



2018 ANNUAL REPORT OF THE INDEPENDENT EMISSIONS MARKET ADVISORY COMMITTEE

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Executive Summary:

The enclosed document is the first annual report of the Independent Emissions Market Advisory Committee (IEMAC or Committee). Through the passage of Assembly Bill (AB) 398 in 2017, the California Legislature and Governor Edmund G. Brown, Jr. directed the development of the Committee within the California Environmental Protection Agency (CalEPA). The provisions specific to the Committee are set forth in the Health and Safety Code, Section 38591.2. They require the IEMAC to meet at least annually and provide an annual report exploring the environmental and economic performance of the State's cap-and-trade program and other relevant environmental programs to the California Air Resources Board (CARB) and the Joint Legislative Committee on Climate Change.

The IEMAC met twice at CalEPA in 2018, forming six subcommittees consisting of two Committee members each to complete the annual report. The enclosed document is a compilation of sub-committee chapters on overlapping policies, environmental justice, leakage, offsets, managing allowance supply, and price ceilings.

The IEMAC recommends that CARB perform additional analysis or collect additional information to cast light on potential problem areas identified by the subcommittees. In some cases, this information may exist and we welcome direction to that information; in other cases, there may be opportunities to improve existing information or to develop new analysis. In some cases, the IEMAC suggests revisions to the draft cap-and-trade regulations CARB issued on September 4, 2018.

Chapter 1: Introduction

Authors: Dallas Burtraw and Ann Carlson

The California carbon dioxide emissions cap-and-trade program is the best designed emissions trading program in the world and has contributed to the state achieving its 2020 goals four years ahead of schedule. In 2017, the California Legislature and Governor Edmund G. Brown, Jr. directed the development of the Independent Emissions Market Advisory Committee (IEMAC or Committee) through the passage of Assembly Bill (AB) 398. The provisions specific to the Committee are set forth in the Health and Safety Code, Section 38591.2.

The statute established the IEMAC within the California Environmental Protection Agency (CalEPA) through January 1, 2031. IEMAC members include at least five experts on emissions trading market design appointed by the Governor (three members), the Senate Committee on Rules (one member), and the Speaker of the Assembly (one member). Membership also includes a representative from the Legislative Analyst's Office.

Committee members must all possess academic, nonprofit, or other relevant backgrounds and lack financial conflicts of interest with entities subject to the cap-and-trade regulations adopted by the California Air Resources Board (CARB). The statute requires at least one annual public meeting and a report to both CARB and the Joint Legislative Committee on Climate Change Policies on the environmental and economic performance of the cap-and-trade regulation and other relevant climate policies¹.

A. Summary of the Committee Research and Recommendations

The role of the IEMAC as outlined by AB 398 is to report annually on the environmental and economic performance of the state's carbon pricing regulation and other relevant climate policies. This report presents six reviews, conducted in subcommittees consisting of two Committee members, of issue areas that affect the performance of California's cap-and-trade program and other relevant climate policies. The reviews cover overlapping policies, environmental justice, leakage, offsets, managing allowance supply, and price ceilings. In this summary, we highlight several recommendations to CARB about data collection, reporting and analysis that the committees believe would help ensure the integrity of California's emissions reduction efforts and help inform regulatory choices. In some of the subcommittee reports we also comment on CARB's proposed regulations for the cap-and-trade market. We first offer several overarching comments focused on big design issues facing CARB in shaping the cap-and-trade market post-2020 and in evaluating the state's efforts to date.

B. Program Design

¹ Statute also requires CARB to consult with the IEMAC and report to the Legislature in the event of specified cap-and-trade auction outcomes.

We begin with three important principles. First, it is crucial that decarbonization of the state's economy not interfere with California's economic growth and that the state continues the trend of decoupling greenhouse gas (GHG) emissions from economic activity. Ensuring that our climate policies are as cost-effective as possible (consistent with other goals) is important to achieving this outcome. Second, the programs the state has adopted to reduce our GHG emissions – both legislatively and administratively – must be administered in ways that maximize benefits to all Californians, particularly those in disadvantaged and vulnerable communities. And third, the state's programs to reduce emissions must be designed to maximize environmental integrity – to produce real, verifiable emissions reductions that help reduce overall global emissions. As the state's emissions targets ratchet down and the state aims to achieve carbon neutrality by 2045², achieving cost-effective reductions that have environmental integrity and produce benefits to all Californians will become tougher. Our aim in this report is to begin to evaluate areas of carbon market design with these background principles in mind.

Our subcommittee reports are worth reading in their entirety but below we summarize key recommendations offered by the Committee. Most of our recommendations ask CARB to gather – either directly or through independent research – information and analysis that would cast light on potential problem areas identified by the subcommittees. In some cases, this information may exist and we welcome direction to that information; in other cases, there may be opportunities to improve of existing information or new analysis may be necessary. In some cases, we suggest revisions to the draft cap-and-trade regulations CARB issued on September 4, 2018. We appreciate that tradeoffs must be made in assigning scarce resources within California's regulatory agencies. In this light, we try to identify priorities.

C. IEMAC Summary Recommendations

Overlapping Policies

- Identify the potential that overlapping or companion policies may reduce allowance prices and examine remedies if this is a problem.
- Evaluate alternative methods to reduce emissions in the transportation sector if the state cannot implement its tailpipe and ZEV standards.

Environmental Justice Implications of California Climate Change Policies

- Local and regional air pollution poses significant environmental and health risks, and these local pollution problems should be addressed as vigorously as global climate change.
- Continue to monitor and analyze the distribution of emissions impacts associated with California's GHG emissions trading program on disadvantaged communities.

² [Executive Order on Carbon Neutrality](#)

- More is expected and must be done to further an inclusive and transparent process between the agency, environmental justice advocates, and local communities to foster trust

Emissions Leakage and Resource Shuffling

- Additional data collection and analysis is needed to refine and improve the current approach to calibrating and conferring output-based leakage mitigation compensation. As California's GHG policies increase in stringency and ambition, the efficiency and distributional implications of any miscalibration of these subsidies become more significant.
- GHG reductions in the electricity sector are driving statewide trends. Electricity imports are potentially subject to resource shuffling. CARB should review and update core resource shuffling accounting methods in the current and proposed regulations. A more comprehensive assessment of the extent to which resource shuffling has occurred would be complicated and inevitably imprecise, but would help to target and inform any mitigation actions going forward.

Offsets

- The proposed regulatory text defining "direct environmental benefits" (DEBs) contains an ambiguity that could enable any offset project to claim a DEB on the basis of its greenhouse gas emissions. CARB should foreclose this option.
- Credits issued under the U.S. Forest Projects protocol account for about three-quarters of the offsets market. The subcommittee recommends additional review of this protocol's crediting methods to reflect technical concerns related to leakage, the timing of credited reductions, and the risk of unintentional reversal due to fires and other exogenous causes.

Managing Allowance Supply

- Public and private banking of allowances that are not needed in the pre-2021 market period will increase market supply in the post-2020 period, with the total number made available depending on future market prices. To improve transparency and address concerns about the ultimate emissions outcome, CARB should increase its public data reporting and prepare a comprehensive report on allowance supply.
- CARB should consider rule-based adjustments to program design that would adjust the supply of allowances based on observable metrics and in response to any concerns identified in the recommended studies.

Price Ceiling Considerations

- The state should develop an independent estimate of the social cost of carbon (SCC) to be included in a justification of the price tiers and price ceiling, accounting for the potential impact on disadvantaged communities from covered sources.
- The focus of program integrity should be placed on the level of emissions reductions achieved, not the amount of revenue the program generates.

- The state should consider the development of out-of-market emissions reduction opportunities in advance of when they might be needed in the program to provide compliance instruments if the price ceiling is triggered. New protocols that might apply can generate global environmental benefits.

D. Looking Forward

Before moving to the subcommittee reports, we offer a word on process. This committee had an abbreviated schedule to meet and develop recommendations, and we accelerated the process to provide our first report within the fall 2018 comment window for the proposed amendments to the cap-and-trade program. Going forward, we are committed to improving committee process to enable better engagement with the public and the legislature.

We appreciate the hard work and dedication of the CalEPA Secretary's office and CARB, under the leadership and direction of the Executive Officer, the CARB Board and its Chair. Their work, along with many other state agencies implementing climate policy, has produced emissions reductions that have met the 2020 GHG emissions cap four years early at the same time that California has led the country in economic growth. Our recommendations intend to assist the Board in the next phase of program development and implementation, as we work collectively to ensure that California meets its ambitious climate goals with environmental integrity, with environmental justice, and in a way that continues to contribute to California's economic health.

Chapter 2: Overlapping Policies

Authors: Dallas Burtraw and Ann Carlson

A. Context

California's cap-and-trade program to reduce greenhouse gases is a highly visible piece of the state's portfolio of climate policies. However, it is only one element of the state's program to reduce greenhouse gases to meet its 2030 target. The state has adopted a number of additional policies, including a stringent Renewable Portfolio Standard, land use measures to reduce vehicle miles traveled, a Low Carbon Fuel Standard, and greenhouse gas emissions standards for various categories of vehicles. The 2017 Scoping Plan adopted by the Air Resources Board, in fact, identifies regulatory measures that are designed to achieve a majority of the emissions reductions required by statute. The cap-and-trade program is, nevertheless, an extremely important part of the program. It serves a number of valuable functions. These include

- 1) introducing greater cost effectiveness by making sure that low cost opportunities for emissions reductions are captured;
- 2) ensuring, through the cap, that the overall statutory emissions goals are achieved;
- 3) providing a signal to innovators about the value of low-carbon investments.

B. Key considerations

Though California's suite of regulatory policies is impressive and responsible for a significant portion of GHG emissions, one issue they raise is that these policies may overlap with the cap-and-trade program by targeting the same regulated entity more than once. By adopting overlapping policies, the state may create effects that are not always fully transparent or that can undermine the goals of the policies. For example, overlapping policies may dampen prices in the cap-and-trade market. These price-dampening effects can, in turn, reduce incentives for technological innovation. Overlapping policies also tend to (though not always) mask their cost and may be more expensive per ton reduction of GHGs than a less fettered cap-and-trade program. Overlapping policies can also produce many benefits, some of which we also highlight. Our focus in our subcommittee report is on these policies and their interaction with the allowance market.

C. Case studies and public comments

1. Overlapping policies

Many policies that overlap with cap and trade are initiated by other agencies in local, state and federal government. Examples of policies that overlap with the cap-and-trade program include:

- 1) The Low Carbon Fuel Standard (LCFS) regulates the full life cycle of transportation fuels. This includes their production, transport, and

- combustion. The cap-and-trade program includes petroleum transport fuels and natural gas, though is not based on life cycle emissions but instead only combustion. Compliance for one program can achieve compliance for the other if the compliance for one program reduces the required amount of reduction for the regulated entity under the other program; whether the LCFS or the cap-and-trade program requires the compliance depends on individual circumstances ([Controlling Greenhouse Gas Emissions from Transport Fuels: The Performance and Prospect of California's Low Carbon Fuel Standard](#)). Even though LCFS allowance prices are significantly higher than allowance prices under cap-and-trade, the interactive effects of the program vary depending on factors like the carbon intensity of a particular fuel. As Parson, et al. explain, a fuel like fossil CNG, which has a relatively low carbon intensity, receives credits under the LCFS but must surrender allowances under cap-and-trade. By contrast, some high-intensity fuels achieve their compliance through purchasing LCFS allowances, not through cap-and-trade.
- 2) The Renewables Portfolio Standard (RPS) requires the state's electric utilities to achieve a set percentage of their energy from defined renewable sources such as wind and solar. The percentage has increased over time, so that by 2030 the state's utilities must achieve 60 percent of their energy from defined renewable sources. The state's utilities (both investor-owned and publicly-owned) are also subject to the cap-and-trade program. The RPS in effect directs the utilities how to achieve the majority of their emissions cuts – by procuring energy from renewable sources and is expected to have additional costs to the state even as it advances the integration of renewable energy technology into the electricity system. If the RPS did not exist, utilities could instead meet their cuts under the cap-and-trade program by choosing how they would comply. Other programs that operate similarly include energy efficiency standards and mandates for the procurement of battery storage. Each of these have their own long-run justifications, but each may introduce additional costs in the short-run compared to cap and trade (though energy efficiency may be cheaper in the short-run).
 - 3) The Zero Emission Vehicle (ZEV) and GHG mobile source standards. Expanded electrification and energy efficiency in transportation will yield reductions over the next decade. Although car manufacturers are not subject to the cap-and-trade program, as described above, fuels are.

2. Issues Raised by Interactive Effects of Cap-and-Trade, Complementary Policies

The overlap of the cap-and-trade program with other regulatory measures could be mutually reinforcing or could undermine the incentives or cost effectiveness of each of the approaches. Overlapping and companion policies have many and varied justifications, including importantly the attainment of ancillary environmental benefits and especially environmental improvements in disadvantaged communities. For example, the RPS, with its requirement that utilities procure renewable energy, lowers

air pollutants to the degree that renewable resources displace dirtier energy sources like natural gas. Other justifications include promoting targeted technological change and building infrastructure. For example, the RPS may have helped stimulate technological innovation and driven down procurement costs for renewable projects.

The policies that directly regulate emissions from sources that are also covered by the cap-and-trade program, however, can be expected to put downward pressure on the cap-and-trade allowance price. That is because when policies direct how emissions will be reduced (through, for example, mandating that utilities procure a set amount of renewable energy), there are fewer emissions to be reduced in the cap-and-trade market (even though the lower emissions resulting from the RPS help utilities achieve compliance). A lower price in the market has advantages, such as protecting California industry, but that lower price masks what are in some cases higher costs for these industries if the cost of meeting the RPS, for example, is higher than the cost of cutting emissions through other means. Another disadvantage of a lower allowance price is that it lessens the economic signal from the cap-and-trade program that influences investments by industry, businesses and households and therefore opportunities for technological innovation. As climate goals become increasingly ambitious, most economists advocate for an increasing role for pricing. However, a declining price that results from an abundance of overlapping policies undermines confidence in the market and expectations about a price signal, creating a cycle that requires yet more regulation to achieve long-run emissions reduction goals.

In some cases, it appears that an allowance price that could practically be achieved – even without overlapping policies – would be insufficient to incentivize the necessary emissions reductions in the short run or the investment in infrastructure and innovation that is necessary in the long run. In this case, government regulation may have a special role in coordinating these transformations. This seems especially true in the transportation sector, where allowance prices in cap-and-trade may be insufficient to direct the changes necessary to achieve large emissions cuts in the sector.

California enforces its vehicle mandates under a waiver granted by the US Environmental Protection Agency (EPA). The EPA is currently proposing to revoke California's waiver to issue GHG standards for passenger automobiles and for its ZEV program. The ARB Scoping Plan for 2017 considers the possibility that the federal government will attempt to limit California's authority to issue tailpipe standards. If the federal effort succeeds in either delaying the implementation of the standards or blocking them all together, the Scoping Plan calls for achieving emissions reductions from the same sector. However, it will be a challenge for California to do so if the federal government succeeds in either delaying or forestalling vehicle emissions standards for 2021-2025 altogether. Additionally, under the Clean Air Act, California will need to get federal permission (a waiver) to issue standards for 2025 and beyond. Although California has a strong legal case that it can continue to impose its 2021-2025 standards for passenger automobiles and require compliance with its ZEV program, no legal case is without uncertainty. And transportation is the largest source of GHGs in

the state and the sector showing increases, rather than decreases, in emissions in recent inventories.

3. Public Comments

We highlight two comments received by the committee. These comments have not been evaluated by the full committee.

