By contrast, restrictions on the timing, holding, and use of allowances from the Price Containment Points could be costly and diminish market performance. Given the potential for Price Containment Point allowances to be released during volatile market conditions, the timely availability of supply to the market will improve price discovery and mitigate price volatility. Sale of Price Containment Point allowances on an on-going basis (an "open window") or through frequent (e.g., monthly) sales will improve market performance. Similarly, CARB is contemplating limits on the use and holding of allowances, such as requirements that Price Containment Point allowances be used immediately for compliance. Such constraints would be costly by potentially constraining market participants' ability to bank allowances for future use. The fact that allowance prices rise to the Price Containment Points does not diminish the economic value of allowance banking.

Finally, changes to the program's banking rules have been proposed, including rules that would discount (devalue) allowances under certain circumstances. Devaluing of allowances should not be adopted, as it creates market risk that distorts banking decisions. However, CARB should consider modifying the current holding limits on allowances to avoid limiting flexibility to mitigate (hedge) the financial risks of compliance.

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California's Greenhouse Gas (GHG) cap-and-trade program is a key element of the suite of policies the State has adopted to achieve its climate policy goals. With the passage of AB 398 ("California Global Warming Solutions Act of 2006: market-based compliance mechanisms…"), California's legislature extended the use of the cap-and-trade program and identified a set of modifications that should be made to the program. The most important of these modifications alters the program's "cost containment" structure to include a Price Ceiling and two Price Containment Points during the post-2020 program. AB 398 also directs CARB to "[e]valuate and address concerns related to ***overallocation*** in [ARB's] determination of the allowances available for years 2021 to 2030, inclusive, as appropriate" (emphasis added). While SB 32 ("California Global Warming Solutions Act of 2006: emissions limit…") and AB 398, together, set clear targets for the GHG cap-and-trade programs, these modifications will nonetheless affect the program's actual stringency by affecting allowance supply under various market conditions.

This white paper addresses key design issues that were identified by the legislature in AB 398 and have been identified by CARB in its "Preliminary Concepts" white paper, designed to "commence the public discussion" on these design issues.[4] Specifically, in this paper, we consider:

1. Price levels for the Price Ceiling and Price Containment Points;
2. Allocation of allowances between the auction budgets, Price Containment Points, and Price Ceiling;
3. "Overallocation" of GHG allowances; and
4. The program's administrative and operational rules, including: (1) procedures for distributing allowances to the market from the Price Ceiling or Price Containment Points; (2) procedures for using allowances once distributed; and (3) banking rules.

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[4] CARB, "Preliminary Concepts" February 2018.

If prices remain at or close to the Auction Reserve price, the program's implicit price floor, then these decisions may not matter much. With CARB continuing to include many complementary policies in the State's suite of climate policies, demand for allowances may continue to be suppressed, and the current low prices may persist.[5] However, as the State's overall emission targets become increasingly stringent, demand for allowances may become tighter, which could cause an increase in allowance prices.

In the event that there is an increase in allowance prices, the market's performance under tight allowance market conditions will depend on the outcome of current decisions faced by CARB. A rapid increase in allowance prices or highly volatile allowance prices could have many adverse economic consequences, which in turn could lead to *ad hoc* regulatory efforts to contain prices that undermine market confidence. Problematic market outcomes due to poor design can also undermine political support for the cap-and-trade program and support for the State's climate change policies more broadly. Because continued – if not expanded – reliance on the cap-and-trade program to achieving GHG reductions at manageable costs is important for California's stated climate goals, such an outcome could undermine achievement of the State's climate policy objectives. Further, demonstrating effective climate policy design has positive spillover effects to other states and countries at various stages of climate policy development and implementation. Because the climate impacts of these spillovers may far exceed the direct effect of emission reductions undertaken in California, careful design of climate policies to demonstrate their efficacy can be one of the most effective approaches available to California to address the global climate problem.

We evaluate GHG cap-and-trade design decisions from an economic perspective, although we identify certain key legal issues that affect the design decisions we evaluate. One economic issue at the core of many design decisions currently under discussion is the program's stringency, as reflected in the tradeoff between GHG emission reductions and abatement costs. The legislature has set the stringency of the GHG cap-and-trade program by establishing a 2030 target of 40 percent below 1990 emissions. **However, the AB 398 cost containment structure effectively modifies the program's stringency over the range of prices between the price floor and Price Ceiling.** The price levels for the Price Containment Points determine the point at which the program's stringency adjusts to changing market demand. Similarly, decisions about allocating allowances between the auctions, Price Containment Points, and the Price Ceiling affect program stringency.

Our analysis *does not* consider the tradeoffs between environmental benefits and abatement costs in making the program more or less stringent. The choice made by the legislature in setting the program's aggregate cap presumably reflects its judgement regarding the balance of these tradeoffs. We do not attempt to re-open that question, while recognizing that the positions of many stakeholders may reflect preferences for either more or less stringent policies. Instead, we focus on how market design decisions affect other aspects of the program's performance, including the program's ability to moderate abatement costs and the various economic risks created by the program, including volatile (or suddenly escalating) allowance prices.

[5] Schatzki, Todd and Robert N. Stavins, "Implications of Policy Interactions for California's Climate Policy," Regulatory Policy Program, Mossavar-Rahmani Center for Business and Government, Harvard Kennedy School, August 27, 2012.

I. MARKET DESIGN DECISIONS RELATED TO THE PRICE LEVELS

A. Key GHG Cap-and-Trade Rulemaking Issues

AB 398 extends the GHG cap-and-trade program through the year 2030, keeping core elements of the system intact. Sources covered by the program are required to obtain allowances to cover their actual GHG emissions. The total quantity of allowances is capped at annual budgets to be set by CARB, with the annual budget for the year 2030 set at 40 percent below 1990 emission levels. Faced with the choice between using an allowance or reducing emissions, in principle, covered sources will opt for the less costly of the two, resulting in allowance prices that equal to the marginal cost of emission reduction. Through this mechanism, the GHG cap-and-trade system creates a price signal that encourages emission reductions that are less costly than the allowance price, but not those that are more costly than the allowance price.

1. The Price Ceiling

In passing AB 398, the legislature mandated several important changes to the GHG cap-and-trade program, and identified certain issues for CARB to consider. One important change is the addition of a **Price Ceiling**. With a Price Ceiling, allowance prices cannot rise above a specified level. Thus, a Price Ceiling is often referred to as a "hard" cap. AB 398 directs CARB to:

"Establish a price ceiling… consider[ing]… all of the following:

- (I) The need to avoid adverse impacts on resident households, businesses, and the state's economy.
- (II) The 2020 tier prices of the allowance price containment reserve.
- (III) The full social cost associated with emitting a metric ton of greenhouse gases.
- (IV) The auction reserve price.
- (V) The potential for environmental and economic leakage.
- (VI) The cost per metric ton of greenhouse gas emissions reductions to achieve the statewide emissions targets established in Sections 38550 and 38566."[6]

A Price Ceiling mitigates the risk that the allowance price rises to economically or politically unacceptable levels, which has several benefits.

First, the Price Ceiling mitigates the potential for sources to take excessively costly efforts to reduce GHG emissions.[7] In turn, the price ceiling also avoids excessive increases in the prices for energy (gasoline for fueling cars and natural gas for heating homes) and GHG-intensive goods and services. In both cases, the Price Ceiling avoids economic costs and consequences that are disproportionately large relative to the benefits created.

Second, the Price Ceiling creates clear *ex ante* rules specifying what happens if allowance prices rise unexpectedly. Absent such rules, decisions to mitigate excessively high allowance prices may be made through rushed, *ad hoc* regulatory processes that do not provide sufficient time for deliberative,

[6] Health & Safety Code § 38562(c)(2)(A)(i).

