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2. ARB, Status of Scoping Plan Recommended Measures (2010).

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16. Mason Inman, Danny Cullenward, and Michael Mastrandrea, California's "self-correcting" cap-and-trade auction mechanism does not eliminate market overallocation. Near Zero Research Note (May 23, 2018).

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APPENDIX E
SETTING THE PROGRAM EMISSIONS CAP

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Appendix E
Setting the Program Emissions Cap

A. Establishing California Greenhouse Gas Allowance Budgets

The limit on greenhouse gas (GHG) emissions—the program "cap"—is a critical part of the cap-and-trade program design. The cap number determines the number of allowances issued by ARB and, when combined with the number of permissible offset credits, determines the total limit on emissions from all of the covered entities in the program.[1]

Assembly Bill 32 requires that California reduce greenhouse gas emissions to 1990 levels by 2020 (HSC § 38550). In December 2007, the Board approved the 2020 economy-wide emission limit of 427 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) of greenhouse gases.[2] The Scoping Plan described the relationship between the AB 32 economy-wide target for 2020 and the desired emission levels in 2020 for the sources covered in the cap-and-trade program.[3]

In the cap-and-trade regulation, staff moves beyond a one-year (2020) framework and proposes a cumulative emissions cap for the years 2012 through 2020 for the emissions sources covered by the program. This nine-year cap is divided into annual budgets, each of which specifies the number of allowances created for each year. This Appendix explains how the cap trajectory, or schedule of annual allowance budgets, was developed and how additional flexible compliance mechanisms were established relative to these allowance budgets.

1. Conceptual Summary of Approach

Staff's intention was to set a cap trajectory that would provide for a gradual GHG emission reduction path toward the 2020 target. Accordingly, staff determined it was appropriate to set the starting allowance budget levels equal to the expected emissions for the year that a category of covered sources enters the program.[4]

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[1] The number of allowances plus the number of offsets allowed is referred to as the total supply of "compliance instruments."

[2] *Staff Report California 1990 Greenhouse Gas Emissions Level and 2020 Emissions Limit*. California Air Resources Board. November 2007. http://www.arb.ca.gov/cc/inventory/pubs/reports/staff_report_1990_level.pdf (accessed 9/18/10).

[3] *Climate Change Scoping Plan: A Framework for Change*. California Air Resources Board. December 2008. http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm (accessed 9/18/10).

[4] This approach was initially proposed in the WCI Partners design document released in September 2008 (*Design Recommendations for the WCI Regional Cap-and-Trade Program.* Western Climate Initiative. September 2008. [Corrected March 2009]), http://www.westernclimateinitiative.org/component/remository/general/design-

With this approach, the allowance budgets enable emissions to continue as expected under business-as-usual (BAU) conditions in the first year of a sector's inclusion in the program.

The approach is presented graphically in Figure E-1. The initial budget for 2012 (Point A) was selected based on the projected 2012 emission levels for the sources that will be covered at the outset of the program. These sources are referred to as the "narrow-scope sources." This BAU estimate reflects the current economic downturn and incorporates reductions achieved by 2012 from other Scoping Plan measures.

The budget levels increase in 2015 as fuel suppliers are phased into the program to cover GHG emissions from distributed fuel use. To account for these newly covered emissions, staff started with the level of the narrow scope budgets in 2015 based on continued decline in the narrow-scope cap (Point C) and added an incremental increase equal to the BAU estimate of emissions for the distributed fuel use sources in 2015. The 2015 BAU for emissions from these fuels reflects reductions from other Scoping Plan measures. The combination of the distributed fuel use sources and the narrow-scope sources are referred to as the "broad-scope sources." The 2015 broad scope budget is Point D.

The 2020 target (Point E) represents the maximum permissible emission levels from capped sources to ensure that the overall AB 32 economy-wide target is achieved. As the Scoping Plan explained, the 2020 allowance budget is a subset of the AB 32 2020 economy-wide target selected such that the number of allowances issued plus expected emissions from uncapped sectors will equal the 2020 economy-wide target.