- 1) AB 32 requires the state to account for emissions associated with imported power. In doing so, the state applies a protocol to identify or assign an emissions rate to imported power. Entities that deliver imported power to the California grid are responsible for surrendering emissions allowances commensurate with the embodied emissions of that power. Consequently, relatively low-emitting power may be preferentially directed to the California market. The same power may have created renewable energy credits that are used for compliance in a renewable portfolio program in California or another state. If the California power market is valuing the power because it is clean, then the renewable credits might be double counting that attribute in other programs. Conversely, the renewable credits might be lowering the price of renewable power that is made available to the California energy market. Among suggestions shared with the committee was the idea that renewable power that is imported to California be identified as a zero-emissions import in WREGIS, so that other programs can consider the influence of the overlapping policies.
- 2) One comment suggested that compliance entities report the greenhouse gas emissions reductions that are achieved from overlapping regulatory programs. This reporting protocol may have merit, but it may lead to ambiguous assignment of emissions reductions across programs. We invite ARB to consider the possibility further.

D. Recommendations for cap-and-trade regulatory amendments

We do not see opportunities to address overlapping policies in the short-run context. We have suggestions for analysis that could be important to the direction of the program in the long run.

E. Recommendations for longer-term implementation

Overlapping policies raise a number of issues that could benefit from additional analysis and consideration.

- 1) Identify the potential that overlapping or companion policies may reduce allowance prices and examine remedies if this is a problem.

We believe it would be beneficial to have more analysis about the price effects of having policies that overlap with cap and trade. First, on a per ton of GHG reduction, are there estimates of the cost of various overlapping policies like the RPS, energy efficiency and car standards? And are there estimates about the degree to which overlapping policies put downward pressure on cap-and-trade allowance prices? If the downward pressure

is significant, there are design choices for the cap-and-trade market that can alleviate this pressure. For example, the existing price floor provides assurance of a minimum value of investments in compliance. But there may be opportunities to supplement the price floor with additional measures, such as additional emissions/price containment points or other adjustments to allowance supply when companion policies have their desired effect. Relatedly, there may be opportunities to align price-based policies like the RPS and the LCFS with the cap-and-trade program provides cost and price management in a complementary way across these programs. We recommend that ARB consider these possibilities and opportunities.

- 2) We ask CARB to evaluate alternative methods to reduce emissions in the transportation sector if the state cannot implement its tailpipe and ZEV standards.

We list below several possibilities, none of which we have examined in detail. We recommend that ARB consider these possibilities.

- a. Consumption based pricing of vehicle miles traveled;
- b. Increase in tax subsidies or direct subsidies for EV purchases;
- c. Feebates associated with vehicles according to technology characteristics;
- d. Additional housing and land use standards to reduce vehicle miles traveled;
- e. Regulations or limitations on extraction of fossil fuel resources;
- f. State fleet mandates, and incentives for corporate and local government fleet conversions;
- g. Carbon intensity of vehicles manufacturing modeled after the Low Carbon Fuel Standard but focused on automobiles rather than fuels.
- h. We encourage ARB and other state agencies to look for opportunities to infuse incentives in regulatory policies that overlap with the cap-and-trade program. We also encourage ARB to look for ways of aligning these efforts to improve cost effectiveness. An example might be linked cost containment.
- i. Without providing guidance about how to do so, the committee urges state agencies including the ARB to rigorously evaluate companion policies to identify their motivation such as market failures, technological or infrastructure development, or research. This effort will help ARB to assess the influence these programs may have or are intended to have on the cap-and-trade program.

F. Conclusion

Policies that overlap with the cap-and-trade program affect the performance of the program. This committee advises that ARB and other state agencies be proactive in understanding how that interaction will affect the market as well as how the market might affect the performance of the overlapping policies.

Chapter 3: Environmental Justice Implications of California Climate Change Policies

Authors: Quentin Foster and Meredith Fowlie

A. Context

California faces intensifying risks from climate change, including more intense forest fires, coastal erosion, prolonged droughts, and more frequent episodes of extreme heat. In response to these escalating risks, California has committed to reducing its greenhouse gas emissions, and to protecting the public against significant climate change related damages. The state is implementing a suite of policies designed to reduce in-state GHG emissions and stimulate the development of low carbon solutions that can be deployed more broadly.

California's efforts to mitigate global climate change are important. However, climate change is not the only environmental concern that poses significant risk to the well-being of Californians. Local and regional air pollution poses significant environmental and health risks. Going forward, these local pollution problems should be addressed as vigorously as global climate change, particularly in marginalized communities which are disproportionately exposed to these risks.

The critical importance of local air pollution problems notwithstanding, our committee is tasked with reviewing California's GHG cap-and-trade program and associated climate change policies. Our charge is not to question the fundamental policy architecture, but rather to evaluate the policy design and governance choices that could have significant implications for program effectiveness. The focus of this sub-committee, in particular, is on how California's climate change policies and programs could impact socioeconomically disadvantaged communities.

In this commentary, we briefly review some of the research that investigates these issues, we assess the ways in which California Air Resources Board (CARB) has been responsive to environmental justice (EJ) concerns, and we highlight some policy design and implementation features that warrant particular attention.

Although conversations with the EJ community were considered carefully in the writing of this report, this is not intended to be a consensus document. This comment seeks to characterize the range of opinions and perspectives on key issues, identify knowledge gaps, and highlight issues that merit careful attention going forward.

B. Lessons from literature on cap-and-trade and environmental justice

Although the GHG cap-and-trade program has attracted a great deal of attention, it is important to keep in mind that cap-and-trade plays a supporting role in California climate policy. More prescriptive programs and regulations are expected to deliver the

majority of mandated GHG emissions reductions.¹ That said, the cap and trade program does have three critical roles to play:

- 1) A binding emissions cap ensures that the state's GHG emissions reduction targets are met.
- 2) Trading of allowances between firms can significantly reduce abatement costs incurred to meet the cap.
- 3) The sale of allowances raises revenues that can be used to mitigate adverse impacts of climate change and/or reduce any inequities in cost burden.

Economists favor market-based climate change policies, such as emissions trading programs, because they are designed to seek out and incentivize the least costly GHG abatement options. Environmental justice advocates have been quick to point out that the least cost climate change mitigation solutions need not be the most equitable or desirable. In principle, revenues raised through the sale of allowances can be used to offset these inequities. In practice, this kind of redistribution can get complicated.

One complication is that GHGs are often co-emitted with local pollutants that cause localized health and environmental damages. Thus, the allocation of GHG emissions abatement responsibilities can have important implications for local environmental quality. Historically, GHG emissions and emissions of local pollutants from point sources have been strongly positively correlated. In the past, changes in emissions have primarily been driven by variation in industrial production levels. However, the relationship between GHGs and local pollution could look quite different if pollution reductions are induced by a policy targeting one form of pollution. For example, a gas-fired boiler could increase combustion temperatures to lower GHGs, but this would increase local pollutant emissions (Holland, 2012). In this case, mandating a decrease in GHGs would lead to a *deterioration* of local environmental quality. The impact of a policy-induced reduction in GHGs on local pollution will really depend on the extent to which local and global pollutants are substitutable.

Economists have begun to empirically investigate the cross-effects of pollution regulations. Holland (2012) examines the response of GHG emissions to an increase in the stringency of NO_x regulations for California power plants. In this context, electricity generating firms primarily complied with the policy by reducing output which reduced both types of pollutants. Brunel and Johnson (2016) isolate plausibly exogenous spatial and temporal variation in local and regional air pollution induced by the Clean Air Act in order to empirically evaluate complementarities in U.S. manufacturing sectors. In contrast to Holland, they find that significant, policy-induced reductions in local pollution have not had ancillary benefits in terms of GHG reductions, presumably because abatement investments delivered targeted reductions in regulated pollutants. These findings highlight the possibility that historic correlations in local and global emissions

¹ Companion policies, such as the renewable portfolio standard, are expected to deliver the majority of GHG emissions reductions. CARB estimates that cap-and-trade will deliver less than 30% of mandated GHG emissions reductions by 2020. See [CARBs Climate Change Scoping Plan](#)

trends can be misleading indicators of how a policy-induced change in one form of pollution will affect the other.

A recent paper by Cushing et al (2018) examines temporal patterns in local pollutants, toxics, and global pollutants emitted from point sources regulated under California's GHG emissions trading program. These authors compare emissions levels prior to the policy (2011-2012) and the three years following the introduction of the policy (2013-2015). The study finds that, variation in GHG and local pollutant emissions were positively correlated over this time period. Notably, 52% of facilities regulated under the GHG emissions trading program increased emissions in the post-policy period relative to 2011-2012. The authors estimate find that emissions increases between these two time periods were disproportionately located in low income and minority neighborhoods.

The findings of Cushing et al. are concerning but not dispositive. One complication lies in the inter-temporal comparison that these authors construct. Comparisons across these two time periods confound the effects of the GHG cap and trade program with some other significant determinants of local pollution and GHG emissions. For example:

- 1) Over the period 2013-2015, in addition to implementing the GHG emissions trading program, California (and the rest of the country) was recovering from the recession. With economic recovery comes an increase in industrial production and associate emissions.
- 2) In the electricity sector, the closure of the San Onofre nuclear power plant in 2012. This major shut down induced a significant increase in output among fossil fuel generation in the state. It is estimated that the nuclear plant closure increased greenhouse gas emissions from power plants in California by 35%.

In order to isolate the effect of the GHG cap-and-trade program on the distribution of emissions over this time period, additional work is needed to control for these and other factors.

A second concern pertains to the sensitivity of the results to the chosen time period. Cushing et al. report: "Since California's cap-and-trade program began, neighborhoods that experienced increases in annual GHGs and co-pollutant emissions from facilities nearby had higher proportions of people of color and poor." However, subsequent research looking into this question has found that the answer is sensitive to how the comparison is constructed. For example, Meng (2018) finds no significant difference in average GHG emissions trends over the period 2012-2015 across disadvantaged and non-disadvantaged communities. If anything, emissions trajectories over this period suggest the emissions gap is narrowing.

In sum, the empirical evidence on the cross-effects of local and global pollution regulations is mixed. It is not our role to debate the merits of these aforementioned studies. Instead, we advise the legislature and staff to monitor and analyze the distribution of emissions impacts associated with California's GHG emissions trading program, in addition to other policies.

C. Governance

CalEPA staff are to be commended for their thoughtful and deliberate approach to addressing some complex issues and tradeoffs across a state that is regionally and culturally diverse. The cap-and-trade program design should continue to reflect its intention of being the backstop to the suite of climate policies that help drive down CO₂ emissions. At the same time, the state should also support efforts to address air quality concerns in marginalized communities across the state through additional policies like AB 617, which we agree with environmental justice communities, is but a first step to truly prioritizing addressing local pollution in vulnerable communities.

It is important to recognize and commend the leadership within the environmental justice movement for pushing the concerns of many Californian's to the forefront of our political discourse pertaining to how we will prioritize those concerns within the context of climate action. Environmental justice communities are supportive of the governance changes that have been adopted to ensure their concerns receive the proper attention and action from senior staff within CARB and CalEPA. Today, the California Air Resources Board has expanded to include two voting members with experience on environmental justice issues. Additionally, the Legislature through AB 197 now has two appointments to CARB that are non-voting members but can continue to provide legislative oversight on concerns raised by environmental justice communities before the Board. CARB has also created the role of Assistant Executive Officer for Environmental Justice primarily responsible for coordinating with and representing the interests of environmental justice communities on behalf of the agency.

Finally, in 2015 the agency recommissioned the Environmental Justice Advisory Committee (EJAC), which is comprised of community leaders and experts on environmental justice issues. Since the passage of AB 32 in 2006, the environmental justice advocates and community leaders have grown in influence. That influence is reflected in these governance changes ensuring that these communities can participate more directly and substantively in how California addresses climate change and local air pollution challenges. CARB staff continue to demonstrate the importance of ensuring community leaders are included in the regulatory process through its public workshops held in environmental justice communities, increased transparency with public reporting of data, and willingness to adjust outreach efforts to ensure cultural relevance and competency. We recommend that CARB remain consistent in these outreach efforts both with local communities and with current EJAC committee members.

D. Monitoring impacts of GHG emissions regulations on local air quality

While climate is the focus of this committee, it is important to recognize the air quality impacts on vulnerable communities of climate regulations. To that end, the 2017 Scoping Plan includes a strong acknowledgement that climate action can only be considered fair and equitable when inequities across communities are addressed.

The passage and subsequent implementation of AB 197 and AB 617 provides an opportunity for the agency and the state to demonstrate the priorities of local air quality

coupled with climate and the prevention or mitigation of unintended consequences. Coupled with the last update to the CalEnviro Screen, a tool that aides the state in identifying hot spots in communities across the state for investment and encourages collaborative action with local communities. This is especially relevant to identified neighborhoods where local air districts are tasked with addressing toxic and local criteria pollutants that are known to exacerbate poor health outcomes. With the support and backing of the Board, increased local monitoring and real-time data collection, fair and equitable action on climate and air quality can be catalyzed throughout the state.

The IEMAC committee had the opportunity to meet with environmental justice advocates to discuss, among other issues, the intent and potential of AB 617. Their assessment is that the AB 617 process is extremely new and under development. EJ advocates correctly note that many of the key pillars and programs of AB 617 have yet to be defined. Important concerns were raised about enforcement protocols for air districts. Thus, while the policy constitutes a promising first step, we cannot safely assume that it will sufficiently address environmental justice issues. Although there is real potential, it is far from clear that AB 617 will indeed provide the robust changes necessary to how the state addresses local criteria pollutants. We agree with this assessment.

In order to be successful, implementation of AB 617 will require consistent and adequate funding from the Legislature, and sufficient and dedicated staff. Workshops are being convened throughout the state to engage communities on best practices and planning. Efforts to develop relationships with local leaders that will lead to truly identifying the sources of concerns are ongoing.

There is a critical trust gap that must be overcome if this program development process is to be successful. Given the striking inequities in exposure to harmful local air pollution, environmental justice communities may have low expectations and/or anticipate minimal attention and effort from the agency. This committee recommends that staff continue to have robust engagement with community leaders, ensuring information materials are culturally relevant, and maintain transparency of timelines, goals, and information. We furthermore recommend that communities that have not been included in the first round of implementation continue to be engaged. For example, Richmond was not prioritized in the first round, but given its proximity to a major oil refinery, should be considered for the second round of implementation.

While AB 617 presents a potentially significant step forward in addressing the social needs that run parallel to air quality challenges, understandable skepticism remains. Agencies must earn trust and demonstrate meaningful progress by investing substantively in substantive environmental quality improvements, particularly in communities impacted disproportionately by adverse public health outcomes related to local air quality conditions and other environmental factors such as transportation, proximity to ports, and freight goods movement.

E. Investing in EJ Communities

California climate change policy includes a number of programs designed to mitigate the impacts of California climate policies on low income households. Programs include: 1) the provision of climate credits directly to households; 2) climate investments and other efficiency, fuel switching, and vehicle mile reducing programs and policies that help households lower their expenditures on electricity, natural gas and gasoline; and 3) low-income rate assistance programs, which although unrelated to the Cap-and-Trade Program, can reduce households' budgetary burden associated with electricity and natural gas consumption. Because the latter two types of measures can lower energy and gasoline bills, they indirectly help to lower any Cap-and-Trade compliance cost passed on to customers.

A 2016 study conducted by the UCLA Luskin Center estimated that low income households would receive more in climate credits than they would pay in Cap-and-Trade associated costs as electricity consumers (Gattaciecce et al. 2016). In other words, low-income households could receive a positive financial impact of between \$215 and \$246 cumulatively, from 2016 through 2020, associated with the Cap-and-Trade Program.