[7] AB 398 requires CARB to achieve GHG emission reductions through other means to offset any new allowances created through the Price Ceiling.

balanced decision-making. As a result, there is an increased likelihood that poor decisions are made that undermine the credibility of the system.

Third, because it reduces the need for *ad hoc* decisions, the price ceiling creates greater certainty for the market which, all else equal, is more conducive to investment in low-GHG technologies. Such technologies often require many years to recover upfront investment costs, making certainty about the durability of the cap-and-trade system important to financing such investments.

AB 398 also directs CARB to establish **Price Containment Points**:

> "Establish two price containment points at levels below the price ceiling. The state board shall offer to covered entities non-tradable allowances for sale at these price containment points. The price containment points shall be established using two-thirds, divided equally, of the allowances in the allowance price containment reserve as of December 31, 2017."[8]

The Price Containment Points are a pool of allowances available for purchase at predetermined prices. The Price Containment Points are referred to as "speed bumps" because they slow the rise in prices by providing additional allowances to the market to meet an increase in allowance demand. If the supply of allowances at the Price Containment Points is exhausted, however, allowance prices can rise above the Price Containment Point.

Figure 1 illustrates how the Price Containment Points and Price Ceiling affect the quantity of allowances available to the market. As prices rise to each Price Containment Point and then the Price Ceiling, additional supplies of allowances become available to the market. While AB 398 specifies criteria for setting the Price Ceiling, it does not identify criteria for setting the Price Containment Points.

The current GHG cap-and-trade system has an APCR comprising of three tiers. AB 398 specifies that two-thirds of the allowances from the APCR as of December 31, 2017 will be allocated to the Price Containments Points, and all allowances remaining in the APCR on December 31, 2020 will allocated to the Price Ceiling.

The new cost containment mechanisms legislated through AB 398 differ in some respects from the APCR's current structure. Lacking a "hard" Price Ceiling, the APCR currently operates like a "soft" price cap, raising stringency to increase emission reduction efforts, providing a buffer in the event that prices rise unexpectedly and providing regulators and legislators with additional time to make market changes in the event that prices rise to economically and politically unacceptable levels.

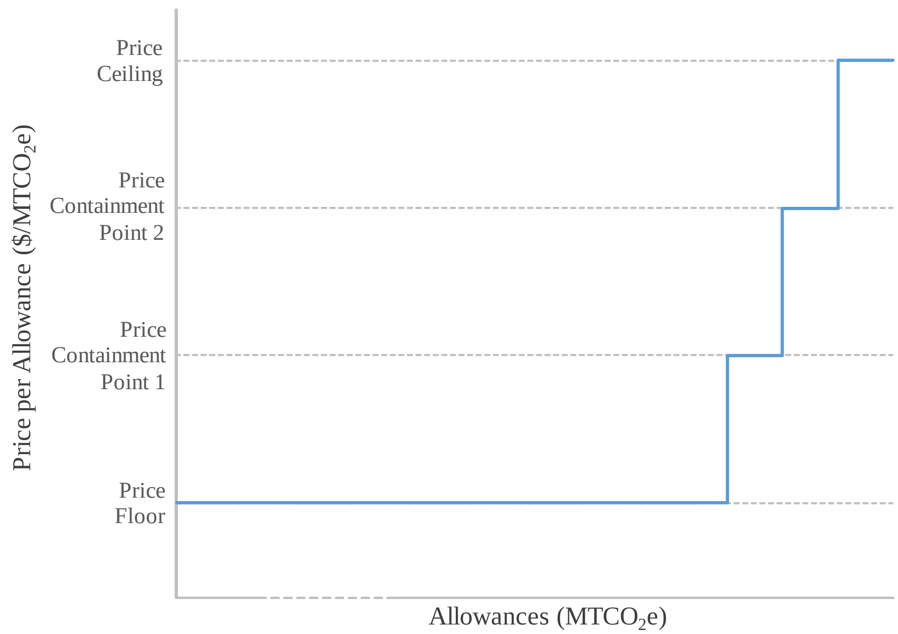
AB 398 adds a Price Ceiling that, among other things, mitigates the risk of ad hoc intervention. Thus, in principle, the Price Containment Points can take on a different role in cost containment than the APCR. Instead of providing a buffer "at the top" of the market, they can achieve other ends. As we describe below, other than the changes in cap stringency inherent in any decision related to the size of an allowance "reserve", such as the Price Containment Points or the APCR, the primary benefit of the price containment points is the mitigation of allowance price volatility.

AB 398 also creates an Independent Emissions Market Advisory Committee (the "Committee"). The Committee has no regulatory or enforcement authority, but is designed to provide guidance to the Board and legislature on the environmental and economic performance of the cap-and-trade system and

[8] Health & Safety Code § 38562(c)(2)(B).

other relevant climate policies. The Committee will be comprised of experts on emission trading market design that, in principle, can provide the Board and legislature with recommendations on changes to program rules and operations depending on the system's performance. The Committee will develop periodic reports (at least annually) on the program's performance for the Board and legislature, and is required to develop a report if two consecutive auctions exceed the lower of the two Price Containment Points.[9]

Figure 1. Illustration of Price Containment Points and Price Ceiling



B. Economic Factors Relevant to Establishing the Price Levels for the Price Ceiling and Price Containment Points

AB 398 does not specify the price levels for the Price Ceiling and Price Containment Points, leaving this task to CARB. For the Price Ceiling, AB 398 specifies certain criteria, listed above, whereas it provides no guidance for the Price Containment Points. In this section of the paper, we consider, from an economic

[9] AB 398 specifies that the report must assess "the potential for allowance prices to reach the price ceiling for multiple auctions." We consider this a less important objective for the Committee in comparison to its role in evaluating program performance and identifying potential rule modifications to improve market function. Forecasting market prices is inherently difficult, and policy decisions should not generally rely on the outcomes of such forecasts. Moreover, even if the Committee found that allowances were likely to remain above the price containment point, there is nothing *per se* problematic with this, and this fact should not be used as a rationale for modifying the program, unless the legislature deems the price levels adopted by CARB for the Price Ceiling or Price Containment Points to be either too high or too low. Health and Safety Code 38562 (c)(2)(J)(i).

perspective, the various factors that should be considered by CARB when setting these price levels, as well as factors that are less useful.

1. Price Ceiling Considerations

AB 398 identifies considerations that CARB should take into account when setting the Price Ceiling, and CARB elaborates on these criteria in its "Preliminary Concepts" paper. We consider these criteria for setting the Price Ceiling, and assess their relevance and usefulness from an economic perspective.

a) Social Cost of Carbon

The social cost of carbon is an important benchmark for the level of the price ceiling. The social cost of carbon is an estimate of the social cost (damages) of additional GHG emissions (represented in terms of CO_2 equivalents). Allowance prices send an economic signal to emissions sources that, in principle, determine the (marginal) costs they will incur to reduce GHG emissions. As a result, if allowance prices rise above the social cost of carbon, then sources may incur cost to reduce emissions that are greater than the benefits created.

The United States Government's Interagency Working Group ("IWG") on the Social Cost of Greenhouse Gases comprised twelve different federal agencies and endeavored to provide United States' regulatory bodies with a consistent estimate of the social cost of carbon for use in regulatory analyses.[10] The IWG published several sets of estimates of the social cost of carbon, with each set estimating the social cost of carbon annually from 2010 through 2030.[11] **The IWG's most recent estimates indicate that the social cost of carbon from emissions occurring in 2030 would range from $25 to $115 per metric ton (in nominal dollars), depending upon the choice of discount rate used to convert the future damages created by those emissions into present value terms.[12]** For example, the damages from 1 metric ton of

[10] *See* TSD 2010 at 1-4. There have been wide ranging estimates of the social cost of carbon; anywhere from a few dollars per ton of CO_2 to over one hundred dollars per ton of CO_2. *See e.g.* National Research Council, 2009, *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use*, Washington, DC: The National Academies Press at 216-219 for a brief review.