The rate of decline in annual allowance budget numbers for the narrow-scope sources (ROD_1) is proportionate to the rate of decline that would occur if the broad-scope sources were covered at the outset of the program (ROD_0).[5] The rate of decline for broad-scope emissions post-2015 (ROD_2) is greater than

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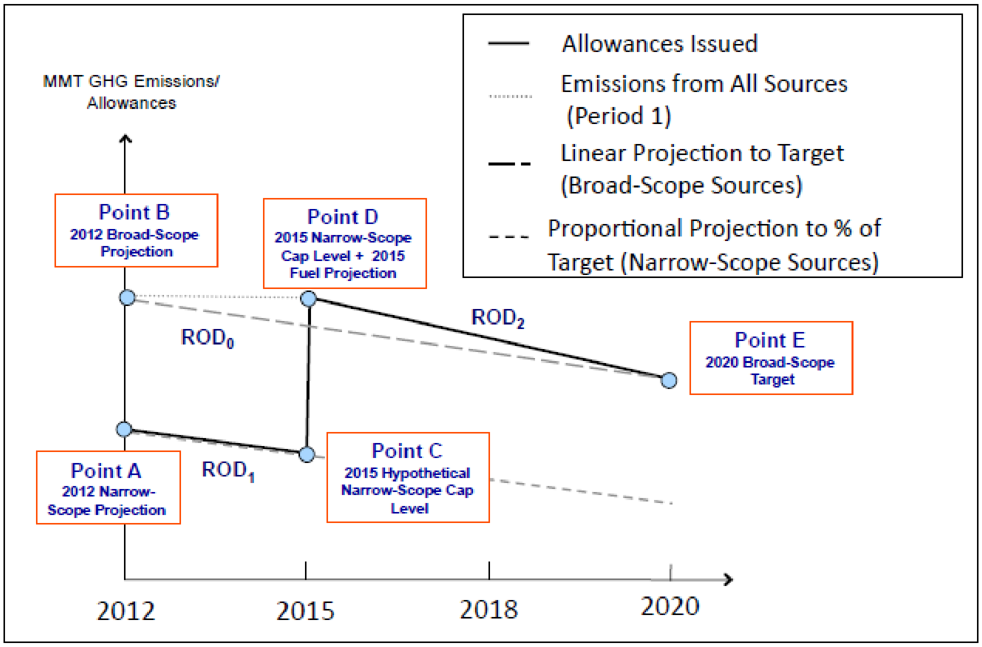
recommendations/Design-Recommendations-for-the-WCI-Regional-Cap-and-Trade-Program/ (accessed 9/18/10).

ARB staff held two workshops discussing this methodology with California stakeholders in April and November of 2009. The Western Climate Initiative process developed guidelines for how Partner jurisdictions should set allowance budgets (*Guidance for Developing WCI Partner Jurisdiction Allowance Budgets*. Western Climate Initiative. July 2010, http://www.westernclimateinitiative.org/component/remository/Cap-Setting--and--Allowance-Distribution-Committee-Documents/Guidance-for-Developing-WCI-Partner-Allowance-Budgets/ [accessed 9/18/10]). These guidelines help prevent any double coverage of emissions by different jurisdictions and ensure smooth functioning of a regional market.

[5] ROD_1 is equal to ROD_0 multiplied by the ratio of expected narrow-scope and broad-scope emissions in 2012 (Point A divided by Point B).

ROD_0 due to expected emissions growth from distributed fuel use sources in the 2012–2015 timeframe.

Figure E-1: Key Points Used to Establish Allowance Budgets



2. Reliance on Mandatory Reporting Data to Ensure Accuracy in Cap Setting

Setting the cap to achieve an appropriate level of stringency is critical to the proper functioning of a cap-and-trade program. If the cap is set too tight, unacceptably high allowance prices will result. If the cap is set too loose, prices will be lower than expected and a weakened incentive to reduce emissions will be created. Accuracy in emissions estimates from covered entities is a key component of ensuring that the desired level of cap stringency is implemented. Throughout the regulatory process, staff heard concerns from environmental groups that the cap would be unintentionally set too lax—a condition sometimes referred to as “oversupply” or “over-allocation.”

The over-allocation condition occurs if too many allowances are supplied to covered entities relative to expected business-as-usual emission levels. This issue arose in the early years of the European Union’s Emission Trading Scheme (EU ETS). During the trial phase of the program, which ran from 2005–2007, caps were set without a good source of GHG emission data for the facilities covered in the program.