In addition to climate credits, it is estimated that over half of the \$2 billion in implemented projects (\$1 billion) is providing benefits to disadvantaged communities, including 31 percent (\$615 million) going to projects located within these communities. This exceeds the requirement under SB 535 (De León) that at least 25 percent of investments are allocated to projects that benefit disadvantaged communities. In 2016, Governor Brown signed AB 1550 establishing new investment minimums for disadvantaged communities, and low-income communities and households. In addition to subsidizing the cost of critical mitigation projects, additional programs designed to reduce the financial pressure on low-income communities due to increase in energy costs are also supported by investments from the revenue in the cap and trade program.

As noted above, the GHG cap-and-trade program provides an essential means of raising revenues to support promising climate change mitigation investments, and to offset inequalities (pre-existing or policy induced). We encourage CARB and the Legislature to continue working together to prioritize promising investments in disadvantaged EJ communities.

F. EJAC Recommendations

While there are some stark differences between the EJAC recommendations on which tools the state should adopt to meet its emissions goals and what was eventually adopted, staff and Board support of the committee is helping to build trust. It is important to note that trust does not require that the recommendations from the EJAC being accepted. Even when there are disagreements and discrepancies between recommendations and policy implementation, trust can still be cultivated if

recommendations are received and analyzed by staff, and if the discussion around these recommendations is transparent and substantive.

Shared benefits from the state's climate policies are critical to ensuring equity is achieved. Some examples of this are the state's California Alternate Rates for Energy (CARE) Program that helps to reduce energy costs for low-income families. Programs like these are supported by EJAC members who understand how these programs will be impacted by new regulations. Having this perspective is important to reducing the potential for negative unintended outcomes associated with the agency's strategies.

Also of concern to environmental justice advocates is the definition of what constitutes a "Direct Environmental Benefit". These communities have long held that offsets, which can provide an important means of enhancing cost effectiveness of climate change mitigation, export California benefits and contribute to the creation of toxic hotspots in vulnerable communities. Ensuring that offset projects from outside of California meet specific verifiable criteria on a project by project basis, can alleviate most of the concerns that benefits from approved offset protocols will indeed benefit Californians in some direct way. The creation of the Offset Protocol Task Force by AB 398 will also provide some assurances to environmental justice communities and advocates that more deliberate consideration will be given to new offset projects in the state.

While differences remain between CARB's positions and the concerns of some environmental justice leaders in how air quality and GHG reductions are addressed, it is crucial that CARB continue to engage and work with environmental justice communities. There also remains concerns that AB 197, which calls for CARB to prioritize direct emission reductions is somehow not being implemented with the appropriate intent of the legislation fully realized.

The most important component of AB 197 to environmental justice advocates is the direction it gives CARB to prioritize direct emission reductions at the source level. There continues to be an underlying concern that the state's primary focus particularly with the cap and trade program to reduce GHG emissions will diminish the priority to address localized criteria pollutants from industrial sources. This tension continues to undermine efforts to narrow the communication gap between CARB staff and many advocates adding to lingering sentiments of mistrust. Although these issues fall outside of the scope of this committee, however we do recognize that trust is earned, and CARB should continue to take the necessary steps to build that trust with communities who have historically not played a direct role in creation and implementation of air quality regulations.

The recommendations of the EJAC, while not accepted completely, demonstrate that people are paying close attention to the decisions that CARB is making and want to be a part of the solution to the crisis. The recommendation of this committee is that CARB continue to be transparent and consistent in engaging with and strongly considering the analysis and recommendations without prejudice from EJAC members and local environmental justice advocates.

G. Conclusion

In this commentary, we have highlighted some issues and concerns that warrant particular attention going forward:

- 1) We encourage the legislature and staff to monitor and analyze the distribution of emissions impacts associated with California's GHG emissions trading program, in addition to other policies.
- 2) We acknowledge the governance changes that have been made to help EJ communities participate more directly and substantively in how California addresses climate change and local air pollution challenges. It is important that CARB remain consistent in these outreach efforts both with local communities and with current EJAC committee members.
- 3) We underscore the importance of investing substantively in critical environmental quality improvements in EJ communities via AB 617 and related regulations.
- 4) We encourage CARB to work with the Legislature to broaden opportunities for meaningful mitigation investments in disadvantaged communities throughout the state.
- 5) We acknowledge EJ concerns pertaining to the implementation and intent of AB 197. We encourage CARB to continue working with the Legislature and EJAC committee members to address and alleviate these concerns.

We are hopeful this commentary will reflect the progress that CARB has made in working to ensure environmental justice communities participate in a robust vetting process of pending regulations so as to feel that they are indeed being heard. It is clear however that in spite of this progress, more is expected and must be done to further an inclusive and transparent process between the agency and local communities. CARB should continue to build trust with communities who have historically not played a direct role in creation and implementation of air quality regulations.

We also sought to provide a balanced analysis of the current program and the EJ perspective that continues to encourage CARB to consider and identify gaps, which may need further action to ensure local communities share in the benefits of California's climate policies. That is an outcome that both the agency, the Legislature, and environmental justice communities want. The IEMAC committee fully agrees with this and believes these recommendations can help continue to keep the state on track to meet its GHG emissions goals, while also ramping up its effort to mitigate and reduce local pollution burdens in California's most vulnerable communities.

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Chapter 4: Emissions Leakage and Resource Shuffling

Authors: Meredith Fowlie and Danny Cullenward

A. Leakage

The global nature of climate change creates challenges for California climate policy, which covers only a small subset of the sources contributing to the problem. This creates the potential for “leakage,” a concept that is most easily illustrated by example. Consider an industrial producer operating in California that is required to purchase GHG allowances to cover its emissions. As a consequence, suppose this producer becomes relatively less competitive in the global market and thus loses market share to its out-of-state competitors. This induces a shift or “leakage” of production—and associated emissions—from the California firm to its out-of-state competitors.

For the purposes of this report, it is useful to distinguish between different forms of leakage:

- 1) “**Emissions leakage**” refers to any change in emissions from sources not covered by the GHG policy or program that is caused by the GHG emissions policy or program. It is worth noting that leakage is a potential issue under any state climate change policy that increases operating costs of regulated entities, not just cap-and-trade. Leakage can also happen within California if there is excess capacity at in-state facilities that are exempt from the GHG regulations (e.g. industrial facilities that emit less than 25,000 tCO₂e of GHGs per year are not covered by the GHG emissions trading program).
- 2) “**Rent leakage**” refers to the transfer of profits from California entities to out-of-state producers that is induced by GHG regulations.

Minimizing emissions leakage caused by California’s climate change policies is a statutory requirement of AB 32 and an important design objective of the cap-and-trade program. Economists have thought carefully about the various channels through which emissions leakage can occur. For the purposes of this report, it is useful to distinguish between two related but conceptually distinct leakage channels.¹

- 1) **Trade-competitiveness channel:** Policy-induced increases in operating costs can cause industrial production (and associated emissions) to move to jurisdictions outside the reach of the regulation via trade flows.
- 2) **Fuel price channel:** If emissions regulations in a large open economy reduces demand for carbon-intensive inputs (e.g., fossil fuels), global input prices will fall and stimulate demand for these inputs in unregulated regions.

¹ The economics literature has also identified additional leakage channels via income effects and technology spillovers from induced innovation that can potentially induce “negative leakage” (see, for example, Gerlagh and Kuik 2014).

The conceptual distinction between these two channels is important for the assessment of leakage mitigation alternatives. Measures such as output-based permit allocations and border adjustments are designed to counteract the first channel. The second channel is much more difficult to mitigate or address.

Concerns about leakage loom large, so it is essential that California's cap-and-trade program incorporate a meaningful response to this problem. It is important to acknowledge California Air Resources Board's (CARB) pioneering work in this area. The output-based approach developed by CARB, which involves allocating production subsidies in the form of free permit allocation to those sectors deemed to be at leakage risk, has set a policy design example that other jurisdictions are studying and following. That said, the approach to determining the subsidy levels is increasingly set by political arrangement, rather than evidence-based analysis. In what follows, we acknowledge some of the formidable challenges that complicate leakage mitigation in practice, and point to critical knowledge gaps that could be usefully narrowed with additional data collection and analysis.

1. Assessing leakage risk

Correctly identifying the kinds of economic activities most at risk of carbon leakage is a critical first step in the design of effective risk mitigation (Fowlie and Reguant, 2018). Here, we will focus on emissions leakage as this, along with "transition assistance", rationalizes free permit allocations to emissions-intensive industries.

There is a growing body of research in economics that assesses the potential for leakage risk across a range of sectors and contexts. One methodological approach uses multi-sector and multi-region computable general equilibrium (CGE) models calibrated to represent global trade linkages and energy flows. CGE models can, in principle, capture multiple leakage channels. A limitation is that results can be very sensitive to assumptions about key parameters, such as trade elasticities.²

An alternative method, called partial equilibrium analysis, involves empirically estimating parameters that determine the extent of leakage potential via the trade/competitiveness channel (see, for example, Fowlie et al., 2016). Intuitively, emissions leakage in a particular industry via the trade/competitiveness channel can be defined as the change in out-of-state production that is induced by California GHG policies multiplied by the emissions intensity of that foreign production:

$$\text{Emissions leakage} = \text{GHG}_{\text{out}} \times \Delta Q_{\text{out}}$$

GHG_{out} (units: GHG emissions per unit of value of production) is the marginal emissions intensity of the out-of-state production that responds to a change in relative operating

² An "elasticity" refers to the change in a given parameter in response to the change in an input cost. For example, as used here, a trade elasticity refers to the change in the value of traded goods and services in response to an increase in energy prices attributable to California's GHG policies. Elasticities measure the proportional change in one term relative to another. For example, if the trade elasticity is -0.5 , this means that for any given increase in energy costs, the value of traded goods and services decreases by half as much.

costs. As we explain in Fowlie and Reguant (2018), these marginal emissions intensity parameters are difficult to estimate empirically for several reasons:

- 1) Reliable data measuring the carbon intensity of out-of-state production can be very difficult to obtain.
- 2) Even if researchers can obtain a reasonable estimate of the average emissions intensity for a given industry and trading partner, this average could significantly over or under-estimate the marginal rate. Past work has documented tremendous variation in emissions intensities across producers in the same industry (Lyubich et al, 2018).
- 3) Marginal emissions rates in a given sector/jurisdiction can change over time as out-of-state producers respond to changing terms of trade and factor prices. A marginal emissions intensity estimate constructed prior to the introduction of a policy need not apply once the policy takes effect.

A more concerted effort to gather data on the emissions intensity of industrial production in various jurisdictions outside would help inform leakage risk assessment efforts in California and beyond.

ΔQ_{out} (units: value of production) captures the responsiveness of out-of-state production to the introduction of GHG regulations in California. These industry-specific measures of supply responsiveness will in turn be determined by a number of factors, including the elasticity of the supply of imports to California, the elasticity of demand for exports from California, and the elasticity of production within California to policy-induced increases in operating costs. These elasticities are difficult to estimate empirically.

- 1) One limiting factor pertains to data availability. For example, data on intra-national, interstate trade is very limited, making it next-to-impossible to assess how these trade flows might be impacted by changes in relative operating costs.
- 2) A second complication concerns the identification of underlying elasticity parameters. It can be very difficult to disentangle the impacts of California climate change policies from the effects of other exogenous, time-varying factors.

These complications notwithstanding, careful work that seeks to evaluate how in-state production, imports, and exports are responding to policy-induced increases in operating costs can help inform our understanding of leakage potential across affected sectors.

2. Emissions leakage mitigation

California, along with other jurisdictions implementing GHG cap-and-trade programs, has been experimenting with using production subsidies to mitigate leakage in sectors deemed to be exposed to leakage risk. Under this approach, emitters are required to purchase cap-and-trade allowances to cover their emissions. But these same firms are freely allocated allowances based on output levels. Thus, the economic effect of this approach is that the producer sees both an emissions tax (via the market-based value

for allowances, which provides an incentive to reduce emissions) and a production incentive (which helps to “level the carbon playing field” with respect to unregulated out-of-state producers).

This output-based free allowance allocation approach used in California can be used to strike a balance between incentivizing emissions abatement and mitigating leakage. However, it is important to stress that this strategy comes with side effects. First, an opportunity cost is incurred when allowances are freely allocated. If allowances were not freely allocated to industry to protect against leakage risks, they could be sold at auction and their revenue used to fund climate mitigation expenditures, cut taxes, or provide direct rebates to consumers. Second, output-based rebating dilutes the carbon price signal in those industries that receive implicit subsidies. This shifts more of the overall abatement cost burden onto producers who are subject to the cap-and-trade program, but ineligible for these subsidies. Thus, the use of output-based subsidies to mitigate leakage will generally increase the total abatement costs incurred within California to achieve a given level of abatement.

In sum, because output-based free allocation has potentially significant implications for both the costs of abatement and the distribution of who bears these costs, these interventions should be judiciously calibrated and targeted. To efficiently mitigate leakage, subsidy levels should ideally reflect the GHG emissions in external jurisdictions that are avoided when production activities remain within California.

Allocating valuable subsidies is an inherently political process, so there is a pragmatic need for a systematic approach that can be applied consistently and transparently across sectors. The current approach to calibrating output-based subsidies is ad hoc. In particular, there is no attempt to rationalize the recent increase in industry-specific allocation factors in terms of factors that determine emissions leakage risk (namely foreign emissions intensity and the responsiveness of out-of-state production to changes in relative operating costs). As we acknowledge above, estimating these parameters is a challenging and imprecise exercise. These complications notwithstanding, more could be done to ensure that production-based subsidies conferred to industry reflect true leakage risk.

As California’s GHG policies increase in stringency and ambition, the efficiency and distributional implications of any mis-calibration of subsidies will become more significant. Additional data collection (e.g., on intra-national, inter-state trade flows) and analysis is needed to refine and improve the current approach to calibrating and conferring leakage mitigation compensation.

B. Resource shuffling

Resource shuffling is a specific type of leakage that can occur in energy markets. It is most commonly discussed in the context of electricity markets, but it can also occur in other energy markets, such as those for transportation fuels. The issue is most easily illustrated by example. Suppose a utility once imported power from a carbon-intensive coal plant prior to the cap-and-trade program’s existence. In response to the new

carbon price, the utility might decide to divest its contract with the coal plant and replace it with natural gas-fired electricity. While this swap will reduce the carbon intensity of the utility's imports, and therefore reduce its compliance obligations under the cap-and-trade program, it may not reduce net greenhouse gas emissions to the atmosphere if the divested coal-fired electricity is purchased by a utility outside of the cap-and-trade program.

Under California's cap-and-trade program, electricity importers are responsible for submitting compliance instruments to cover the greenhouse gas emissions associated with all imports.³ As a result, electricity importers have a financial incentive to divest imports from high-carbon resources and replace them with low-carbon resources. Energy modeling studies have identified a significant potential for resource shuffling in the electricity sector (Chen et al., 2011; Bushnell and Chen, 2012; Bushnell et al., 2014; Borenstein et al., 2014).

Much of the progress California has made in reducing its greenhouse gas emissions in the electricity sector has been attributed to reductions in emissions from imports (CARB, 2018a: Figures 7-8). This underscores the importance of assessing the potential for electricity resource shuffling. In what follows, we identify four potential "channels" through which resource shuffling can manifest in the electricity sector. We then highlight some cross-cutting issues which we see as particularly pressing.