[11] *See e.g.* Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12688, Interagency Working Group on Social Cost of Carbon, United States Government, February 2010 ("TSD 2010"); *see also* Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12688, Interagency Working Group on Social Cost of Greenhouse Gases, United States Government, August 2016 ("TSD 2016"). Updated estimates were published in May 2013, November 2013, and July 2015. See TSD 2016 at 3 and Appendix B. Further discussion was added in 2016, with no changes to the estimates themselves. *See* TSD 2016 at 3-4. While the underlying method between the 2010 and 2016 document did not change, a recent publication by the National Academies has recommended an overhaul of how the IWG estimates the social cost of carbon. *See* National Academies of Sciences, Engineering, and Medicine, 2017, *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide*, Washington, DC: The National Academies Press. doi: https://doi.org/10.17226/24651.

[12] See TSD 2016 at 4. The IWG also presents a set of higher estimates reflecting more extreme assumptions regarding the underlying modeling inputs. This higher set of estimates places the 2030 social cost of carbon at $240 in 2030 (in $2030). The IWG reports the social cost of carbon in $2007. We convert $2007 to $2030 using historical annual

emissions in 2030 would be $79 in 2030 dollars when the future impact of those emissions are discounted back to 2030 at a 3% discount rate. These Social Cost of Carbon estimates represent the global damages to various sectors, including agriculture and energy dependent sectors, climate driven human health impacts, the damages of sea-level rise, and impacts to ecosystem services.[13]

The IWG's estimates have become a respected benchmark for the social cost of carbon. Several federal rules incorporated these estimates in determining the net benefits of proposed regulations. For example, the EPA Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards utilized the IWG's 2010 estimates.[14] The EPA also employed the IWG's estimates in recent rulings regarding vehicle emissions standards.[15] The Trump administration now estimates the social cost of carbon to be $1 to $6 per $MTCO_2e$, using only the higher discount rate and counting only domestic, rather than global, damages.

IWG estimates have also informed state policy. CARB adopts the IWG's 2016 estimates in its 2017 Scoping Plan and references the estimates in its "Preliminary Concepts" paper. CARB's Scoping Plan assumes a social cost of carbon of $57 in 2030 (in $2015) based on IWG's 2016 estimates.[16]

Other studies have also developed estimates of the social cost of carbon. To the extent that CARB relies on estimates from other research, it should perform a thorough and careful evaluation of each estimate and come to its own sound conclusions through scientific methods such as meta-analysis. **CARB should not rely on estimates of the social cost of carbon from individual studies, particularly if those studies produce estimates substantially departing from the central tendency of other research.[17]**

average CPI values for all urban consumers provided by the BLS (https://www.bls.gov/cpi/tables/supplemental-files/home.htm) and forecasted CPI values that we derive from forecasted year to year (specifically Q4 to Q4) percent changes in the CPI presented by the 2018 Economic Report of the President, (https://www.whitehouse.gov/wp-content/uploads/2018/.../ERP_2018_Final-FINAL.pdf, Table 8-1, column 4).

[13] These values derive from three integrated assessment models ("IAM") that describe in reduced-form how changes in greenhouse gas driven temperatures impose costs and various impacts. All models also contain some description of adaptation, and in various ways capture catastrophic or extreme climate change driven impacts. *See* TSD 2010 § III.A for further detail regarding the models underlying the social cost of carbon estimates. *See also* TSD 2016 § II for further detail regarding updates to these models that underlie the most recent social cost of carbon estimates. For further details regarding the process IWG followed in estimating the social cost of carbon, see TSD 2010 § III, IV.

[14] United States Environmental Protection Agency, Regulator Impact Analysis for the Final Mercury and Air Toxics Standards (MATS RIA).

[15] *See* EPA, "Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles; Final Rule," *Federal Register* Vol. 76 No. 179, 57106–513 at 126; *see also* EPA, "2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards; Final Rule," *Federal Register* Vol. 77 No. 199, 62624–63200 at 2929.

[16] CARB relies on the IWG's estimate assuming a 3% discount rate. CARB also converts this value to 2015 dollars, accounting for inflation. *See* California Air Resources Board, California's 2017 Climate Change Scoping Plan, November 2017 ("2017 Scoping Plan") at 40 and fn. 97; *see also* Concepts at Table 5.

[17] For example, CARB's Preliminary Concepts paper cites one paper, Moore and Diaz (2015), that estimates the social cost of carbon could be approximately $220 per ton of CO_2. However, this is the only study cited by CARB other than the IWG study, and CARB provides no description of the methodology used to identify this study among the many estimating the social cost of carbon. Moore, F. and Diaz, D.B., 2015, "Temperature impacts on economic growth warrant stringent mitigation policy," *Nature Climate Change*, 5:127–131.

b) Leakage

Leakage occurs when the cost of complying with a new (or more stringent) regulation leads to a shift in economic activity from the region with the regulation to regions with less stringent regulations. Leakage can occur through many routes, including a shift in the level of production at in-state business, and actual relocation of in-state businesses. The shift in economic activity leads to apparent emission reductions in the region with the more stringent regulation, when in fact emissions may have simply shifted geographic location. As a result, leakage reduces the effectiveness of the regulation in achieving actual (rather than apparent) emission reductions.

Under cap-and-trade, compliance costs, and thus the incentive to shift production to avoid these costs, are directly proportional to the allowance price. As a result, limiting allowance prices through the price ceiling can limit the leakage that occurs due to the GHG cap-and-trade program. Leakage potential is a particular concern for California given its substantial trade and close economic ties with other states and countries.[18]

c) Linkage

Linkage between cap-and-trade systems allows covered entities under one program to use allowances from another system to comply with its cap-and-trade obligations.[19] With linkage, the two systems become integrated into one market. As entities buy and sell across programs, allowance prices converge, which lowers economic costs of reducing GHG emissions by harmonizing the GHG price signal across a broader economic area.

Linkage also has implications for the rules related to trading, compliance, and allocation of allowances in each of the linked systems. Decisions about the Price Ceiling (and other price containment mechanisms) in California can have consequences for the other systems to which it is linked. In effect, a Price Ceiling in California's cap-and-trade system would extend to all systems that are linked to California's system. For example, if the price ceiling was set at $90 per $MTCO_2e$, then allowances in any linked system would not rise above $90 per $MTCO_2e$, because market participants in the linked systems could always purchase allowances from California sources at $90 per $MTCO_2e$.

The level of the Price Ceiling has several potential implications for a region's willingness to link their cap-and-trade system to California's system. **First, a region may be less willing to link with another system if the Price Ceiling is set at a level that is inconsistent with the region's policy objectives.[20]** A price ceiling set too low may make it less desirable to link with that system, since price ceilings would

[18] *See* Fowlie, M., "California's Carbon Border Wall," *Energy Institute Blog*, May 22, 2017. Available at: https://energyathaas.wordpress.com/2017/05/22/californias-carbon-border-wall/. See also Cullenward, D., (2014) "Leakage in California's Carbon Market," The Electricity Journal, 27(9): 26-48.

[19] For background on linkage, *see* Jaffe, Judson and Robert Stavins, *Linking Tradable Permit Systems for Greenhouse Gas Emissions: Opportunities, Implications and Challenges*, prepared for the International Emissions Trading Association, November 2007.