The lack of accurate emissions data led to initial cap levels that, although intended to require a reduction of 4 percent at the outset of the program, in actuality created a surplus of approximately 4 percent. This oversupply—8 percent beyond intended levels—coupled with the fact that allowances could not be saved from the trial periods for use in the later phases, led to a price crash in August 2006, when the first year of verified emissions data were made publicly available.[6]

In 2007, ARB put in place a mandatory reporting program to provide accurate greenhouse gas emissions data for the sources that will be covered in the first compliance period of the cap-and-trade program. The data gathered through this program will help ensure that the over-allocation issue is not repeated in the California context.

3. Adjustment of the Cap-and-Trade 2020 Target from Scoping Plan Levels Using Mandatory Reporting Data

The Scoping Plan's rough estimate of the target for the 2020 allowance budget (Point E in Figure E-1) was 365 $MMTCO_2e$. Since the plan was adopted, staff have developed more specificity on what emission sources within the different sectors will be covered in the cap-and-trade program. Staff have also used the 2008 facility-level data gathered through the mandatory reporting program to improve emissions estimates for the covered entities. Using these improved estimates, staff calculated a new broad scope 2020 allowance budget of 334 $MMTCO_2e$. This number was developed by multiplying the Scoping Plan 365 $MMTCO_2e$ 2020 budget estimate by the ratio of the improved estimate of 2008 broad scope emissions (403 $MMTCO_2e$, determined using information from mandatory reporting of GHGs at the facility level) to the 2008 emissions inventory estimate for broad-scope sector categories (440 $MMTCO_2e$, calculated used the Scoping Plan accounting).

4. 2012–2020 Allowance Budget Levels

To inform the cap-setting work, ARB staff revised and improved the greenhouse gas emissions projection conducted for the Scoping Plan.[7] This refinement involved creating a dataset that represents historical emissions from the capped sources and then anticipating the way in which these emission levels will change in the future.

Figure E-2 compares staff's projection for the broad-scope emissions covered in the California cap-and-trade program with the Energy Information Administration's (EIA) projection of CO_2 emissions for the Pacific region from the

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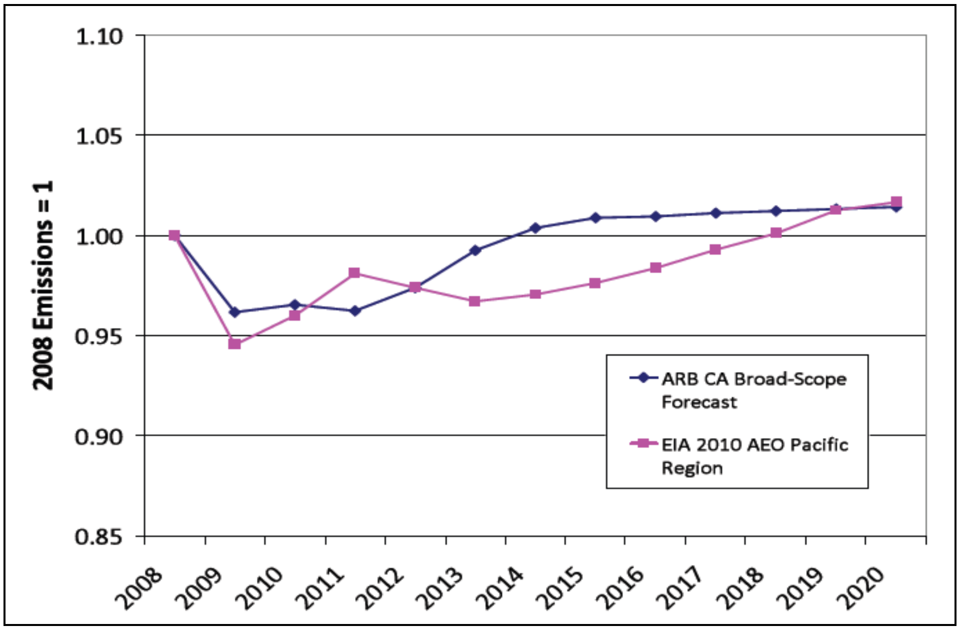
[6] *Pricing Carbon: The European Union Emissions Trading Scheme*. A. D. Ellerman, F. J. Convery, C. Perthuis, E. Alberola, and B. Buchner. Cambridge University Press. Cambridge, U.K. 2010.