1. Bilateral Contract Shuffling

To the extent that California's climate change policies increase the cost of importing power generated by carbon intensive, out-of-state resources, electricity importers have an incentive to shift the type and duration of private bilateral import contracts towards less emissions intensive resources. If the electricity generated by the relatively more emissions intensive resources is shuffled to out-of-state consumers, California's GHG accounting will overstate the extent to which emissions have actually declined. This "contract shuffling" can occur via short-term bilateral trades, or it can manifest via the systematic divestment of California utilities' legacy ownership positions in, and long-term contracts with, out-of-state coal-fired facilities (Cullenward & Weiskopf, 2013).

Although CARB's regulations nominally prohibit resource shuffling,⁴ CARB decided to exempt a range of so-called "safe harbor" practices—first via an informal guidance document in late 2012 (Cullenward, 2014a) and subsequently via formal rulemaking completed in 2014.⁵ Among the exempted "safe harbor" practices are any trades affecting legacy coal contracts subject to the provisions of SB 1018's Greenhouse Gas Emissions Performance Standard⁶ and transactions in the day-ahead and real-time electricity markets operated by the California Independent System Operator (CAISO).⁷

³ Cal. Code Regs., title 17, § 95852(b).

⁴ *Id.* at § 95852(b)(2).

⁵ *Id.* at § 95852(b)(2)(A).

⁶ *Id.* at §§ 95852(b)(2)(A)(2), (7).

⁷ *Id.* at §§ 95852(b)(2)(A)(2)(10).

For a deeper discussion of how these safe harbors might operate in practice, see Cullenward & Weiskopf (2013: 21-26).

After CARB released its safe harbor exemptions to the prohibition on resource shuffling, California load-serving entities divested several major legacy coal contracts (Cullenward, 2014b). These divestitures reduced GHG emissions as reported in California's cap-and-trade program and GHG inventory. To the extent that electricity generated by affected coal plants was simply re-directed to out-of-state electricity customers, some resource shuffling and associated emissions leakage has already happened. To more rigorously estimate the extent to which resource shuffling has actually occurred, one would need to carefully construct a credible counterfactual scenario against which to measure the unit dispatch outcomes we actually observe.

2. Resource Shuffling via Retail Choice

As California embraces various new customer retail choice models in the electricity sector, another potential channel for resource shuffling is emerging. California electricity customers are beginning to transition from legacy retail service providers (e.g., an investor-owned utility) to become customers of new entrants (e.g., a community choice aggregator (or CCA)). According to one projection, by the mid-2020s, CCAs and direct access customers could be responsible for 85% of retail load in California investor owned utilities' service territories (CPUC, 2017: 3).

Many CCAs are contracting with existing out-of-state electricity resources, particularly in service of high-renewable energy retail choice programs. Historically, incumbent utilities have relied on relatively emissions-intensive out-of-state resources. If a CCA procures existing clean energy resources that were previously delivered to load-serving entities outside California, those external entities might replace them with higher-carbon alternatives. As demand for electricity supplied by incumbent utilities declines, the relatively emissions-intensive, out-of-state resources that once supplied California utilities in the past could be re-allocated to out-of-state customers in the future, leading to GHG emissions leakage.

There is some preliminary evidence that CCA procurement may be leading to resource shuffling (Rivard, 2018). Given the growing role played by CCAs, we see the potential for resources shuffling in the CCA context as a topic worthy of further investigation.

3. Resource Shuffling in Regional Electricity Markets

Concerns have also been raised about resource shuffling in the context of the CAISO Energy Imbalance Market (EIM). The EIM is a real-time, bulk power market that dispatches electricity generating resources to meet short-term supply imbalances across much of the Western U.S. Out-of-state power plants are dispatched to CAISO if and only if they elect to become subject to the cap-and-trade program and submit a "GHG Bid Adder" that is based on facility-specific GHG emissions factors and the California cap-and-trade market price.

The GHG Bid Adder affects the EIM operator's dispatch order such that lower-carbon resources are preferentially dispatched to serve California load. Low- and zero-carbon resources outside of California thus have an incentive to opt in to the EIM to serve CAISO load. However, as relatively clean out-of-state resources are called on to supply California, higher-carbon resources may be reallocated to serve non-California EIM load. This is sometimes called "backfilling" or "secondary dispatch" (CARB, 2018b: 70-73; CAISO, 2018).

CAISO, CARB, and other stakeholders have been experimenting with ways to address this problem. Until recently, CAISO was testing what it called a "two-pass solution" where the EIM market algorithm would be run twice: once without the carbon price, and again with the carbon price included from entities' bids. By comparing these two real-time optimization results, CAISO hoped to identify resources that were being re-allocated across state borders in response to the carbon price.

However, some observers criticized the method's use for determining which resources should be deemed dispatched to California on the grounds that the two-pass solution could enable gaming of electricity market bidding strategies (Hogan, 2017). CAISO has since moved away from the two-pass approach. In principle, however, this approach could still be used to estimate the policy-induced increase in emissions from generating resources outside of California, even if CAISO adopts another method for determining which out-of-state resources are dispatched to serve CAISO load.

More recently, CAISO developed an alternative approach to mitigating leakage in the EIM that restricts the volume of power out-of-state generators can bid to serve CAISO load (CAISO, 2018) and filed for EIM tariff amendments with the Federal Energy Regulatory Commission in August 2018. FERC's regulatory review is ongoing as of this writing.

4. Renewable Energy Certificate (REC) and GHG accounting

Finally, there may be additional complexities associated with the accounting systems used to track power, GHG emissions, and RECs. One commenter (the Center for Resource Solutions) notes that CARB does not require electricity importers to retire the renewable energy certificates (RECs) associated with out-of-state renewables, yet nevertheless counts these electricity imports as zero-carbon resources for the purposes of the mandatory reporting regulation (MRR) and therefore for compliance obligations under the cap-and-trade program. As a result, the RECs associated with these renewable electricity imports are available for use outside of California and could, if counted by external parties as zero-carbon resources, lead to double-counting of GHG emission savings.

We are unable to independently investigate these concerns due to the IEMAC's expedited schedule but believe that this issue merits analysis going forward. Additional work is needed to understand whether this approach leads to inconsistencies with state or regional mechanisms for tracking power, RECs, and GHG emissions, as well as whether additional data disclosures would allow other jurisdictions to harmonize their

approaches and policy preferences with California’s accounting decisions. We take no substantive position on these issues at this time.

C. Leakage-related matters in CARB’s proposed regulations

Based on the very limited time in which the IEMAC was able to review CARB’s proposed regulations, we have identified three key program design issues with potentially significant implications for leakage and/or resource shuffling.

1. Default unspecified emissions factor

One issue that merits close attention is the role of unspecified power in the cap-and-trade program, and GHG emissions accounting more generally. Under the regulations, electricity imports from specified power plants receive source-specific greenhouse gas emissions factors. But many California utilities import significant quantities of electricity from “unspecified” sources (Weissman, 2018). Under AB 1110, unspecified sources are defined as “*Electricity that is not traceable to specific generation sources by any auditable contract trail or equivalent.*”⁸

In the MRR and cap-and-trade regulations, unspecified resources are assigned a default, time-invariant emissions factor of 0.428 tCO₂e per MWh.⁹ This factor was developed in 2010 and was based on the average western grid supplies from the years 2006 through 2008 (Kaatz & Anders, 2016). Using this factor as the default, there is the potential for coal-fired generation to be classified as unspecified power for delivery to California at a substantially lower cost than it would face if made as a specified transfer.

Calibrating the unspecified emissions factor in a way that accurately reflect the emissions intensity of unspecified imports is challenging for two reasons.

First, the choice of default emissions factor changes the incentive market participants face when determining whether or not to reveal the source-specific emissions of their electricity imports. In other words, the composition of unspecified imports will depend in part on how the default emissions factor is calibrated. Electricity resources that are more GHG-intensive than the default factor (e.g., coal) may prefer transactional arrangements that are reported as unspecified imports, whereas those resources that are less GHG-intensive than the default factor (e.g., renewables) may prefer to find transactional arrangements that reveal them as specified sources, and therefore enable them to reduce costs. The default factor should be chosen with this supply-response in mind.

A second, related challenge stems from the significant heterogeneity in the emissions intensity of sources supplying the California electricity market. The average emissions intensity of generators that comprise unspecified imports could be very different from the average emissions intensity across all suppliers. It can thus be very challenging to

⁸ Cal. Pub. Util. Code § 398.2(e).

⁹ Cal. Code Regs., title 17, § 95852(b)(1)(C) (citing *id.* at § 95111(b)(1) (specifying the default unspecified emissions factor)).

identify the marginal resources that ramp up in response to increased demand for California imports.

We note that electricity import data from CARB and the California Energy Commission appear to be diverging, especially with respect to unspecified power (see CARB, 2018c; CEC, 2018). Additional analysis could be helpful to understand the causes of these differences and what, if anything, they mean for accuracy in tracking electricity emissions. There is nothing inherently problematic with different definitions of unspecified power that are used for different purposes. At the same time, however, differences in data reporting may enable analysts to evaluate whether market participant are responding strategically to default emissions factor and associated incentives.

2. Accounting for CAISO EIM emissions

As noted above, CARB initially supported CAISO's two-pass market optimization approach as a mechanism to provide a rigorous accounting framework for EIM emissions accounting. However, based on stakeholder feedback, CAISO determined not to implement the two-pass solution and instead has proposed a mechanism to FERC that limits the amount of energy an out-of-state power plant can bid to deliver to serve CAISO load (CAISO, 2018).

In the current cap-and-trade regulations, CARB has developed what it calls a "bridge solution" to address emissions leakage in the EIM market. Under this bridge solution, CARB must first estimate emissions leakage that has occurred. CARB does this by assuming that the true emissions associated with EIM imports is determined by the unspecified emissions factor, and therefore that the calculated leakage from EIM imports is the difference between the unspecified emissions factor and the source-specific emissions of resources that the CAISO EIM algorithm deems to be dispatched to serve CAISO load (ARB, 2018d: 15-16). Then, CARB will retire allowances to account for outstanding EIM obligations from the pool of allowances that remain unsold from the 2016-17 auction collapse. In the new proposal, CARB proposes to retire allowances from future program budget years to account for estimated emissions leakage associated with EIM transactions in 2018 and Q1 2019, rather than retiring allowances from the pool of temporarily unsold allowances from undersubscribed auctions (CARB, 2018b: 73).¹⁰

Beginning in Q2 2019, CARB proposes to calculate EIM-wide leakage using the method as for the "bridge solution" and assign this leakage in the form of annual compliance obligations for EIM importers on a basis that is proportional to their share of total EIM electricity imports (CARB, 2018b: 72). From this point forward, there would be no need to retire allowances to account for leakage in the EIM because the calculated leakage would be assigned to EIM importers on an ongoing basis. Again, the leakage is

¹⁰ Such a change may be necessary because the pool of unsold allowances from undersubscribed auctions is temporary and may not be available on an ongoing basis. See the [Managing Allowance Supply subcommittee report](#) for more details.

calculated based on the difference between the source-specific emissions from power that CAISO deems delivered to California and the unspecified emissions rate, which is taken as the “true” emissions profile of EIM imports. Under the proposal, EIM importers would face compliance obligations that are equal to the emissions associated with source-specific imports that CAISO deems to be delivered to California plus a proportional leakage factor (CARB, 2018b: 72-73).

Based on a preliminary review, we believe that retiring allowances to account for emissions leakage from resource shuffling is a reasonable approach to preserving the environmental integrity of the cap-and-trade program, provided that this leakage can be credibly estimated. CARB’s proposal to retire allowances first from the pool of unsold allowances, and later, directly from future budget years, is a sensible way to accomplish these ends.

However, there may be additional economic consequences to the proposed solutions that merit additional analysis. CARB’s “bridge solution” would retire allowances that would otherwise be made available for sale to the entire market, reducing market-wide supplies and increasing the market-wide cost of program compliance to account for leakage. Under this approach—whether allowances are retired from the pool of temporarily unsold allowances from undersubscribed auctions, or future allowance budget years—the cost of mitigating leakage in the electricity sector is borne by all market participants.

In contrast, the proposal for Q2 2019 and beyond would impose the costs of mitigating leakage in the electricity sector on the electricity importers directly, rather than across all sectors in the cap-and-trade program. This could increase the costs of purchasing electricity imports via the EIM, which could in turn affect electricity importing decisions more broadly. It is possible that these effects would induce importers to switch away from EIM imports, where CARB calculates the “true” emissions at the unspecified emissions factor rate, and instead prefer bilateral contracts with the same low-carbon resources, which would be eligible for source-specific emissions accounting outside of the EIM and without mitigating leakage.

The subcommittee has not had sufficient time to review CARB’s proposed methods in detail and therefore cannot express a final view on these important matters. However, it is clear that the concept behind CARB’s new proposal will alter electricity market incentives. The market implications of these incentive changes will be important to study and monitor going forward.

Meanwhile, we note that under both the bridge solution and the proposed regulatory changes that would apply beginning in 2019, leakage in the EIM is calculated based on the assumption that the “true” EIM emissions are captured by CARB’s unspecified emissions factor. Therefore, the effectiveness of this approach depends on the relevance and accuracy of CARB’s unspecified emissions factor. As discussed in [Section: Default unspecified emissions factor](#) the unspecified emissions factor has two important shortcomings. First, it is based on older data that may no longer be

representative of actual average WECC-wide emissions. Second, it is a time-invariant estimate of average emissions, not an estimate of the marginal emissions that result from the effect of California’s climate policies on electricity imports at any given point in time. The subcommittee believes that further analysis of these issues is warranted.

3. Increase in Industry Assistance Factors in third compliance period

AB 32 and AB 398 require that CARB act to reduce GHG emissions while minimizing emissions leakage. To this end, free allowances are allocated to industrial emitters on the basis of their industrial output and leakage risk. As we note above, emissions-leakage-mitigating subsidy levels should ideally reflect the GHG emissions in external jurisdictions that are avoided when production activities remain within California.

CARB categorizes covered industrial sectors operating under specific NAICS codes as either high, medium, or low leakage risk. To calibrate the output-based subsidy, CARB uses the product of an industry-specific emissions benchmark and an “industry assistance factor” (IAF) to determine the number of allowances allocated to industries per unit of production. The IAF assigned to high, medium, and low risk industries has changed over time (see Table 1).

Table 1: Industry assistance factors in CARB regulations

Leakage risk	First Period (2013-2014)	Second Period (2015-2017)	Third Period (2018-2020)	Fourth Period (2021-2023)
2010 Regulation (Original rules) (CARB, 2011: Table 8-1)				
High	100%	100%	100%	N/A
Medium	100%	75%	50%	N/A
Low	100%	50%	30%	N/A
2013 Regulation (Current rules) (CARB, 2014: Table 8-1)				
High	100%	100%	100%	N/A
Medium	100%	100%	75%	N/A
Low	100%	100%	50%	N/A
2018 Regulation (Proposed rules) (CARB, 2018b: 59-64)				
High	100%	100%	100%	100%
Medium	100%	100%	100%	100%
Low	100%	100%	100%	100%
Legal authority:	CARB determines how to minimize leakage risks pursuant to AB 32			AB 398 requirement

As we note above, output-based permit allocation to targeted industries shifts abatement cost burdens to unsubsidized sectors and increases the costs incurred within California to meet California’s GHG reduction goals. Given these side effects, production subsidies should be judiciously targeted. If the legal requirement is to mitigate varying degrees of emissions leakage risk, changes to the calibration of IAFs should be justified on the basis of analysis and empirical evidence on foreign emissions intensities and trade responsiveness within targeted sectors ([see Section Assessing Leakage Risk of this report](#)). In our judgment, the analysis offered in the proposed regulations does not explicitly provide such a justification. If instead the proposed change in free allocation is also intended to serve broader re-distributional purposes, a broader set of considerations may guide the targeting of production subsidies, including policy judgments that lie outside of this subcommittee’s scope. In either case, the subcommittee believes that the benefits of conferring subsidies in the form of free allowance allocation should be weighed against the potentially significant costs.