[20] If a region objects to price ceilings, in principle, including a price ceiling could act as a barrier to linkage. However, regions that achieve cost containment through other means, such as *ad hoc* changes in allowance budgets and allocation, pose other economic risks to linked systems.

prevent allowance prices from reaching levels that the region may deem necessary to achieve its climate policy objectives. However, a price ceiling set too high may also make it less desirable to link with that system, because allowance prices could reach economically and politically unacceptable levels.

Second, while linkage can lower aggregate economic costs and risks, it also exposes each region to economic risks from events that originate in other regions. With linkages, a sudden shock in demand for allowances in one region would cause allowances prices to rise in all linked systems, with allowances flowing to the region that experienced the increase in demand. **A Price Ceiling can mitigate these economic (and political) risks by acting as a "brake" on allowance prices caused by unexpected events in other regions.**

d) Continuity

AB 398 requires CARB to consider the tier prices of the APCR when establishing the Price Ceiling. All else equal, continuity in market rules provides greater certainty to participants and thus reduces investment risks in low-GHG technologies. By contrast, changes in market rules send a signal to market participants that future rule changes might occur that could undermine the value of investments, which further increases these investments' financial risk. **Thus, when deciding where to set the Price Ceiling, it is reasonable to consider prior cost containment mechanisms. However, continuity should be balanced against the need to have a sound market design, which may require modifications of market rules.**

e) Costs of Abatement

AB 398 indicates that CARB should consider the cost of achieving GHG abatement under other California climate policies when setting the Price Ceiling.[21] **Several factors suggest caution in using GHG abatement costs as a benchmark for setting the Price Ceiling.**

In principle, from an economic perspective, the goal of any environmental policy is to achieve economic benefits through improvements in environmental conditions. **Thus, relying on measures of abatement costs to set the pricing ceiling would confuse benefits – the objective of environmental policy – with costs.** While the cost of achieving reductions under one policy might imply that society is "willing to pay" that amount to achieve environmental benefits, there are several reasons why this inference may be inappropriate.

Policies and programs in the Scoping Plan are undertaken to achieve multiple benefits in addition to reducing GHG emissions, including: reducing emissions of particulate matter, criteria air pollutants, and toxic air pollutants; health improvements from active transportation;[22] technology transformation; and other benefits. **When a policy achieves multiple benefits, attributing all costs to only one stream of benefits will overstate the cost of achieving that type of benefit.** In this context, relying on CARB's estimates of

[21] See, for example, comments of the Natural Resources Defense Council (NRDC), summarized in CARB, "Summary of Stakeholder Comments" April 2018, p. 6.

[22] Active transportation includes walking and biking. CARB, 2017 Scoping Plan, pp. ES7, 47-50.

the abatement cost per metric ton of GHG (from the Scoping Plan) to set the Price Ceiling may inappropriately attribute all costs incurred by the program to only a portion of the environmental benefit, reductions in GHG emissions. CARB notes this in the Scoping Plan:[23]

> The cost (or savings) per metric ton of CO_2e reduced for each of the measures is one metric for comparing the performance of the measures. Additional factors beyond the cost per metric ton that could be considered include continuity with existing laws and policies, implementation feasibility, contribution to fuel diversity and technology transformation goals, as well as health and other benefits to California. These considerations are not reflected in the cost per ton metric below.

Of course, it is also possible that non-GHG benefits are relatively small for certain policies. If this is the case and the estimated cost per $MTCO_2e$ is particularly high, it may raise questions about the efficacy of this particular policy in addressing climate change, rather than serve as a sensible benchmark for other policies.[24]

CARB might also be considering the cost to deploy a particular "backstop" technology as a benchmark for the Price Ceiling, particularly a technology at an early stage of development. There are several concerns with this approach. First, this approach also conflates costs with benefits. Simply because a technology exists to reduce GHGs does not mean it is sound policy to deploy at any cost. Second, the development of any particular technology faces many unknowns, making the timing of commercialization and eventual costs highly uncertain. Moreover, cap-and-trade is not well suited to promoting the development of particular technologies because it creates uniform incentives for innovation that are technology neutral, encouraging the least-cost means of achieving emission reductions, regardless of technology.

Finally, many policies in the CARB Scoping Plan may affect a limited scope of economic activity. **Simply because CARB has adopted a policy with a high (marginal) economic cost that affects a limited amount of economic activity does not imply that it is sensible to impose such a cost on all economic activity covered by the GHG cap-and-trade program.**

f) Carbon "Shadow Prices"

A few corporations have voluntarily adopted an internal social cost of carbon, or carbon "shadow price," for use in internal decision-making.[25] CARB indicates it intends to consider these shadow prices in its decision regarding where to set the price ceiling.[26] It should not do so for several reasons.

[23] CARB, 2017 Scoping Plan, p. 44.

[24] For example, one measure, increased utilization of renewable natural gas, has an estimated cost of $1,500 per $MTCO_2e$ in 2030, which appears to have extremely high costs compared to alternative approaches to abating GHG emissions *if* the only benefits derived are GHG reductions. CARB, 2017 Scoping Plan, p. 46.

[25] CDP, "Embedding a carbon price into business strategy," September 2016.

[26] CARB, Preliminary Concepts, p. 6.

First, unless the corporation has expressly tied its shadow price to the social cost of carbon, there is no reason to think that the selected shadow price truly reflects the benefits associated with reducing emissions. Instead, this price reflects the decisions of an unelected, unrepresentative group of individuals on behalf of a corporation reflecting a number of different considerations that may differ from the social benefits of GHG emission reductions.

Second, many factors affect actions taken for corporate social responsibility, including the value customer's place on a good or service, worker benefits, political influence and other factors unrelated to GHG emissions.[27] Because carbon shadow prices are adopted not for compliance with state or federal environmental laws, but as part of these corporate social responsibility objectives, the rationale for adopting a particular value of the shadow price reflects these other corporate benefits, in addition to the underlying social cost of carbon. Moreover, because the implementation of such shadow prices within the context of corporate operations and investment decisions is not monitored, there is no way to verify that the corporation actually incurs financial costs that correspond to these shadow prices.

Third, estimates of corporate carbon shadow prices vary widely. Some corporations use prices less than $1 per $MTCO_2e$, while others claim to use prices in excess of $800 per $MTCO_2e$.[28] Many, of course, adopt no shadow prices at all. Developing any inferences about the social cost of carbon from this wide range of values is scientifically challenging, particularly in light of the various incentives associated with the choice of shadow price.

In light of these factors, we recommend that CARB not consider corporate "shadow prices" when determining the level for the Price Ceiling.

2. Price Containment Point Considerations

Under the current GHG cap-and-trade design, the Price Containment Points, are developed largely as a tool for mitigating short-term fluctuations in prices, referred to as allowance price volatility. The structure of California's energy and allowance markets creates a potential risk that prices fluctuate between the price floor and the Price Ceiling over relatively short time periods. An element of this risk is that

[27] For example, some evidence suggests that consumers are willing to pay a higher price for goods and services that are produced in a socially responsible manner. For example, *see* Servaes, H., & Tamayo, A. (2013). The impact of corporate social responsibility on firm value: The role of customer awareness. Management Science, 59(5), 1045-1061; Elfenbein, D. W., Fisman, R., & Mcmanus, B. (2012). Charity as a substitute for reputation: Evidence from an online marketplace. Review of Economic Studies, 79(4), 1441-1468. Likewise, workers may show preferences for working for a socially responsible company, making them more willing to work hard or work for a lower wage. For example, *see* Turban, D. B., & Greening, D. W. (1997). Corporate Social Performance and Organizational Attractiveness To Prospective Employees. Academy of Management Journal, 40(3), 658- 672. For analysis of the impact on corporate social responsibility on employee misbehavior, *see* List, John, and Fatemeh Momeni, "When Corporate Social Responsibility Backfires: Theory and Evidence from a Natural Field Experiment," NBER Working Paper No. 24169, December 2017. Reinhardt, Forest L, and Robert N. Stavins. "Corporate Social Responsibility, Business Strategy, and the Environment." *Oxford Review of Economic Policy* 26.2 (June 2010): 164-181; Reinhardt, Forest, Robert Stavins, and Richard Vietor. "Corporate Social Responsibility Through An Economic Lens." *Review of Environmental Economics and Policy* 2(2008): 219-239.