[7] A detailed description of the ARB projection methodology is available at http://www.arb.ca.gov/cc/inventory/data/forecast.htm

2010 Annual Energy Outlook.[8] Both projections show a similar trend in the near term. Emission levels dip below 2008 levels slightly before returning to a gradual growth path in the longer term. The ARB forecast predicts that a recovery in emissions growth happens slightly more quickly but that growth in the 2015–2020 period is moderate. The EIA numbers foresee GHG levels remaining below 2008 levels for a longer period but a steeper upward trend in the later years.

Figure E-2: Comparison of ARB and EIA Emissions Projection Estimates



The ARB projected values and the methodology summarized above was used to set the 2012–2020 allowance budgets. These budgets, and the amount of offsets available, are shown relative to the business-as-usual trend in Figure E-3 and discussed in greater detail below.[9]

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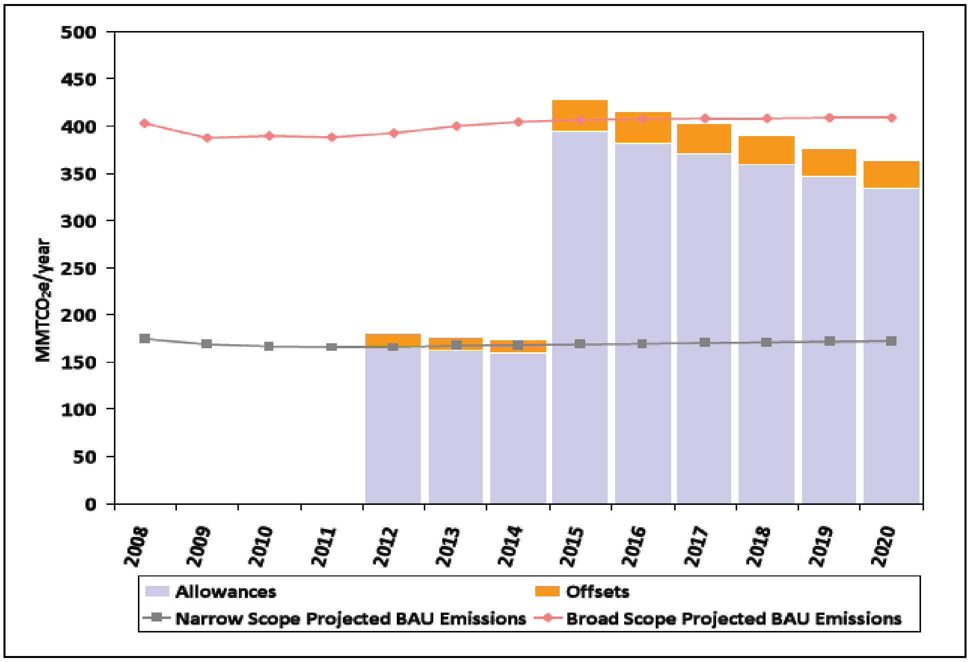
[8] See the supplemental tables of the EIA's 2010 Annual Energy Outlook CO_2 Emissions from the Pacific Region (*Annual Energy Outlook 2010: Supplemental Tables*. U.S. Energy Information Administration. December 2009. http://www.eia.doe.gov/oiaf/aeo/supplement/supref.html [accessed 9/18/10]). The Pacific region includes California, Oregon, Washington, Hawaii, and Alaska. Although these EIA data include some emissions that do not fall within the scope of the California program, a large portion of these emissions in the Pacific region do come from Californian broad-scope sources. Therefore, staff believes that this dataset provides a useful external point of comparison for the ARB projected emission values.

[9] Expected offset levels are also shown in this figure, assuming the amount of offset use in each year is proportionate to the allowance budget for that year and that offset supply equivalent to 8 percent of the total compliance obligation (8.7 percent of each allowance budget) is available.

Figure E-3: Projected GHG Emissions Relative to Allowance and Offset Levels



5. Expectations for Establishing Post-2020 Budget Levels and Other Adjustments

Post-2020 budgets will be set as targets for economy-wide greenhouse gas levels are revised through the Scoping Plan update process.

Corrections to budget levels from 2012–2020 are conceivable; however, to the extent feasible, ARB expects to avoid such changes to provide the maximum level of certainty to market participants as they forecast market prices and plan investments in greenhouse gas reductions based on an understanding of cap stringency.