D. Recommendations

We make several recommendations with regard to the monitoring and mitigation of emissions leakage in the context of its cap-and-trade program:

- 1) **Intra-national trade data.** In order to estimate emissions leakage potential for specific sectors in California, one needs data on intra-national, interstate

trade transactions over time. Research to date has not fully leveraged the available data. Additional data sources could be used to construct a more complete picture of interstate trade in EITE industries. CARB could leverage the ongoing efforts of academic researchers to collect and analyze these data.

- 2) **Emissions intensity of out-of-state suppliers.** A critical determinant of emissions leakage is the marginal emissions intensity of out-of-state suppliers. Researchers are actively collecting data on the emissions intensity of industrial production in various jurisdictions outside California. A concerted effort to collect these data and assess their credibility would substantively inform leakage risk assessment efforts in California and other jurisdictions.
- 3) **Evidence-based decision making.** Rigorous empirical assessments of leakage risk are complicated by data limitations and identification challenges, as discussed in this subcommittee report. To date, these complications have limited the extent to which commissioned research informs California's approach to leakage mitigation. The subcommittee notes that the current abundance of caution has potentially important implications for abatement costs and the distribution of those costs. Methodological challenges notwithstanding, CARB should continue to work with the research community to strengthen the link between empirical evidence on leakage risk and the calibration of compensating subsidies.
- 4) **Resource shuffling.** The leakage subcommittee believes that the research and policy communities could benefit from further study of the extent to which emissions leakage caused by resource shuffling may have occurred in response to the cap-and-trade program's carbon price signal, including with respect to divestment of legacy coal contracts and ownership interests pursuant to SB 1368.
- 5) **EIM leakage.** CARB should report its calculation of GHG emission obligations in the CAISO Energy Imbalance Market, including both the outstanding GHG emission obligations related to CARB's "bridge solution" for 2017, 2018, and Q1 2019, as well as for the new compliance obligations that will be imposed on EIM importers beginning in Q2 2019. CARB's analysis of these obligations should be transparent and publicly accessible. Furthermore, we recommend that CARB and other stakeholders monitor the effect of the proposed compliance obligations associated with mitigating leakage in the CAISO EIM. Not only does the estimate of leakage need to be accurate (see Recommendation 6, below), but the potential for the remedy to cause leakage to shift to sectors that lack leakage mitigation solutions should be carefully tracked. Additional analysis to compare the potential consequences of imposing leakage mitigation requirements on electricity importers versus the market as a whole would be helpful in understanding whether these risks are large or small.

- 6) **Unspecified emissions factor.** CARB should evaluate the unspecified emissions factor and consider updating it. The current factor is based on outdated data and may no longer be representative of unspecified imports in the current market environment. We specifically recommend that CARB consider how the choice of a default emissions factor may affect market behavior; higher default emissions factors are likely to encourage relatively low-carbon resources to self-identify as “specified” resources to avoid the higher default emission factor applied to unspecified resources, potentially improving the quality of data on California’s electricity imports. Additionally, CARB should evaluate whether a default parameter that is calculated as an average is a reasonable proxy for the marginal emissions associated with electricity imports.
- 7) **Harmonizing electricity, RECs, and GHG data.** CARB works with the California Energy Commission and the California Public Utilities Commission to collect data on electricity imports, renewable energy certificates, and GHG emissions. Ensuring consistency between the data used across agencies is an important priority. Additional analysis to evaluate the different approaches California’s regulators are using to track electricity imports and their environmental attributes would be helpful. In light of the potential for double-counting of GHG reductions associated with “unbundled” RECs that are used by out-of-state parties yet associated with electricity delivered to California, additional analysis could help evaluate (1) whether the risk of double-counting of GHG reductions is significant, (2) whether alternative accounting mechanisms would better address the multiple needs of REC and GHG reporting systems, and (3) whether additional data reporting could enable external jurisdictions and private actors mitigate the risk of double-counting for any particular accounting system in used in California.

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Chapter 5: Offsets

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A. Overview

Offsets are an important part of both the current and post-2020 cap and trade program. By statute and regulation, the requirements for offsets and the allowable amounts are defined differently for pre-2021 and post-2020 market periods. In the pre-2021 market period, no statutory limits apply, but California Air Resources Board (CARB) has established limits by regulation. Under CARB regulations, regulated entities can submit offset credits to cover up to 8% of their emissions through the end of 2020. Beginning in 2021, new offset limits apply pursuant to the cap-and-trade extension bill, AB 398. Under AB 398, regulated entities can submit offset credits for up to 4% of their emissions associated with the years 2021 through 2025, and up to 6% for the years 2026 through 2030. In addition, no more than half of the offsets used in the post-2020 market period can come from projects that do not generate “direct environmental benefits” to California air or water quality.

The basic idea of the offset program is that a percentage of the reductions in carbon dioxide equivalent emissions under the cap-and-trade program can come from sectors outside of the cap and be used by regulated parties under the cap to meet part of their compliance obligations. The theory behind offsets is that—from a climate change perspective—it does not matter where or how a ton of emissions is reduced since climate change is caused by the accumulation of greenhouse gases in the atmosphere. One fewer ton in the atmosphere is one fewer ton, regardless of its source.

When offsets are used, total GHG emissions from “covered sources” (i.e., those that are regulated under the cap-and-trade program) increase and may exceed the nominal program cap, but the increases are “offset” by reductions outside the regulated sector. This is because for every offset credit used, emissions rise by one ton of carbon dioxide equivalent from covered sources. At the same time, however, every emissions increase at covered sources has a corresponding credited reduction from non-covered sources—most often in other states, but sometimes at in-state sectors not covered by the cap-and-trade program. Thus, even though GHG emissions from covered sources increase as a result of offset use, there is no net change in GHG emissions to the atmosphere.

CARB has approved six offset protocols to date. As of August 2018, CARB has issued over 116 million offset credits under these protocols, each worth a ton of carbon dioxide equivalent (CARB, 2018); Quebec has issued just over 600,000 offset credits from its own protocols (MDDELCC, 2018). The approved offset credits have overwhelmingly been issued by CARB under the U.S. Forest offset protocol, which has generated three quarters of the total supply. The Ozone Depleting Substances protocol is responsible for an additional 15% of the total issued to date, and a relatively small number of credits have been issued under the Livestock and Mine Methane Capture protocols. Two of the

approved protocols, the Urban Forest and Rice Cultivation protocols, have not issued any credits thus far.

The table below shows the categories of offsets that have been approved by the Air Resources Board for use by regulated entities and the total number of credits issued to date.

Table 1: CARB-issued offset credits as of August 2018

Project type	Ozone Depleting Substances	Livestock	U.S. Forest	Urban Forest	Mine Methane Capture	Rice Cultivation
Total credits	17,249,969	5,060,098	89,180,683	0	5,272,971	0
% of total	14.8%	4.3%	76.4%	0%	4.5%	0%

Offsets can serve valuable functions but have also been controversial. The valuable functions include: 1) reducing cap-and-trade program compliance costs (i.e., providing price containment to the market); 2) stimulating innovation in non-capped sectors for reducing GHGs; 3) generating environmental co-benefits from offset projects, particularly with respect to local air pollution reductions; 4) providing revenue to sectors and jurisdictions that generate offsets for compliance purposes, including projects in disadvantaged communities within and outside of California.

The controversies about offsets include: 1) concerns about whether GHG reductions from offsets are real, additional, quantifiable, and permanent; 2) concerns about allowing regulated entities to purchase their way out of facility-level compliance rather than reducing their own emissions on site; 3) relatedly, losing co-benefits (particularly air pollution reductions) due to shifting GHG mitigation away from large stationary source emitters as a result of offset projects; 4) depriving California of program auction revenue from the higher auction market prices that would result without carbon offsets; and 5) the distributional concern that offsets' benefits may largely accrue outside of California yet be financed by California residents.

The state has made a policy determination to allow offsets, subject to statutory limits and conditions. As a result, our report does not rehash whether offsets should or should not be allowed, nor does it analyze whether the percentage of offsets allowed by regulation in the pre-2020 period and by statute in the post-2020 period are set at the optimal level. Instead, our report is directed at analyzing whether the current and proposed programs are meeting legislative and regulatory expectations, maximizing offset benefits and minimizing the risks of offsets.

B. Example: U.S. Forest protocol

In order to approve a compliance-grade offset protocol, CARB goes through an extensive public stakeholder process. The end result is a protocol that has been scrutinized by Board staff and stakeholders and subsequently approved by the Board

itself. The way that offset projects earn credits under approved protocols is by meeting the protocol's eligibility criteria and following its approved methodologies for calculating avoided or reduced greenhouse gas emissions. The protocols attempt to ensure that the accounted for emissions are semi-permanent: for example, the U.S. Forestry Protocol requires that projects have a life of 100 years; for avoided conversion projects (projects that avoid converting forestry land to another use), the owner must record a conservation easement against the property; and offset providers must monitor the projects by visiting the sites every six years. If the offset project experiences a reversal, resulting in the release of carbon that was supposed to remain sequestered, there is a compensation rate that applies to intentional reversals, requiring compensation of allowances based on the number of years the project remained in compliance; there is also a buffer fund for unintentional carbon releases caused by events such as drought and wildfire.

The offsets subcommittee is interested in whether any new information and feedback could or should lead to any changes to the offset protocols.

Given the fact that the U.S. Forest protocol is responsible for three quarters of the offsets issued to date, it may make sense to first consider these issues in the context of the U.S. Forest protocol. For example, under the U.S. Forest protocol, a portion of the credits that would otherwise be awarded to offset projects are set aside in a buffer pool to protect against the risk of "unintentional reversal"—the possibility that fire, drought, disease, or other unexpected problems release the carbon that is stored in a credited forest. In light of the record fire season in California this year and last, is the size of the buffer pool sufficient to cover our best biophysical understanding of reversal risks in California? Across the West?

Similarly, the U.S. Forest protocol makes assumptions about the extent to which emissions will "leak" from offset projects. Take an avoided conversion project, for example (the protocol also covers reforestation projects and projects that improve forest management). The idea is that if a carbon-rich forest is protected to store carbon, rather than harvested to produce timber or cleared for some other land use, some share of the timber production will shift to another location, resulting in a reduction in the GHG benefits of the reductions or avoided emissions at the credited project (see Leakage subcommittee report for more detail).

The U.S. Forest protocol assumes that for Improved Forest Management projects, 20% of calculated project-level benefits will leak (CARB, 2015: 69-70 (see "Secondary Effects" in Equation 5.10)). CARB's protocol is based on the Climate Action Reserve's voluntary forest offset protocol, Version 3.3. Last year, the Climate Action Reserve updated its leakage factor for Improved Forest Management projects. The previous version of the Climate Action Reserve's forest protocol, Version 3.3, used a leakage factor of 20% for Improved Forest Management projects (CAR, 2012: 62 (see "Secondary Effects" in Equation 6.13)). In the new Version 4.0 of the Reserve's protocol, however, the leakage factor for Improved Forest Management projects can

now be as high as 80% for improved Forest Management Projects (CAR, 2017: 62-63 (see “Secondary Effects” in Equation 6.10)).

Leakage factors are a controversial part of forestry offsets and, in fact, the Environmental Commissioner of Ontario recently recommended that Ontario not pursue forest offset credits (Environmental Commissioner of Ontario, 2018: 144-145) because of concerns about the evidentiary basis for the leakage factor. Some peer reviewed studies suggest that a leakage number that is significantly higher and perhaps closer to 80% may be appropriate (Wear & Murray, 2004: 328; Gan & McCarl, 2007: 430). The Environmental Commissioner’s report also cited evidence that in some cases lower leakage rates similar to the U.S. Forest protocol’s number may be appropriate, but noted that the evidence supporting these lower rates excludes international leakage effects and that inclusion of international leakage effects significantly increases leakage estimates in other contexts (Environmental Commissioner of Ontario at 145, citing a study of Pacific Northwest leakage rate estimates). While the subcommittee has not had time to independently survey the academic literature on leakage rates, we note that review studies identify a wide range of leakage rates that range close to zero to more than 90% (Siikamäki et al., 2012: 11). At least in this review, lower leakage estimates are associated with project- or country-level analysis, whereas higher estimates are associated with regional or global analysis.

Given that the U.S. Forest protocol is the largest of the protocols in terms of credits issued, it would be helpful to have a better understanding of the scientific basis for leakage factors and the temporal accounting between reductions that are credited, emissions that leak, and actual physical emissions reductions or avoided emissions that take place. It would also be helpful to know if CARB is considering revising the protocol to reflect the Climate Action Reserve changes. The subcommittee recognizes, however, that leakage factors may be highly contextual to each individual project and therefore empirically difficult to estimate. Nevertheless, if reliance on the protocol continues to be large, additional information would be useful to understand whether and to what degree leakage is occurring, as well as to evaluate whether or not credits under this protocol can be reliably deemed “quantifiable” pursuant to state law.

C. Post-2020 offsets

One of the key reforms that the cap-and-trade extension bill, AB 398, made to the offsets program is to limit the total number of offset credits that can be used from projects that do not produce “direct environmental benefits,” or DEBs, to in-state air or water quality.

These direct environmental benefits are defined by statute as “the reduction or avoidance of emissions of any air pollutant in the state or the reduction or avoidance of any pollutant that could have an adverse impact on waters of the state.” We have reviewed the draft regulations and accompanying documentation CARB released on September 4 and have only one clarifying suggestion.

CARB proposes to adopt the statutory definition of direct environmental benefits directly from the statute, which seems appropriate as a starting point. In its staff report, CARB has provided helpful examples of the ways in which the existing approved protocols for in-state projects provide direct air and water pollution benefits (for example, reduced runoff from offsets that produce healthy forests and reduced air pollution from livestock projects) and is recognizing them by regulation as producing the direct environmental benefits contemplated by the statute. This treatment seems consistent with the statutory language and intent of the legislature.

One key question is whether project-level GHG reductions or avoided GHG emissions constitute a DEB. This issue has been discussed extensively in the cap-and-trade stakeholder process and in legislative oversight hearings. It is relevant because if offset projects can establish a DEB on the basis of project-level GHG reductions or avoided emissions, then all offset projects would meet this standard and AB 398's restrictions on this point would be rendered meaningless on implementation. We assume that the language in AB 398 requiring DEBs refers to environmental benefits to air or water quality that occur in addition to those impacts that are traceable to reduced or avoided GHG emissions; otherwise, the language of the statute would seem superfluous. On the other hand, we have not conducted an extensive legal analysis of the issue and have not looked for extrinsic evidence of legislative intent to restrict DEBs in this fashion. We are, instead, following a relatively standard canon of statutory construction that words in a statute are to be given effect rather than to have no consequence.

CARB proposes to operationalize the DEBs requirement in Section 95989 of the regulations. In subsection (a), CARB proposes to allow projects that are located in California to demonstrate a DEB either via their location in California or by avoiding GHG emissions within the state based on its analysis showing that in-state offset projects under the currently approved protocols produce air and/or water pollution benefits. In subsection (b), CARB proposes a set of requirements for out-of-state entities. In order to demonstrate a DEB, out-of-state projects must show either "[1] the reduction or avoidance of emissions of any air pollutant that is not credited pursuant to the applicable Compliance Offset Protocol in the State or [2] a reduction or avoidance of any pollutant that could have an adverse impact on waters of the State." The first clause addresses how an out-of-state project can demonstrate a DEB on the basis of air pollution and excludes "pollutants that are credited" under an offset protocol (i.e., it excludes the GHG emissions credited by the offset project). In contrast, the second clause addresses how an offset project can establish a DEB on the basis of a water pollution benefit. Unlike the first clause, however, the second does not explicitly exclude pollutants that are credited by the applicable Compliance Offset Protocol (i.e., the second clause does not exclude GHG emissions).