[28] CDP, 2016.

allowance prices suddenly increase from the currently low prevailing market prices. By providing a supply of allowances at intermediate points between these extremes, the Price Containment Points reduce the likelihood that prices fluctuate or swing between these extremes.

Price volatility can have adverse consequences, including inefficient operations and investment (if abatement is undertaken in response to temporary high prices), uncertainty in investment and pricing of energy and energy-intensive goods and services, financial losses (and risks) for companies short on allowances, and challenges to the operation of a well-functioning allowance market. Price volatility, in turn, has consequences for the strategies used by companies to manage their compliance risks. The Price Containment Points reduce market volatility by increasing the supply of allowances as allowance prices increase. This additional supply of allowances can bound the range of price movements and provide additional time for price discovery.

In the context of California's GHG cap-and-trade program, empirical analysis indicates that allowance price volatility could be very high. Borenstein, Bushnell and Wolak (Borenstein et al., hereafter) find that there are limited options to reduce GHG emissions (at reasonable cost) if market conditions increase the demand for allowances.[29] The limited supply of abatement options is largely due to the many complementary climate policies that limit the incremental opportunities for covered sectors to reduce emissions under the cap-and-trade program. Due to the limited supply of abatement options, there is a risk that allowance prices fluctuate rapidly between the price floor and Price Ceiling in response to relatively small changes in allowance demand.

Specifically, Borenstein et al. find that 145 $MTCO_2e$ of emissions can be reduced at a cost less than $85 per $MTCO_2e$. As result, if demand increases more than 145 $MTCO_2e$ (over the course of the 2021-2030 period) due to, for example, increased economic activity, then allowance prices could suddenly rise from the allowance price floor to the allowance price ceiling. Given allowance banking and the market's anticipation of future market conditions, the market could capture changes in allowance prices relatively quickly if underlying market conditions change to project future allowance scarcity. **Price Containment Points at intermediate points between the allowance price floor and Price Ceiling can mitigate such the large increase in allowance prices that could occur under these circumstances.**[30]

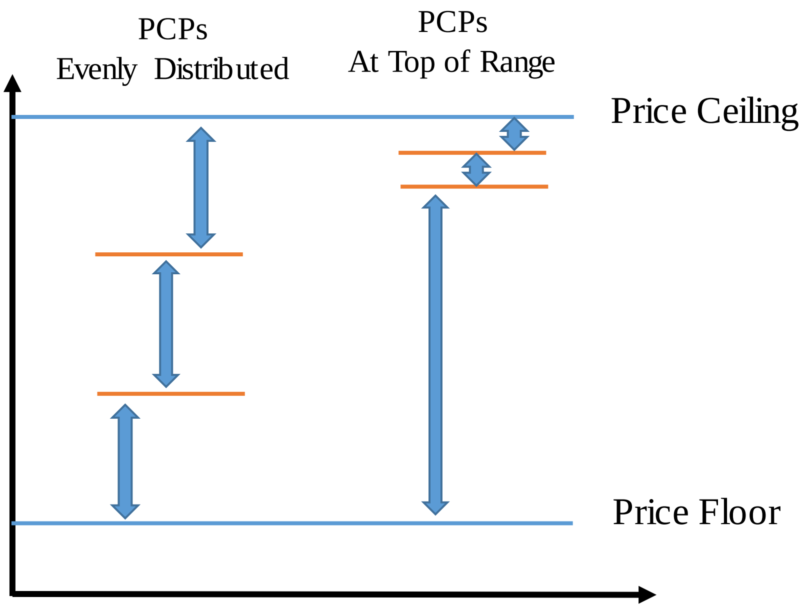
[29] Borenstein, Severin, et al., "California's Cap-and-Trade Market Through 2030: A Preliminary Supply/Demand Analysis", Energy Institute at Haas, Working Paper 281, July 2017, Table 1. For earlier analysis, *see* Borenstein, Severin, James Bushnell, Frank Wolak and Matthew Zaragoza-Watkins, "Report of the Market Simulation Group on Competitive Supply/Demand Balance in the California Allowance Market and the Potential for Market Manipulation," Energy Institute at Haas, Working Paper 251, July 2014; Borenstein, Severin, James Bushnell, Frank Wolak and Matthew Zaragoza-Watkins, "Expecting the Unexpected: Emission Uncertainty and Environmental Market Design," Energy Institute at Haas, Working Paper 274, August 2016.

[30] Volatile commodity prices can impose economic costs, although such costs may not (and typically do not) justify regulatory interventions given the costs such interventions impose, particularly when they introduce distortions of the commodity's true opportunity cost. However, allowance markets differ from commodity markets in at least two respects. First, economic volatility arising from the program can undermine the political consensus needed to support the underlying regulatory policy. Second, allowance markets arise from a regulatory design used to achieve certain environmental objectives, and the regulation's design reflects tradeoffs among many factors, including variability of environmental and economic outcomes. A tax and cap-and-trade differ in the tradeoff between variability of environmental and economic outcomes; and a cap-and-trade program with allowance reserves, such as the Price

Borenstein et al.'s analysis illustrates the potential benefit of the Price Containment Points in the context of California's market. Their analysis finds that, due to the limited supply of GHG abatement, prices are likely to be at one of the two extremes, the price floor or the Price Ceiling. With the addition of two Price Containment Points, the likelihood that prices in 2030 are between these two extremes increases from 20% to 39%.[31] Thus, the Price Containment Points substantially reduce the likelihood that allowance prices are not at the price floor and Price Ceiling, consistent with less volatile market outcomes.

To illustrate how placement of the Price Containment Points can affect market outcomes, **Figure 2** compares the range of allowance prices between two Price Containment Point configurations. On the left, the Price Containment Points are distributed evenly between the price floor and Price Ceiling. Under this configuration, a sudden increase in demand will cause prices to rise to the first Price Containment Point, allowing the market to readjust. On the right, the Price Containment Points are placed at the top of the range between the price floor and Price Ceiling. In this case, a sudden increase in demand leads to a larger price increase, because there is no influx of supply until the first Price Containment Point.

Figure 2. Illustration of Price Containment Point Placement



By adding allowance supply to the market, the Price Containment Points may also bound allowance price volatility. For example, if prices are near to the price floor, new events or information may lead to price volatility. When the Price Containment Points are distributed evenly, price fluctuation is bounded by the price floor and first Price Containment Point, since the additional supply in Price

Containment Points, is a hybrid of these two approaches. The choice among these regulatory mechanisms reflects, among other things, the extent to which marginal impacts vary over time. For GHG emissions, such variation is relatively small, suggesting less value to time-varying (or volatile) prices compared to other environmental impacts (or commodities).

[31] Borenstein et al., 2017, Table 2.

Containment Points tends to limit the range of short-run price increases. With the Price Containment Point at the top of the range, these price fluctuations could be much larger given the larger range between the price floor and the first Price Containment Point. Thus, even distribution of the Price Containment Points provides greater limits on short-term price fluctuation compared to a tight clustering of Price Containment Points.

Second, placing the Price Containment Points at the top of the range provides less opportunity for CARB and the Emissions Market Advisory Committee to assess the market's performance and function, and the need for modifications to market rules. Through evaluation of market outcomes, the Committee can assess the drivers of changes in market allowance prices to ensure that they reflect market fundamentals, identify limitations to market rules, and develop recommendations for changes to those rules, if any. A lower Price Containment Point can slow an otherwise rapid increase in prices, providing the Committee with more time to conduct its review.

In light of these factors, Price Containment Points equally distributed across the range between the price floor and Price Ceiling appear to offer positive net benefits, compared with placement at the upper end of this range.

3. Decisions Related to Additional Allowances

Prior to the passage of AB 398, CARB passed rules that would shift 52.4 million allowances from the 2021-2030 allowance budgets to the APCR.[32] CARB has sought comment regarding how it should allocate these allowances in the context of its rulemaking under AB 398.[33] In principle, these allowances could be allocated to: (1) annual budgets, (2) Price Containment Points, (3) the Price Ceiling, or (4) retirement accounts. Stakeholder comments vary widely, encompassing all of these options.

Each of these has implications in terms of the program's stringency. At one extreme, placing the allowances in the annual budget for sale through the auctions provides an additional supply at all price levels (above the auction reserve price). As a result, allowances prices are lower at all levels of demand.

At the other extreme, placing allowances in the Price Ceiling limits supply to the market, raising allowance prices and increasing likelihood that prices rise to the Price Ceiling (compared to placing allowances in the budget or Price Containment Points).

Placing allowances in the Price Containment Points not only affect program stringency, but the extent to which price volatility is mitigated. Given the risk that the quantity of GHG abatement possible at reasonable prices is limited, the Price Containment Points allowances can mitigate price volatility and provide the market with time to adjust to sudden increases in price. Supplying allowances to the Price Containment Points tends to support this end, although, in principle, marginal benefits may diminish (or even become negative) with additional allowances. We are not aware of analysis to determine how market

[32] Cap-and-trade regulation, Table 8-2.

[33] CARB, Preliminary Concepts Paper, p. 8.

outcomes (e.g., distribution of market prices or price volatility) would likely vary with the quantity of allowances placed in the Price Containment Points.[34]

Retiring these allowances altogether makes little sense. Under AB 398, if allowances at the Price Ceiling are exhausted, CARB is required to achieve additional GHG abatement through some means. Thus, if CARB retires allowances rather than placing them in the Price Ceiling, it might inadvertently increase the quantity of additional "out of market" abatement required to make up for a lack of allowances at the Price Ceiling.

II. DECISIONS RELATED TO "OVERALLOCATION"

A. Background on "Overallocation"

In designing the new cap-and-trade program regulations, AB 398 directs CARB to "[e]valuate and address concerns related to *overallocation* in the state board's determination of the number of available allowances for years 2021 to 2030, inclusive, as appropriate."[35] The discussion around "overallocation", while often not well-defined, relates to concern that the supply of banked allowances may threaten compliance with statutory requirements in California's climate legislation or the achievement of California's climate policy objectives. For example, one commentator states: "Unaddressed, oversupply and expected banking is large enough to allow for significantly more emissions than intended under the 2017 Scoping Plan, cutting into cumulative emissions and possibly leaving 2030 emissions above the SB 32 target."[36] Another states: "But we want to emphasize that ultimately AB 32 and SB 32 charge ARB with the responsibility of meeting annual targets in 2020 and 2030, not a cumulative target expressed over a period of time."[37]

The "overallocation" concern stems from the fear that an "overallocation" of allowances will cause actual emissions to be above "intended" emission levels or statutory targets. This concern is most salient for the 2030 target of 40% below 1990 emissions. To mitigate this threat, some stakeholders propose that CARB eliminate (or reduce the value of) some portion of unused allowances, including allowances not yet auctioned (particularly unsold allowances from prior auctions), allowances in the APCR, and even allowances held in covered entities' accounts (i.e., banked allowances). In effect, these options would increase the stringency of the GHG cap to achieve additional environmental benefits.

We do not consider any legal issues raised regarding statutory compliance, **but it is important to appreciate that none of the regulatory mechanisms available to CARB can "guarantee" compliance**

[34] Borenstein et al.'s analysis does not test the sensitivity of market outcomes to different quantities of allowances in the Price Containment Points. Their analysis assumes 174 $MMTCO_2e$ for the Price Ceiling and Price Containment Points, including both the current APCR (121 $MMTCO_2e$) and the 52.4 million allowances from the 2021-2030 allowance budgets. They find there is a 60% likelihood that prices are at the price floor or Price Ceiling.

[35] Emphasis added. Health & Safety Code § 38562(c)(2)(D). *See also* Health & Safety Code § 38562(c).

[36] Busch, Chris. "Oversupply Grows in the Western Climate Initiative Carbon Market," December 2017.

[37] Cullenward, Danny, et al., "Removing excess cap-and-trade allowances will reduce greenhouse gas emissions", January 11, 2018, p. 4.

with a GHG target for 2030 (or any other year). For example, the Low Carbon Fuel Standard affects the rate of emissions (i.e., GHG emissions per mile traveled), but does not affect the number of number of miles traveled. Thus, total emissions may exceed any fixed target. In fact, among all the available regulatory mechanisms, cap-and-trade provides the most effective option for achieving particular targets because cumulative emissions are constrained to the cap by design. But, even with cap-and-trade, the state could only guarantee achievement of an annual target by *eliminating allowance banking*, which would impose undue economic costs and risks. Absent this change, reductions in the current allowance budget at most increase the *likelihood* that total emissions are at or below a particular target in a particular year. **But, these proposed remedies do not help CARB meet some bright line with respect to its "responsibility" to meet particular emission targets.**

Below, we address several questions related to "overallocation" concerns. First, the concerns regarding "overallocation" reflect, in part, a focus on short-run (even annual) climate targets rather than long-run, cumulative targets. This is inconsistent with the underlying science and can raise the cost of achieving climate objectives. Second, we consider factors affecting the likelihood that 2030 emissions are not 40% or more below 1990 emissions.

B. The Importance of Cumulative Emission Targets and Allowance Banking

Concerns raised regarding "overallocation" reflect, in part, the concern that actual emissions exceed particular annual targets, rather than cumulative emission targets. **A shift in focus away from cumulative emission targets and toward annual targets would be both costly and inconsistent with the underlying science of the climate problem.** To understand why this is so, it is important to understand first the underlying economics of the climate problem. Like many air emission problems, climate impacts reflect the total concentration of GHGs in the atmosphere. However, unlike typical pollutants, such as criteria air pollutants, the impact of GHG emissions are much less sensitive to the timing of emissions.[38]

With many other air pollutants, health impacts reflect emission levels over short a period of time, requiring regulations to ensure that annual (or even daily) emissions do not exceed levels that would lead to health impacts. However, with GHGs, impacts reflect cumulative emissions.