We recommend that CARB clarify whether it intends to foreclose the argument that a project-level avoided GHG emission or GHG reduction constitutes the "reduction or avoidance of any pollutant that could have an adverse impact on waters of the State." The provision as currently drafted is ambiguous in this regard and could raise questions

on implementation. GHGs are considered “air pollutants” under the federal Clean Air Act (see *Massachusetts v. EPA*) and therefore might be considered “any pollutant” under Section 95989(b). Given this relationship, it may be useful to clarify that to qualify as an offset credit providing direct environmental benefits in state, a project must reduce or avoid not only greenhouse gas emissions but at least one additional air or water pollutant that “could have an adverse impact on waters of the state.”

Finally, the new restrictions on offsets to require that half produce direct environmental benefits in state will restrict the number of offset projects that are eligible for compliance. The subcommittee is interested in knowing what efforts CARB, and/or the Compliance Offsets Protocol Task Force established pursuant to AB 398, are undertaking to increase the supply of offset credits that will meet the DEB requirements. Additionally, the subcommittee thinks it would be beneficial for CARB to analyze the degree to which DEB-compliant offsets are likely to be available in the post-2020 period and whether such offsets will provide cost-containment. One commenter (Dentons) notes that the supply of credits under existing protocols may increase if allowance prices rise; we would encourage CARB to consider whether and how rising allowance prices might affect the supply of offset credits in such an analysis.

D. Recommendation for amendments to draft regulations

- 1) As specified above in more detail, we recommend clarifying the definition of DEBs with respect to projects that may adversely affect waters of the State.

E. Longer term recommendations

- 1) As described above, we recommend that CARB determine whether the buffer pool amount included in the U.S. Forestry offset protocol is sufficient to protect against unintentional reversals given the recent experiences with drought and wildfire.
- 2) We also recommend that CARB either conduct or solicit research to determine whether the leakage rate for avoided conversion projects in the forestry protocol is appropriate.
- 3) We further recommend that CARB consider whether it should amend the U.S. Forest Offset Protocol to change the leakage factor for Improved Forestry Practices to be consistent with recent changes to the Climate Action Reserve Forestry Protocol.
- 4) Finally, we recommend that CARB either conduct or solicit research to determine how many offsets are likely to be DEB-compliant in the post-2020 period and whether offset credits are likely to provide cost containment in the cap-and-trade program.

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Chapter 6: Managing Allowance Supply

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A. Context

The term “overallocation” refers to a market condition where the supply of compliance instruments persistently exceeds emissions. Some independent analysts estimate that the volume of allowances in California’s program, accounting for allowances that will be newly issued after 2020 and the carryover of privately and publicly held allowances from the current period, is large enough to put at risk the State’s ability to achieve its 2030 greenhouse gas limit. California Air Resources Board (CARB) projects a smaller difference between cumulative allowances and expected emissions. We identify steps CARB could take to make it possible for the public and market participants to better estimate this market fundamental, as well as mechanisms that could remedy an allowance supply surplus if it is necessary to do so to comply with statutory goals.

B. Key considerations

1. Introduction

The cap-and-trade program covers approximately 75% of California’s statewide emissions. Although its coverage is broad, the cap-and-trade program is only one of many climate policies in the state. Some regulations affect emitters subject to the cap-and-trade program (called *covered sources*); others apply to emissions outside of the cap-and-trade program. The interaction between the cap-and-trade program and regulations that affect covered sources is important to understanding the costs, benefits, and environmental effectiveness of California’s climate policies. These companion regulations and policies lead to emission reductions at covered sources, reducing those sources’ need for allowances and thereby reducing the price observed in the market. If the price falls to the price floor, the supply of allowances entering the market will be reduced; if the price rises to the cost containment price tiers, the supply of allowances will be increased. Over a large range of price outcomes (that is, at prices above the price floor and below the cost containment price tiers), there is no adjustment to the number of new allowances introduced into the market (see Policy Interactions subcommittee report). Hence, the supply of allowances in the market and emissions from covered sources is uncertain and contingent on future market conditions.

The terms *overallocation* or *oversupply* are frequently used to refer to the concept of the cap-and-trade program’s supply of compliance instruments (i.e., allowances and offsets) exceeding the demand for those instruments (i.e., emissions from covered sources). Because California has achieved its annual emissions reduction target for 2020 four years ahead of schedule, with allowances issued on a pre-determined schedule that is independent of this outcome, any extra allowances that are not needed for compliance through 2020 can be banked, or carried over, for use in subsequent years. This carry over of allowances from the pre-2021 program period triggers two sources of concern. One is that the state may not have been as ambitious as it could have been in its near-

term emission reductions goals; a second and somewhat opposite concern is that the surplus of allowances in 2020 that can be banked for future use may cause the state to fail to achieve its goals for 2030.

California's cap-and-trade program features unlimited allowance *banking*, meaning that market participants can buy and save significant numbers of allowances for future compliance needs. There are two dimensions to banking in the program. One is the ability to bank across years within a multi-year compliance period, and the second is the ability to bank across compliance periods, which together imply unlimited banking as long as compliance period milestones are achieved.¹

In practice, this means that cap-and-trade with banking functions as a *cumulative* pollution reduction policy: it does not guarantee that emissions fall to any particular level in any given program year or compliance period, but rather that cumulative emissions across multiple compliance periods are equal to or less than the number of compliance instruments made available over that same time horizon. In contrast, California law sets statewide *annual* emissions limits for the years 2020 and 2030. There is a possibility that firms will use allowances banked from previous years to enable higher-than-allowed emissions in 2030. Moreover, it may be that emissions over the ten years covered by the extension to the trading program, from 2021-2030, are greater than the cumulative issuance of new emissions allowances because compliance entities may draw on banked allowances from the pre-2021 program period. In either case, the surplus of allowances currently in circulation could cause emissions to exceed the emissions budget for sources covered by the trading program after 2020.

The statutory obligations apply to emissions on an economywide basis, meaning both sources covered under the trading program and those that are not. Reductions not achieved under the trading program must be achieved elsewhere. Consequently, a transparent understanding of market fundamentals is not only important to the operation of the market, but also to guiding strategy for regulations and policies that apply to uncovered sources.

For context, the 2017 Scoping Plan calls for the cap-and-trade program to deliver a cumulative reduction of 236 million tons of CO₂e (MMtCO₂e) in the market's 2021-2030 period, relative to a scenario that includes the projected effect of all of California's regulatory measures. The number of new allowances (the emissions cap) to be issued in 2020 is 334.2 MMtCO₂e; in 2030 it is 200.5 MMtCO₂e.

2. The overallocation debate

The size of the projected surplus after 2020 depends on multiple factors, including the allowance price—which determines the number of allowances purchased at auction and

¹ The proposed regulatory amendments state that “Each compliance period represents either a 2-year or 3-year block in the Program, 2013-2014, 2015-2017, 2018-2020, 2021-2023, 2024-2026, 2027-2029, and 2030 and beyond” (ARB, 2018e: 15). We interpret the year 2030 as a single-year compliance period, which is of course subject to change if the program is re-authorized by statute past its current expiration at the end of 2030.

whether allowances in the program's cost containment reserves are purchased and enter private circulation—as well as future emissions subject to the cap-and-trade program. Several independent researchers and government entities have estimated the number of surplus allowances that will be in private circulation by the end of 2020 and therefore banked for use after 2020:

- 1) 270 (\pm 70) million allowances (Busch, 2017)
- 2) Between 100 and 300 million allowances (LAO, 2017a)
Central estimate of 200 million allowances (LAO, 2017b; LAO, 2018)
- 3) More than 300 million allowances (ECO, 2017)

Most of the allowances that previously went unsold at auction in 2016-2017 because the price was at the price floor are expected to be re-introduced through subsequent auctions and are included in these estimates.² Approximately one third of the unsold allowances will be removed from the normal auction supply and transferred to the post-2020 cost containment reserve.³

The studies referenced above were published prior to Ontario's exit from the cap-and-trade program, which increased the net supply of compliance instruments by approximately 13 million allowances (Mastrandrea et al., 2018; CARB, 2018b). The proposed regulation addresses this issue by enabling CARB staff to cancel program allowances to account for the excess Ontario allowances currently held by California compliance entities (CARB, 2018e: 75-76).

These studies were also conducted before CARB published data for 2016 emissions, which indicated that emissions were 58.3 million tons below program caps that year, contributing further to the allowance surplus (Cullenward et al., 2017; LAO, 2018). However, the studies may not fully account for several million allowances to be set aside in the voluntary renewable energy program accounts and to be retired in response to a natural gas power plant's bankruptcy proceeding, nor the potential for CARB to retire tens of millions of allowances to account for resource shuffling in the CAISO Energy Imbalance Market (CARB, 2018a: 8-9; see Leakage subcommittee report for additional discussion).

As suggested above, another important factor influencing the assessment is the role of cost containment measures that contain allowances in government-controlled accounts. If prices fall to the price floor, the number of allowances entering private accounts will

² Each of these studies considers the re-introduction of previously unsold allowances, but it is unclear whether the LAO calculations exclude some 39 million unsold allowances that will be transferred to the allowance price containment reserve as a result of remaining unsold for 24 months (CARB, 2018a; LAO, 2017a; LAO, 2018). Busch (2017: 4) and the Environmental Commissioner of Ontario (ECO, 2018: 4) properly include the transfer of unsold allowances to the reserve (see also Inman et al., 2018b).

³ All the unsold allowances will either be re-introduced and sold at future auctions or transferred to the post-2020 market reserve. Assuming that the maximum number of previously unsold allowances are sold in the next auction, the total number of allowances transferred to the post-2020 price ceiling will be approximately 39 million (CARB, 2018e: 44 (see Table 8)). This is about 1/3 of the approximately 120 million allowances that went unsold at auction in 2016-17, of which about 2/3 are expected to be purchased at auction and therefore included in private accounts (Inman et al., 2018b).

fall. If demand remains low, some of these allowances will be shifted into cost containment reserve. Even if the price floor is never binding, the proposed post-2020 cost containment reserve will hold 235.9 million allowances, which would begin to enter the market only if the auction price rises to a price tier of \$39.01 (2018\$) in 2021, growing at 5% per year in real terms. Consequently, the total supply of allowances in the market depends on future market conditions.

Of the 239.5 million allowances designated for the post-2020 price containment tiers in CARB's proposed regulations, 160.8 million (67%) originate from the pre-2021 market period (CARB, 2018e: 44 (see Table 8)). These pre-2021 allowances are currently held in government accounts and are therefore excluded from the independent estimates of private banking cited above (Busch, 2017; LAO, 2017a; ECO, 2018).⁴ If post-2020 market prices rise to the cost containment price tier levels, then these allowances will also enter the market as part of the allowance supply.

In contrast, CARB (2018a: 8-9) has projected that no more than 150 million allowances are likely to be banked at the end of 2020 and argues this quantity would not put the state's 2030 climate target at risk.⁵ Some analysts (including a member of this subcommittee) argued that the staff report is in error and that the surplus of allowances in 2020 will cause the state to overshoot its 2030 target under the Scoping Plan scenario's assumptions (Inman et al., 2018a). A legislative oversight committee found similar concerns (JLCCCP, 2018). CARB continues to dispute these issues (CARB, 2018c; CARB, 2018d).

There are no textbook rules or standard methodologies that specify the ideal size of an allowance bank. Typically, economic models that look for least-cost pathways to achieve deep decarbonization under cap-and-trade programs suggest that large allowances banks may form in the early years of a program; however, large banks may only be consistent with a policy goal of limiting cumulative emissions but not necessarily with achieving annual emission limits. Analyzing appropriate banking levels is a highly contextual exercise that depends on the policy goals of the program. Both the Regional Greenhouse Gas Initiative and EU Emissions Trading System cap-and-trade programs have analyzed this question in their own contexts and made program adjustments to affect the size of allowance banks in their respective programs.

Official analysis of California's cap-and-trade program has evaluated the program as a *quantity* instrument—including the 2008 Scoping Plan, its 2014 update, and the 2017 Scoping Plan, which assume the program will operate as a backstop to limit emissions and ensure the state will achieve its 2020 and 2030 emission limits. However, if the allowance price is at the floor or cost containment price tiers, the supply of allowances

⁴ All three studies exclude allowances in CARB's price reserve accounts, but there is a dispute over whether LAO properly excluded some 39 million allowances that went unsold at auction and will be transferred into the post-2020 price reserves, rather than re-introduced at auction. See footnote 2 for details.

⁵ CARB assumed that no post-2020 reserve allowances are introduced to the market.

will differ from expected levels, and the program may not ensure a specific cumulative or annual emissions outcome. Under these conditions, the emissions outcome will be influenced by *price* impacts. CARB made assumptions about price-induced mitigation in the 2017 Scoping Plan (CARB, 2017: 65) that vary from other studies (Borenstein et al., 2017; Busch, 2018; Cullenward et al., 2018a: 11). There is no analysis in the proposed regulations of what prices are required to deliver the emission reductions called for in the 2017 Scoping Plan. In particular, if the price were to fall to the price floor, it would cause a reduced sale of allowances, but it is uncertain what the emissions outcome would be at the designated price floor level.

Empirical evidence continues to indicate that entities are acquiring more allowances than they need in the short term and the private bank is growing. Emissions subject to the cap-and-trade program are below annual program caps (Cullenward et al., 2017; LAO, 2017b). Yet quarterly auctions continue to clear at prices above the price floor and all allowances are entering the market. As detailed further below, we believe that CARB should develop metrics to track these outcomes empirically and consider regulatory reforms that would automatically adjust allowances supplies in response to the accumulation of an excessively large allowance bank—that is, one that would appear to preclude the market from contributing to the attainment of long-run emission reduction goals.

3. CARB's proposed regulatory amendments

AB 398 added Section 38562(c)(2)(D) to the California Health and Safety Code, under which ARB is required to:

Evaluate 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.

In its proposed regulations, CARB reaffirms its April 2018 staff report calculations and concludes that no adjustment to the cap-and-trade program budgets is warranted (CARB, 2018d: 7-11). Without expressing a view on this question, the subcommittee suggests that going forward, additional technical disclosures and public analysis from CARB would help address the statutory direction on overallocation. One member of this subcommittee has authored a separate statement on the issues addressed here.

4. Public comments

We received comments addressing concerns related to the public's ability to evaluate complex cap-and-trade program reporting data and clarify a common factual understanding of those data with ARB staff. As a general matter, the subcommittee believes it is essential for CARB to produce clearly documented public data that promotes a shared factual understanding of objective program conditions. This norm underlies several of our recommendations below on the need for additional reporting.

C. Recommendations

Conflicting views of market fundamentals highlight a challenge that needs to be addressed by CARB. Current reporting of allowance supplies and associated private account holdings are not sufficiently timely or transparent to facilitate easy analysis of the status of the program. Additionally, the potential differences in outcomes and the likely persistence of uncertainty even with more transparent accounting suggests there may be value in the development of program adjustments that would automatically occur if the accumulation of surplus allowances continues or if it reaches undesirable levels in the context of the state's long-term emissions reduction goals.

To help address the debate over overallocation and mitigate the consequences of impacts that many expect to arise, we recommend that CARB strengthen its data reporting disclosures and analyze three key issues.