The fact that GHG emissions impacts reflect cumulative rather than annual emissions has many important implications. **First, establishing a cap-and-trade system that limits emissions to a cumulative cap without requiring specific reductions in any given year will ultimately provide the same environmental benefit as requiring specific reductions in each compliance period year.**

Second, given that environmental impacts reflect cumulative rather than annual emissions, regulation that can provide emission sources with flexibility to achieve cumulative emission targets will lower economic costs. California's GHG cap-and-trade system is designed to take advantage of this flexibility through allowance banking. Rather than emit GHGs, sources can carry out additional emissions reductions, and hold and "bank" unused allowances for future use. Through banking, sources

[38] This arises due to a combination of factors, including the lifetime of various emissions and the relationship between physical changes in the atmosphere and impacts. In particular, many GHGs, including CO_2, remain in the atmosphere for a very long time, on the order of decades to centuries.

can achieve emission reductions in lieu of using allowances if the future cost of abating GHG emissions is expected to be higher, which lowers the costs of achieving cumulative emissions.

Along with reducing aggregate economic costs, banking can help manage the financial risks of complying with the GHG cap-and-trade program given uncertainty in allowance prices. Banking reduces allowance price volatility by providing a supply of allowances to buffer against short-term fluctuations in allowance demand and supply. The absence of effective banking provisions was one of the primary causes of the dramatic price spikes observed in the year 2000 in the RECLAIM program in Southern California. Without banking, covered sources would face more volatile allowance prices, which would raise financial and operational risks due to the potential for restricted allowance supply in later years, and reduce incentives to make early emission reductions.

A requirement that annual emissions be at or below annual allowance budgets effectively eliminates the value of allowance banking. If, in total, actual emissions can *never* exceed the annual budget, banked allowances would have no value.

However, *the use of banking does not imply that at some point in time actual emissions will exceed annual allowance budgets*. In a system where market participants anticipate that the program will extend (indefinitely) into the future, the market may hold a bank of allowances to address the *possibility* that banked allowances are needed to achieve compliance. Given this possibility, actual emissions paths may remain below the budgets to allow the market to maintain an ongoing bank of allowances needed to mitigate against economic and financial risks.

C. The Need to Take Action to Lower Emission Caps

We do not assess the likelihood that actual emissions in 2030 are above the 2030 target of 40% below 1990 emissions, but we make several observations about the potential for this to occur. **First, given uncertainties in the drivers of future emissions, it would seem premature to begin eliminating allowances to address a compliance concern 12 years in the future.** Borenstein et al. find that there is a 34% likelihood that allowances prices hit a price ceiling of $85 per $MTCO_2e$ (in 2030).[39] Thus, they find that there is a 1-in-3 chance that the allowances will be so scarce that prices rise more than 6 times compared to their current level. Under such scenarios, banking plays a critical role in mitigating environmental goals while achieving long-run climate objectives. Their analysis accounts for the many factors that drive the demand for GHG allowances, most of which are virtually impossible to predict with certainty, including:

1. <u>Macro-economic trends</u>: Macro-economic growth will drive the future demand for allowances. Just as the recession in 2008-2009 reduced California's total emissions, expansion of the State's economy puts upward pressure on emissions. Uncertainty in macro-economic growth is a key driver of future variation in GHG emissions.

2. <u>Complementary Policies</u>: Complementary policies, such as the Low Carbon Fuel Standard (LCFS) and Renewable Portfolio Standards (RPS), lower demand for allowances[40] by requiring

[39] Borenstein, Severin, et al., "California's Cap-and-Trade Market Through 2030: A Preliminary Supply/Demand Analysis", Working Paper, July 2017, p.12.

[40] Schatzki and Stavins, 2012.

that covered entities reduce emissions outside the program. However, the effectiveness of these programs in reducing emissions is uncertain, which in turn creates uncertainty about these programs' impacts on the GHG cap-and-trade program.

3. Technological Change: The effectiveness of many of the state's complementary policies and the future cost of GHG abatement depends on the availability of new low-GHG technologies and the ability of California's energy systems, such as its electricity grid, to reliably and cost-effectively deploy expanded shares of low-GHG technologies.

4. Consumer decisions: Reducing GHG emissions in many sectors depends on consumer decisions. However, there is uncertainty about the extent to which consumers will deploy certain low-GHG technologies or will curtail activities that lead to GHG emissions. For example, consumers' decisions regarding vehicle purchases and miles driven (and energy consumption more generally) will have a large impact on emissions levels and subsequent demand for allowances.

5. Linkages: With linkage between systems, market events that increase or decrease demand for allowances in linked systems would flow through to California. For example, substantial operational or legal problems with Quebec's hydropower resources could increase demand for allowances in Quebec, which would diminish available supply in California.

Second, the concern that an allowance "over-supply" would create a non-compliance risk for California implicitly makes the unlikely assumption that the cap-and-trade program ends in 2030, covered sources remit their banked allowances to achieve compliance, and revert back to pre-cap-and-trade program emissions rates.[41] Such a fear is unwarranted for several reasons. First, once implemented, abatement technologies, such as low-carbon electric power generation, alternative fuel vehicles, and more efficiency equipment and buildings, remain in place and generally have lower variable operational costs than fossil fuel technologies. For example, if a firm operating delivery service vehicles switches to electric vehicles, it would not suddenly switch back to gasoline powered vehicles in 2030 simply because it has additional allowances. Second, it is reasonable to assume that the cap-and-trade program will continue beyond 2030 and, more importantly, market participants are likely to assume the program will continue in making their investment decisions. In fact, if CARB and the California legislature fail to convey a strong signal that the program will continue beyond 2030, this will substantially dampen investment incentives because the market benefits gained from investment in low-GHG technologies would be reduced once the program is terminated. In fact, the potential for higher abatement costs beyond 2030, given the increased cost of achieving more stringent targets, will incentivize covered entities to hold onto, rather than remit, banked allowances. This risk of higher allowance costs creates continued incentives for banking, which would lead to emissions below the 2030 cap.

Third, the current cap-and-trade program already has measures that implicitly address concerns about "overallocation". The cap-and-trade program has an auction reserve price that sets a floor on allowance prices, thus limiting the creation of new allowances when there is very low demand for

[41] Busch, Chris, "Oversupply Grows in the Western Climate Initiative Carbon Market", Energy Innovation Report, December 2017; Cullenward, Danny, (2014) "Leakage in California's Carbon Market", The Electricity Journal, 27(9): 26-48; Cullenward, Danny, "Removing excess cap-and-trade allowances will reduce greenhouse gas emissions", Research Note, January 11, 2018.

allowances. The cap-and-trade program also has a mechanism that further tightens the cap when demand for allowances remains low for extended period. AB 398 creates a new requirement that any allowances that remain unsold in the auction for 24 months be transferred to the APCR, which would raise the price at which these allowances could be accessed. Further, any allowances shifted to the APCR would then be moved into the Price Ceiling reserve as of 2021, making it even more costly to access this allowance supply.

III. DECISIONS RELATED TO ALLOCATION, HOLDING, AND USE OF PRICE CEILING AND PRICE CONTAINMENT POINT ALLOWANCES

Operation of the cap-and-trade system requires rules and procedures for determining how allowances are allocated to market participants, and how they can be traded, held, and used. These rules are important because they can affect market participants' abilities to trade allowances, which in turn affects market volatility, allowance price discovery, and the market's ability to equalize (marginal) costs across sources. By affecting trading and holding of allowances, these rules also affect companies' abilities to manage the financial risks of compliance with the GHG cap-and-trade program. These rules can also affect the risk of market manipulation or exercise of market power.

CARB has explicitly sought input on certain administrative rules related to the Price Ceiling and Price Containment Points. Effective market design decisions will differ for the Price Ceiling and the Price Containment Points due to differences in the supply of allowances available through each mechanism. Because the Price Ceiling ensures a supply of allowances sufficient for companies to comply with cap-and-trade, the Price Ceiling is like a carbon tax (for any allowances that an emission source is short). As a result, the timing of sales and flexibility of allowance use is less critical.