- 1) **Improve and increase program reporting.** Current program data reporting is helpful, but incomplete. We recommend CARB increase transparency by:
 - a) Reporting allowance holdings by jurisdictional type (i.e., distinguishing between allowance holdings from California, Quebec, and Ontario in quarterly compliance instrument reports).
 - b) Reporting the number, vintage, and jurisdictional totals of allowances that are banked at the end of each three-year compliance period.
 - c) Developing a metric that tracks the bank of compliance instruments on an annual basis, not just at the end of three-year compliance periods (e.g., as developed by Inman et al., 2018c).
 - d) Reporting public data on secondary spot market prices (e.g., weekly averages), as is done for other key climate programs such as the Low Carbon Fuel Standard.
- 2) **Develop a report on Ontario's withdrawal.** Most observers expected that Ontario would be a net consumer of compliance instruments through 2020. Instead, Ontario's brief participation increased market supply. We recommend CARB develop a report that:
 - a) Analyzes the impact of Ontario's withdrawal on the net supply of allowances in the cap-and-trade program;
 - b) Analyzes whether the impact of Ontario's withdrawal could have been anticipated and mitigated in advance; and
 - c) Evaluates alternative strategies for managing cross-border allowance transfers in future de-linking events.
- 3) **Develop a comprehensive report on allowance supply.** Given the different assumptions made by public studies, we recommend CARB develop a report that:
 - a) Compares and contrasts all public projections of allowance supply, including the different assumptions and methods used;

- b) Includes all of the “allowance pools” in the pre-2021 and 2021-2030 market periods in the assessment, including the transfers mandated by AB 398 (see Cullenward et al., 2018b);
 - c) Addresses the “self-correcting” auction mechanism in California’s regulations, whereby allowances that go unsold for 24 months are sent to the allowance price containment reserve (Inman et al., 2018b);
 - d) Undergoes a public review process.
- 4) **Develop a report on options to manage allowance supply.** In parallel to an assessment of overallocation, we recommend CARB develop a report that focuses on options for addressing allowance supply concerns that may manifest in the future, including:
- a) Adjustments to the price floor, price containment points, and offsets regulations within statutory constraints;
 - b) Replacement of Ontario allowances with California allowances from different “allowance pools”;
 - c) Cancellation of allowances or transfers of allowances from future year program budgets into the post-2020 reserve or price containment points;
 - d) Comparison of automatic rule-based adjustments to market supplies versus administrative interventions;
 - e) Implications of any potential interventions on linking arrangements.

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Chapter 7: Price Ceiling Considerations

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A. Context

This document seeks to provide CARB with input to inform one of the important design elements now a part of the cap-and-trade program: the allowance price ceiling.

The fact that California is four years ahead of schedule to meet its 2020 greenhouse gas reduction goals increases the likelihood that it is indeed possible to build more ambition into the design of the program post-2020. However, uncertainty about market outcomes, technological change, and related policies makes it difficult to predict the allowance price over the next decade although the price floor and previous price containment reserve as well as many other market features provided some helpful stability and predictability. One of the new design elements intended to further mollify uncertainty about the allowance price is the inclusion of a price ceiling. The price ceiling is intended to provide a stronger level of assurance to the Legislature that marginal costs to consumers and producers associated with a declining cap post-2020 do not rise to levels that are economically or politically unsustainable. It also is expected to further limit market volatility. Importantly, California's price ceiling design takes an innovative approach to protecting environmental integrity by requiring that any instrument sold at the price ceiling is backed up by a reduction purchased with the revenue on at least a ton-for-ton basis.

B. Key considerations

1. Implementation of a Price Ceiling

The price ceiling will be implemented beginning in 2021 and will make available alternative compliance instruments, which currently are called "price ceiling units," at a pre-determined price. The alternative instruments become available only after the reserves of allowances that are available at the three cost containment price tiers are sold, and all these compliance instruments are sold in a secondary process following the regular allowance auction. The highest of these price tiers will be at the price ceiling level. When the allowances that are available at this price tier (the price ceiling) are sold, price ceiling units become available.

A key consideration is the level of the price ceiling. After considering a range of options, CARB has proposed that the price ceiling be set at \$65 in 2021, and that it increase at 5% per year plus inflation. Given the time constraints, it is difficult for this committee to offer analysis on the specifics of the price ceiling level. Nonetheless, we observe that \$65 in 2021 (\$61.75 in real 2018 dollars) is well within the range of estimates of the social cost of carbon from the federal Interagency Working Group (IWG 2016). The 2020 estimate of the social cost of carbon with a 2.5% discount rate is about \$75 in 2018 dollars. We also observe that a higher price ceiling would likely increase the probability of capturing additional environmental benefits. For example, stronger incentives because of a higher price ceiling might create a better market for mitigation

projects with substantial development costs and high average costs per ton, such as carbon capture and sequestration. Providing financial incentive for the development of such projects is valuable given the importance of adaptation efforts in response to more forest fires. At a lower price, these projects might not be economically viable, causing the state to miss the opportunity to further environmental ambition.

However, we also observe that a higher price ceiling has the potential to enable greater price volatility at prices between the price floor and the price tiers and price ceiling, at least in the short/medium term (i.e., over the course of several years), because the supply of abatement options at prices near the price ceiling may be inelastic for several years until new technology and investments are realized.

2. Accounting for Emissions Enabled by a Price Ceiling

If the price ceiling is reached and allowances available at that price are exhausted, and price ceiling units are introduced, then emissions from sources covered by the cap-and-trade program will be greater than the number of emissions allowances issued under the emissions cap. An important question for the environmental integrity of the trading program is what the source of the price ceiling units will be, and how the state's overall emissions goal will be achieved.

Stakeholders have suggested that abatement opportunities exist that cannot be taken directly by sources covered by the program, and that many of these options offer emissions reductions at costs far lower than the price ceiling. Examples might include offsets including international forest offsets, innovative investments on natural and working lands, and purchasing emissions allowances from other trading programs. These alternatives would yield emissions reductions that could be used to account for the emissions increases embodied in price ceiling units. Because the cost per ton of these alternatives is likely less than the price ceiling, a ratio greater than ton per ton should be achievable. Coupled with the increased revenue that would be available from the sale of price ceiling units, high quality reductions could be secured outside of the market at greater than ton per ton, leading to greater environmental ambition. CARB may want to design the program so that investments in a reserve of emissions to account for the possible use of price ceiling units occurs before they might be brought into the program. This advance investment would have the indirect benefit of identifying new protocols for out of market emissions reduction opportunities, which might be useful in other jurisdictions. However, it could shift the location of emissions reductions to outside California. CARB may have limited opportunity to maximize reductions in California via the price ceiling, however, given that a price ceiling with instruments backed up on a ton-for-ton basis is required by statute. This dynamic could warrant further consideration.

3. Environmental Justice

This committee supports the recommendations from the Environmental Justice Advisory Committee (EJAC) that strongly supports the inclusion of the social cost of carbon (SCC) values as a justification for price tiers and the price ceiling in CARB's modeling.

In light of the continued efforts by the Federal EPA that continues to lessen protections, California can set an important example and signal to EJ communities the importance of impacts in vulnerable communities by including SCC. These values as estimated by the Interagency Working Group, while not tied to any specific price point at the ceiling or floor, can be helpful as a point of reference for policy-makers in the state to underscore the costs associated with carbon pollution, and help support greater environmental ambition. CARB's consideration of SCC can be significant to alleviating some of the criticisms from the EJ community, some of whom are concerned that a low price that did not reflect the SCC would have minimal impact in reducing emissions, specifically in low-income communities, and that taking the SCC into account would imply a price that triggered additional positive health outcomes. Without proper accounting of social costs, critics believe that market-based approaches are more likely to leave behind vulnerable communities and increase hotspots in marginalized regions. Sending a signal that support for a viable carbon market does not exclude the concerns of EJ communities in this state is important to further demonstrating that the social impacts of climate change deserve the same focused attention of the agency as does the health of the atmosphere. An important consideration is how the increased emissions associated with price ceiling units will impact disadvantaged communities, and how measures to account for these emissions are designed.

4. Environmental Integrity

The most important factor to highlight is the level of emissions reductions achieved, not the amount of revenue the program has generated for investments into mitigation projects, etc. The same is true with the introduction of the price ceiling. What is important to focus on are the emissions reductions the state will likely achieve, not whether the ceiling will be reached. Too much focus on where the price is set can create a narrative that puts the focus of our environmental goals secondary to how much revenue is being generated. As important as these investments are, especially those going to disadvantaged communities, these investments and the level of revenue available for them does not in itself suggest whether the program is working.

This was the case a few years ago when the general assumption by legislators and even some stakeholders was that the program was failing as a result of declining revenue, which was attributed to low demand for allowances based on a number of factors, one of which was the uncertainty with the program prior to passage of AB 398. We now know that the program has indeed succeeded as a backstop, working in concert with complementary measures that have led to reducing the state's emissions such that it is four years ahead of meeting its 2020 target. Should the allowance price reach the price ceiling in the future, it would not mean the program had failed. Rather, the success of the program can be judged by whether added abatement opportunities occurred at higher prices, and whether the state secured emissions reductions, including those that might fall outside of the cap using instruments as required by statute in reducing climate pollution from the atmosphere. We suggest that CARB staff strongly consider these implications as the rulemaking process continues forward. The

focus and long-term success of the program should be based on the program's impact on emissions and the environment.

5. Lessons from literature

Public comments to the committee draw attention to literature on the social cost of carbon that considers equity weighting and alternative discount rates, as well as damages that are not monetized because of uncertainty, which yield substantial variation in the social cost of carbon (e.g. Adler et al. 2017; Anthoff and Tol 2010, 2013).

6. Recommendations for cap-and-trade regulatory amendments

- 1) We encourage the state to investigate simplifying the program by providing for the sale of price ceiling units as well as sales of allowances from the cost containment price tiers in the regular auction by assigning reserve prices to the availability of those compliance instruments.

7. Recommendations for longer-term implementation

- 1) Damages from climate change are expected to be severe in California. The state should develop an independent assessment of the social cost of carbon to provide a guide for determination of the price ceiling and other price points in the cap-and-trade program.
- 2) The state should anticipate potential sources of emissions reductions outside the market that can be realized if price ceiling units are made available.
- 3) Continue to ensure that in evaluating and setting the price ceiling, the primary focus for CARB should be whether our environmental goals will be achieved, not the amount of revenue the cap-and-trade program produces.
- 4) Potential out-of-market emissions reductions to account for the potential use of price ceiling units are likely to be less expensive per ton than the price ceiling. The state should consider a ratio greater than ton per ton to account for the use of price ceiling units.
- 5) The state should consider the development of out-of-market emission reduction opportunities in advance of when they might be needed in the program. Initial investments in these opportunities and efforts to develop new protocols that might apply to account for price ceiling units can propagate methods that generate global environmental benefits. Having reductions available before they are needed can also help protect the environmental integrity of the program. CARB could make recommendations to the Legislature or work with the Legislature to explore the role of each body in considering these opportunities.

C. Conclusion

These are complex decisions and CARB staff is under enormous pressure to maintain the most successful carbon market in the world. The IEMAC appreciates the opportunity to provide input that we are hopeful CARB staff as well as stakeholders will find helpful. While these recommendations are purely for consideration and not for adoption, we

believe that the aforementioned criteria will ensure that the state's cap-and-trade program continues to function as the backstop for California's suite of climate policies. At the same time, the program can drive further climate ambition, deliver cleaner air for all Californians, and remain a viable market that attracts the technological innovation and investments that are good for the economy and good for the environment.

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Appendix A

Comments on Subcommittee Chapters by IEMAC Member Dallas Burtraw

IEMAC did not have an opportunity to adequately discuss two items of potential importance. I wish to draw attention to these items here.

Overlapping Policies/ Report on Emissions Leakage and Resource Shuffling

One item is mentioned in Chapter 2: Overlapping Policies, and in Chapter 3: Subcommittee Report on Emissions Leakage and Resource Shuffling. This item concerns **renewable energy certificates (RECs) and greenhouse gas accounting**. After the September 21 in-person meeting of the committee, we received a comment from the Center for Resource Solutions that expressed concern that CARB does not require electricity importers to retire the RECs associated with out-of-state renewables, yet nevertheless counts these electricity imports as zero-carbon resources under the cap-and-trade program. As a result, the RECs associated with these renewable electricity imports are available for use outside of California and could, if counted by external parties as zero-carbon resources, lead to double-counting of GHG emission savings. This issue about the effect of overlapping policies on the integrity of the market for RECs is not particular to California; it has surfaced in other venues. Assuredly, the desire of the state agencies is to strengthen renewable markets and not to undermine them. I urge CARB to consider safeguards against the issues that might arise because of the interaction of these policies.

Price Ceiling Considerations

A second item is mentioned in Chapter 7: Price Ceiling Considerations. This concerns the **structure of the auction and the sale of allowances from the cost containment reserve and price ceiling units**. If these compliance instruments entered the market, they would do so outside of the regular allowance auction through a secondary process. They would be deposited directly into compliance accounts and would not be transferable. In recommendations for Chapter 7, we encourage CARB to investigate simplifying the program by providing for the sale of allowances from the cost containment price tiers and the sale of price ceiling units in the regular auction by assigning reserve prices to the availability of those compliance instruments and selling them at the auction-clearing price. In the chapter, we do not present a thorough motivation for this important reform. I want to do so here.

The two-stage process of issuing compliance instruments—the regular auction and subsequent conditional direct sale—introduces complexity. One does not need to make a fetish of simplicity to observe that increasing complexity makes the program harder to understand and raises costs for participants. Sometimes additional detail is needed to solve a problem, and sometimes it provides opportunities for unintended outcomes, as applies in this case. The time lag between the primary auction and the availability of

additional compliance instruments conditional on the price in the regular auction creates a situation in which regular auction participants may need to factor in expectations about the behavior of others, introducing a strategic setting that entices auction participants to bid a price different than their marginal cost of abatement.

One appeal of a uniform price auction for a single good is that it provides participants with a robust incentive to bid their true willingness to pay, that is, there is no expected gain from engaging in strategic bidding in response to expectations about how others might bid. In auction theory, there is no guarantee that the same attribute applies in a multi-unit auction such as the auction for emissions allowances, but there is a general sense based on experience in laboratory settings and in the field that entities will approximately do so. This is helpful because it relies on information that bidders have.

The issuance of allowances through two sequential and separate events can result in two different prices for the issuance of allowances because if entities bid their true willingness to pay in the regular auction it is possible for the clearing price to be above one or more price tiers. However, if bidders anticipate the price to be near a price tier at which additional allowances or price ceiling units would enter the market, they have a strategic incentive to reduce their bid in order not to win an allowance at a price above the price tier. These strategic considerations complicate the decision of compliance entities but have no benefits for environmental or market integrity.

In our Chapter 7 recommendations, we suggest a simple program reform that would address this concern. This reform would issue all compliance instruments using information provided during the regular auction. Allowances sold at the price tiers and price ceiling units would be available at reserve prices specific to each tier, in a directly analogous way to how the auction price floor is implemented. This approach is used to issue allowances at cost containment price tiers in the Regional Greenhouse Gas Initiative, where the process has worked effectively. In California, if allowances issued from the cost containment reserve could be issued proportionately among all eligible winning bids and could be deposited directly into compliance accounts. Or, auction participants could indicate whether they want to be eligible to receive these allowances. This reform would simplify the administration of the allowance auction and the participation activities of compliance entities. We encourage CARB to consider this reform.

Appendix B

Comments on Subcommittee Chapters by IEMAC Member Dr. Danny Cullenward

Managing Allowance Oversupply

I would like to thank my subcommittee colleague and IEMAC Chair, Dr. Dallas Burtraw, for his thoughtful engagement over the past few months. While I endorse our subcommittee report in full and believe its recommendations identify the most practical opportunities to improve the effectiveness of California’s cap-and-trade program, I respectfully dissent from the subcommittee’s decision not to address the validity of ARB’s justification for inaction on allowance overallocation.

A. The IEMAC should have reviewed ARB’s analysis of allowance overallocation

Cap-and-trade program design is an inherently complex topic. That is why it is especially important for expert advisory bodies, such as the IEMAC, to address critical disputes over key market parameters in plain and accessible language.

In extending the cap-and-trade program through 2030, the California Legislature indicated its concern about allowance overallocation, which multiple independent studies have suggested may put the state’s 2030 climate target at risk.¹ AB 398 specifically requires ARB to evaluate whether the program has too many allowances.² ARB has since provided its response to AB 398’s instruction to analyze allowance overallocation and concluded that no change to allowance budgets is warranted.³ In particular, the proposed regulation rests on the findings of a disputed April 2018 staff report that are repeated in Appendix D to the Initial Statement of Reasons.⁴

Given the jurisdiction of this subcommittee and the critical importance of the April 2018 staff report to a clear statutory direction, I believe the subcommittee should have expressed its views on the technical validity of the Board’s analysis. In my opinion, there is no more significant analytical question in the proposed regulation. If the cap-and-trade program has too many allowances, it will fail to reduce emissions in line with the 2017 Scoping Plan and may put the state’s 2030 climate target at risk.

B. ARB’s analysis of allowance oversupply is technically deficient

¹ See, e.g., Environmental Commissioner of Ontario, [Ontario’s Climate Act: From Plan to Progress](#) – Appendix G: Technical Aspects of Oversupply in the WCI Market (Jan. 2018); Chris Busch, [Oversupply Grows in the Western Climate Initiative Carbon Market](#), Energy Innovation Report (Dec. 2017); Legislative Analyst’s Office, [Cap-and-Trade Extension: Issues for Legislative Oversight](#) (Dec. 2017).

² Cal. Health & Safety Code § 38562(c)(2)(D).

³ ARB, Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation, Staff Report: Initial Statement of Reasons, Appendix D: AB 398: Evaluation of Allowance Budgets 2021 through 2030 (Sept. 4, 2018) at 15-16.

⁴ *Id.* at 9-11 (citing ARB, Supporting Material for Assessment of Post-2020 Caps (Apr. 2018)).

Had the subcommittee reached this question, I would have encouraged my colleague to join me in expressing concern about the Board’s analysis of allowance overallocation. In my opinion, the Board has offered no analysis that shows how the proposed market design will achieve the role ARB designated for cap-and-trade in the 2017 Scoping Plan. The proposed regulation purports to demonstrate the adequacy of current allowance budgets via two different arguments—one focused on supporting a “steadily increasing carbon price signal” and the other on the number of allowances in the program—but neither analysis provides a sufficient technical basis for determining the proposed regulation has resolved concerns related to overallocation.

Historically, the cap-and-trade program has operated as a “backstop” or “insurance” policy designed to “close the gap” between the effect of regulatory efforts and any remaining mitigation needed to achieve statewide climate targets.⁵ This language is found in every scoping plan to date—including the 2017 Scoping Plan, which contains multiple references to this functional role.⁶ Now, however, ARB appears to refer to the program as having the primary goal of supporting a “steadily increasing carbon price signal.”⁷ This shift in emphasis is profound and calls for a distinct kind of economic analysis.

While I agree with ARB that price-induced mitigation effects are perfectly capable of delivering greenhouse gas emission reductions, nowhere in the proposed regulations does ARB provide an empirical or model-based analysis of what carbon prices might be necessary to achieve the state’s climate goals. Without a basis for determining what prices are necessary to achieve state climate goals and what prices might be expected from the proposed market design, I do not believe this line of inquiry responds to concerns about allowance overallocation.

⁵ Guri Bang, David G. Victor, and Steinar Andresen (2017), California’s Cap-and-Trade System: Diffusion and Lessons, *Global Environmental Politics* 17(3): 12-30; Michael Wara (2014), California’s Energy and Climate Policy: A Full Plate but Perhaps Not a Model, *Bulletin of the Atomic Scientists* 70(5): 26–34.

⁶ ARB, California’s 2017 Climate Change Scoping Plan (Nov. 2017) at 25 (stating the Final Scoping Plan’s strategy to “Continue the existing Cap-and-Trade Program with declining program caps to ensure the State’s 2030 target is achieved”); *id.* at 26 (describing the cap-and-trade program’s capability to deliver additional reductions if planned measures are delayed or ineffective, “to ensure the 2030 target is achieved”); *id.* at 30 (describing the final Scoping Plan Scenario and cap-and-trade’s projected backstop role to “ensure the 2030 target is achieved”); *id.* at 34 (Table 4) (noting under the criterion “Ensure the State Achieves the 2030 Target” that the cap-and-trade program “scales to ensure reductions are achieved,” despite uncertainty in projected emissions and emission reductions); *id.* at 52 (“Flexibility allows the Cap-and-Trade allowance price to adjust to changes in supply and demand while a firm cap ensures GHG reductions are achieved”); *id.* 53 (“The aggregate emissions cap of the Cap-and-Trade Program ensures that the 2030 target will be met—irrespective of the GHG emissions realized through prescriptive measures”); *see also* ARB, Responses to questions at the [Joint Hearing of the Senate Environmental Quality Committee and Senate Budget and Fiscal Review Subcommittee No. 2](#) (Jan. 17, 2018) at 2-3 (describing the cap-and-trade program as a program that will achieve certain reductions with prices determined by the market).

⁷ ARB, ISOR Appendix D, *supra* note 3 at 3.

The question, then, is whether the number of allowances in the program is sufficient to contain 2030 emissions at a level consistent with the legally binding limit set by SB 32. The only analysis of these quantity effects comes from an April 2018 staff report.⁸ As the subcommittee report notes, however, not only does this staff report project a much smaller number of extra allowances than do credible independent reports, but its factual accuracy is in dispute.

My colleagues at the non-profit research organization Near Zero and I have claimed that ARB made a significant modeling error in its April 2018 staff report. We published our step-by-step criticism in May,⁹ included our analysis in a comment letter to ARB,¹⁰ discussed it in testimony before a legislative oversight hearing where ARB leadership also testified,¹¹ responded to ARB's testimony in a follow-up letter to the same legislative committee with a courtesy copy to ARB,¹² and addressed the matter again in a second comment letter to ARB.¹³

Despite this extensive engagement, ARB has never addressed the criticism head-on. Here is the full extent of how Board staff responded in the proposed regulations:

In response to the initial staff analysis, one commenter stated there was an error in the CARB analysis. Staff evaluated the assertion and found that no error existed. The proposed adjustment by the commenter would have actually introduced an error.¹⁴

In fact, even now staff admit the error Near Zero identified by acknowledging their projections of covered emissions included “fugitive emissions” that are not actually subject to the cap-and-trade program.¹⁵ If staff believe the size of the error is not as large as Near Zero found using ARB's own data, they should show their calculations and not merely assert their conclusion.

Because the debate over ARB's April 2018 staff report concerns a key technical question related to the core jurisdiction of this subcommittee, and because the April 2018 staff report is at the center of ARB's response to AB 398's instruction to evaluate concerns related to overallocation, I would have preferred that the subcommittee

⁸ ARB, Post-2020 Caps Report, *supra* note 4.

⁹ Mason Inman, Danny Cullenward, and Michael Mastrandrea, Ready, fire, aim: ARB's overallocation report misses its target. Near Zero Research Note (May 7, 2018), [An Open-Source Model of Supply And Demand in the Western Climate Initiative Cap-And-Trade Program](#).

¹⁰ [Comment letter from Near Zero to ARB](#) (May 10, 2018).

¹¹ [Testimony of Dr. Danny Cullenward before the Joint Legislative Committee on Climate Change Policies](#) (May 24, 2018).

¹² [Letter from Dr. Danny Cullenward to Hon. Eduardo Garcia and Sen. Henry Stern](#) (May 30, 2018).

¹³ [Comment letter from Near Zero to ARB](#) (July 5, 2018).

¹⁴ ARB, ISOR Appendix D, *supra* note 3 at 10-11 (see footnote 11).

¹⁵ *Id.*

evaluate ARB's response to the criticism and make a substantive finding about the staff report's technical validity.

Nevertheless, my sincere hope is that the analysis and metrics recommended by the subcommittee will provide policymakers with an evidence-based framework for evaluating whether adjustments to the current supply of allowances are warranted. I look forward to working with my fellow IEMAC members, Board staff, and program stakeholders to that end.

Environmental Justice

I write separately to address to the subcommittee report on the Environmental Justice Implications of California's Climate Change Policies. I would like to thank my colleagues for revising their subcommittee report in response to public comments at our September 2018 meeting and appreciate its expanded scope. In my judgment, however, the report's evaluation of CARB's engagement with the environmental justice community lacks sufficient balance and remains inadequately supported by evidence.

Furthermore, this particular topic lies outside our committee's proper scope. The IEMAC does not include representation from anyone whose professional role focuses on the interests of environmental justice communities.¹⁶ An inclusive consultation process might fill that gap, but if the subcommittee engaged in substantial discussion with environmental justice organizations during the revision process, the final report contains few details. I therefore respectfully submit that the subcommittee report should not be taken as an adequate evaluation of the interaction between CARB and the environmental justice community in California. Going forward, I would urge the IEMAC to conduct a more balanced and inclusive analysis of environmental justice governance concerns, if indeed it is our proper role to evaluate the processes by which CARB and the environmental justice community interact.

Separately from these concerns, I want to thank my colleagues for expanding the coverage of their subcommittee report to include technical matters related to the relationship between greenhouse gas emissions, local air pollutants, and the distributional consequences of state energy, climate, and environmental policy—all important issues that are relevant to environmental justice communities and state policymakers alike. I believe the IEMAC is well suited to analyze these kinds of issues and welcome the subcommittee's engagement here.

¹⁶ Four of the five voting committee members are academics who do not specifically focus on environmental justice issues (myself included). A fifth member, Mr. Foster, specifically disclaimed any role in speaking for the environmental justice community in his present professional capacity. CalEPA video recording of the [September 2018 IEMAC meeting, morning session](#), timestamp 1:51:50.

Appendix C

Comments on Subcommittee Chapters by IEMAC Member Quentin Foster

Managing Allowance Oversupply

I would like to thank the subcommittee for their thoughtful work on this issue. On the whole I believe the joint subcommittee report provides a careful look at what has become a contentious issue around the supply of cap-and-trade allowances. I write separately here to make a few higher level points that are absent from the joint report, noting that the cap-and-trade program is functioning as intended, although there could be an important opportunity to increase ambition.

A. The Cap and Trade Program was designed to incentivize early reductions through banking and achieving the 2020 target four years early is a clear demonstration of success that is benefiting the atmosphere right now.

From the tone and framing of the subcommittee report it could be unclear to readers whether banking is a positive or negative aspect of the program or what the pros and cons are. I would like to note that the cap and trade program was intentionally designed to include banking which provides a number of benefits. From an environmental perspective, the most important is encouraging earlier emissions reductions. Banking means that if regulated entities can find cost-effective reductions earlier than required by the scarcity of allowances, they can bank allowances for a later date. This dynamic is clear in California's cap and trade program where the state has met its 2020 target four years early. This means at least a delay in emitting GHGs into the atmosphere where they will have a warming effect. Banking can also have benefits for price stability. In short, it is important to note that the cap-and-trade program is working as intended. Meeting the 2020 target four years early is a clear demonstration of the success of California's suite of climate policies.

B. Banking can create opportunities for increased ambition.

The fact that banking can provide benefits to the program does not mean that a larger bank of allowances is necessarily better. As the subcommittee report notes there are no "textbook rules or standard methodologies for determining the ideal size of an allowance bank." I agree. Under the right circumstances, EDF, the organization I currently work for, has supported decreasing the size of the allowance bank by making cap adjustments. A large bank of allowances and allowance prices consistently close to the price floor can indicate an opportunity to increase the ambition of a program by decreasing the overall supply of allowances. This type of cap adjustment can occur as a onetime cap adjustment or through an automatic mechanism that removes allowances either temporarily or permanently from circulation. To some extent this is already happening in California. As CARB has noted in Appendix D of the current regulatory package, at least 39 million allowances will be moved to the price containment reserves due to the new rule that is triggered if allowances go unsold for a period of 24 months. There has also been advocacy

for a minimum permanent cap adjustment that is equivalent to the 52.4 million allowances that are the difference between cap setting methodologies CARB considered during the regulatory development process. CARB has instead proposed to move these allowances into the price containment reserves as well. Again since there is no clear best practice, these different approaches represent a difference in calculation as to the best way to balance policy objectives.

C. In considering whether it is appropriate to make a cap adjustment, it is worthwhile to consider emissions impact, price impact, and adequate notice to the market.

In considering whether a cap adjustment to increase ambition is appropriate there are two sets of key questions to consider: First, what will the impact of reducing the supply of allowances actually be on overall emissions (and prices)? And second will the method of cap adjustment provide adequate notice to the market or unduly penalize market participants for over complying?

On the first point, the theory of cap and trade means it should be relatively simple to reduce emissions by decreasing the supply of allowances. However, it gets more complicated in practice. As Borenstein et al. have pointed out in a 2017 working paper, there could be a high likelihood that prices are either at the floor or the ceiling meaning there are few cost-effective abatement opportunities between the floor and the ceiling price.¹ Some comments on the regulatory proposal have used this result to suggest that reducing the overall supply of allowances may not have any real emissions impact on the program. However, this argument ignores two key points. First, that there is insufficient real data to test this modeling result and thus it could be significantly underestimating the abatement opportunities between the floor and the ceiling. Second, that there is a requirement to purchase reductions on a ton-for-ton basis if instruments are sold at the ceiling. While this might not result in reductions in California, it will result in reductions to the atmosphere that will reduce the warming impacts of pollution. Therefore, it seems clear that there is an emission benefit to reducing the supply of allowances; the question is balancing that benefit with the potential to increase allowance prices.

The second question regarding notice and penalization is also somewhat subjective. There are two major opportunities for making cap or supply adjustments that are worth considering. First, when initial budgets are being set as they are now for the 2021-2030 period. The market has an expectation about the end point in 2030 that will be used as a fixed goal. But there could be multiple appropriate methods for determining the trajectory and thus annual budgets between two fixed targets in 2020 and 2030 that the agency could freely choose between. The second way to adjust budgets would be to set up an automatic process that is outlined in the regulation for tightening budgets. California has this with the “24 month rule” but it represents a temporary removal from circulation vs. a permanent removal which would guarantee an emission reduction via the ton-for-ton requirement at the ceiling. RGGI has also adopted an Emissions Containment Reserve starting in 2021 which will automatically tighten the cap if prices are below a set trigger price that rises over time.²

D. An important factor in California’s progress towards achieving climate goals as the state approaches 2030, will be whether and how soon the state can codify ambitious, midcentury goals.

Setting binding, statutory goals and extending the cap-and-trade program beyond 2030 could significantly influence the behavior of the market and market participants as the state approaches 2030. Setting these ambitious goals could keep the pressure on market participants to continue banking and to achieve relatively cost-effective reductions as soon as possible. It could also send a stronger signal to the larger economy that could spur adoption and innovation which could bring more reduction opportunities within that cost-effective range. As described above, there could be an important opportunity to increase ambition through cap adjustments at strategic points. Setting a long-term target that will drive necessary reductions is another important way to keep California on the reduction trajectory that science demands.

¹ [2017 working paper](#)

² [Elements of RGGI](#)