By contrast, because the supply of allowances at each Price Containment Point is finite, it is important that liquidity be supplied in a timely way and that sources can flexibly use and hold these allowances. Below, we discuss how rules can support this objective.

A. Frequency of Sale of Allowances

California's GHG cap-and-trade system allocates allowances through a combination of free allocations and quarterly allowance auctions. The quarterly allowance auctions provide a regular flow of allowances to the market that approximately corresponds to the system's aggregate compliance obligations.

CARB must decide how frequently (and through what mechanism) to allocate allowances from the Price Containment Points and Price Ceiling. CARB has several options, including periodic, regular sales and an "open window", where allowances can be purchased at any time at the price containment point.

Frequent allowance sales for the Price Ceiling is not critical to a well-functioning market. Because compliance entities know that they can purchase any allowances needed for compliance at the price ceiling, there is no need to have periodic sales. Allowances can be sold at the end of the compliance period so that entities that are short on allowances can come into compliance.[42]

Offering Price Containment Point allowances on a more frequent basis, through either an open window or frequent (e.g., monthly) sales offer greater benefits compared to infrequent (e.g., annual) sales. Several basic considerations lead to this conclusion.

More frequent sales can increase market liquidity. Liquidity is the volume of a commodity traded in the market. Liquidity is important to a well-functioning market. A higher volume of trading leads to more reliable price discovery, reduces the risk of market manipulation, and lowers risk management costs for market participants.

More frequent sales also provide more timely mitigation of price volatility and improved price discovery. More-frequent allowance sales will ensure that the increase in allowance supplies in the Price Containment Points are available to the market in a timely way when market prices rise to the Price Containment Points. If the release of allowances from the Price Containment Point reserves is delayed, market participants would need to trade "as though" these allowances were available, even if the actual supply of allowances available in the market was less than this quantity. While commodity markets often operate with uncertainty about commodity supplies, price discovery is improved with more trading of the physical product (i.e., allowances) as opposed to financial products (e.g., forward allowance purchases). Because the Price Containment Points are likely to occur during periods of higher price volatility, when efficient price discovery is particularly important, timely availability of allowances could be particularly valuable to supporting a well-functioning allowance market.

With either an open window or periodic sales, institutional infrastructure and procedures must be developed, which entail administrative costs. All else equal, more frequent sales would likely impose higher costs than less frequent sales, although any difference is likely to be modest.

B. Constraints in Use and Sale of Price Containment Points or Ceiling Allowances

CARB has asked for comments on certain potential administrative rules related to use of allowances from the Price Containment Points or Price Ceiling, including:

1. Timing Price Containment Points and Price Ceiling sales to occur between the end of a compliance period and the time when compliance is determined;
2. A limitation that Price Containment Point or Price Ceiling allowances can be used only to achieve compliance in the current compliance period; and
3. A requirement that each firm's holding account be empty before purchasing Price Containment Point or Price Ceiling allowances.

For the Price Ceiling, as discussed above, it is sensible to have Price Ceiling sales at the end of the compliance period, consistent with the first rule. The second and third rules would effectively ensure

[42] In fact, there is little reason for compliance entities to purchase allowances at the price ceiling prior to the end of the compliance period, because market prices may fall, which would allow the compliance entity to purchase allowances at a lower price.

that market participants do not purchase allowances at the Price Ceiling and bank them for use in the future compliance period. These limitations would not meaningfully impact market function because sources know that supplies are available for compliance at the Price Ceiling. Moreover, assuming the Price Ceiling is available in the future, it would make little sense for market participants to buy and hold (i.e. bank) allowances, since these could only depreciate in value (i.e., prices can only decline below the Price Ceiling). Nonetheless, if CARB wants to minimize the likelihood that actual emissions exceed allowance budgets, these limitations would support this goal.[43]

By contrast, these rules would be highly problematic for the Price Containment Points, exacerbating market volatility, raising financial risk and limiting banking, which in turn would raise costs. As described above, failure to make Price Containment Point allowances available to the market in a timely way could have many adverse consequences, including increased market volatility and weaker price discovery. While it is sensible to structure the Price Ceiling as a mechanism that allows sources to "true up" deficiencies between allowance holdings and actual emissions at the end of the current compliance period, this is not the purpose of the Price Containment Points. The Price Containment Points are intended as a mechanism to mitigate price volatility, and thus allowances need to be made available in a timely way to achieve this objective.

The second and third rules would effectively eliminate the banking of allowances when allowances prices rise to the Price Containment Point levels. This would be highly problematic. **Simply because allowance prices have risen to the Price Containment Points does not mean that banking is not economically efficient given potential future escalation in abatement costs (and allowance prices), nor does it mean that banked allowances are not valuable in mitigating price volatility.** Elimination of banking would raise economic costs and increase financial risks to companies requiring allowances for compliance. Further, from an environmental perspective, elimination of banking removes incentives for covered sources to undertake "early" emission reductions. There is simply no rationale for eliminating banking (or reducing firms' abilities to bank) simply because the market prices for allowances rise above the Price Containment Point prices.

C. Decisions Related to Allowance Banking

The economic benefits of allowance banking are well understood and demonstrated. As described above, allowance banking gives flexibility about when emission reductions can occur, thus lowering the cost of achieving emission reductions, and can help mitigate volatility in allowance prices, thus lowering financial risk. California's existing cap-and-trade program allows banking, and banking is a standard element of cap-and-trade systems for GHG emissions and other pollutants (e.g., SO_2).

Some stakeholders have proposed to modify the rules for allowance banking, including proposals that would discount any allowances held (banked) in individual allowance accounts. **CARB should avoid any discounting of banked allowances, which would distort market participants' future banking**

[43] Increases in emissions could occur if allowances were purchased at the Price Ceiling and banked for future use, allowance prices then fell below the Price Ceiling in the next compliance period, and banked allowances from the prior period were used for compliance. In this case, total emissions would increase if CARB were unable to take actions that reduced GHG emissions for all allowances sold at the Price Ceiling, as required by AB 398. The proposed rules mitigate this risk.

decisions due to the risk of allowance devaluation. CARB should preserve the current banking rules with one exception: it should consider modifying the current limits on the quantity of allowances that can be held in allowance accounts ("holding limits"). Holding limits were imposed to address the concern that a market participant could accumulate a large share of allowances and manipulate allowance prices through the exercise of market power. These limits, however, are imposed uniformly across all market participants irrespective of the difference in the costs they impose on different types of market participants. These limits could constrain the ability of firms subject to cap-and-trade to hedge the financial risks of compliance by banking allowances for use in future periods. Other markets with similar holding limits (e.g., derivative markets regulated by the Commodity Futures Exchange Commission) provide exemptions for legitimate business activities, such as hedging. ARB should modify these holding limits to account for legitimate hedging and banking activities through exemptions or increases in holding limits that reflect the size of market participant's compliance obligations.[44]

IV. CONCLUSION

California's GHG cap-and-trade system is well designed, serving as a template for systems in other parts of the world. However, its performance has not to date been seriously tested, because of a combination of factors, including the existence of complementary policies that achieve emission reductions (albeit at higher cost). As it moves into the 2021-2030, CARB must address a number of rules and considerations that will affect the likelihood that more scarce market conditions occur, and will affect the market's performance. Decisions aimed at mitigating economic risks while achieving environmental objectives will provide the greatest net benefits for California's citizens, while also maintaining political support for the program (and California's climate policies more broadly) and providing leadership on effective climate policy design that can inform other regions contemplating similar initiatives.

[44] For further discussion, *see* Schatzki, Todd and Robert N. Stavins, "Three Lingering Design Issues Affecting Performance in California's GHG Cap-and-Trade Program," November 19, 2012.