In the Preliminary Draft Regulation (PDR) the concept of explicit administrative adjustments to allowance budgets was proposed.[10] This concept involved providing some flexibility for the ARB Executive Officer to adjust the cap trajectory in response to predefined criteria in the case that budget levels were set too loosely or too stringently. Staff has removed the notion of administrative adjustments in response to stakeholder comment and has replaced it with the price containment mechanism described below. With the removal of the

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[10] *Preliminary Draft Regulation for a California Cap-and-Trade Program*. California Air Resources Board. November 2009. http://www.arb.ca.gov/cc/capandtrade/meetings/121409/pdr.pdf (accessed 9/18/10).

administrative adjustment option, any future changes to the 2012–2020 budget levels will require a revision of the cap-and-trade regulation.

B. Enhancing Compliance Flexibility and Program Adaptability to Manage Compliance Costs

1. Offsets

Offset credits are generated from sources or sinks of emissions not directly covered under the cap-and-trade program. Offsets provide additional low-cost abatement options to the program participants, and can reduce the costs of the program for covered entities.[11]

The cap-and-trade program is part of a suite of AB 32 policies that will collectively generate the emissions abatement from 2012–2020 needed to stay within the cap levels. The majority of the emissions reductions needed in the cap-and-trade program will come from actions required under other Scoping Plan measures. Offsets will serve a limited role in achieving the AB 32 target unless the complementary policies do not perform as well as the Scoping Plan estimated.

In the case where complementary policies are less effective than anticipated, offsets credits can provide a mechanism to help ensure that the AB 32 reduction goals are still achieved at reasonable costs to the covered entities. Offsets provide this cost containment by increasing the supply of compliance instruments available at a given price.

In adopting the Scoping Plan the Board embraced a limit on the use of offsets designed to ensure that the majority of reductions from the cap-and-trade program come from sources covered by the program rather than from offsets. This policy helps maintain a strong incentive for emission reductions from covered entities. Action by covered entities will help California move toward a clean-energy, low-carbon economy.

In the PDR, staff proposed an approach to enforcing the offset limit to ensure that the majority of the required emission reductions under AB 32 programs would come from direct action by the covered entities. The result was that the use of

[11] *Updated Economic Analysis of California's Climate Change Scoping Plan*. California Air Resources Board. March 2010. http://www.arb.ca.gov/cc/scopingplan/economics-sp/economics-sp.htm (accessed 9/18/10).

offsets would be limited to four percent of the compliance obligation for each covered entity.[12]

In developing the offset limit in the PDR, staff started from the Scoping Plan goal of ensuring that the majority of emissions reductions come from action at covered entities.[13] An illustrative example, shown in Table E-1, is useful to understand the relationship between reductions expected from reference levels, the sum of expected program-wide compliance obligations, and the offset limit.

If emissions remained constant at the levels when a source category is initially covered under the cap (2012 levels for narrow-scope sources and 2015 levels for fuel supplier emissions) a total of 2,920 $MMTCO_2e$ of greenhouse gases would be cumulatively emitted from the capped sources over the 2012–2020 period. Imagine, for this example, that the potential emission levels of sources outside of the cap, from which offset credits can originate, represent an additional potential emissions of 300 $MMTCO_2e$ for all years from 2012–2020.

If we first consider a case in which ARB did not allow any offsets into the cap-and-trade program, ARB would issue 2,675 million allowances for all years between 2012 and 2020. This cap would ensure that no more than 2,675 $MMTCO_2e$ would be emitted from the capped sources and 245 $MMTCO_2e$ of emission reductions would occur. The non-capped sources that represent potential offset opportunities would still emit 300 $MMTCO_2e$.

[12] This limit may be better understood by imagining a covered entity with a compliance obligation of 100 metric tons. To meet this obligation the entity could surrender up to 4 metric tons of offset credits and no fewer than 96 metric tons of allowances.

[13] Greenhouse gas targets can be defined in relation to a given base year, or in relation to expected future development trends (*Climate Change 2001: Mitigation*, *Chapter 7: Costing Methodologies*. Intergovernmental Panel on Climate Change. March 2001, http://www.ipcc.ch/ipccreports/tar/wg3/index.php?idp=314 [accessed 9/27/10]). Staff distinguishes between “reductions” from a given base-year emission level (e.g., 2012) and “abatement” relative to projected future emission levels under a business-as-usual projection.

Table E-1: Illustrative Example of the Relationship between Offset Limit and Reductions from Initial Emission Levels

	Reference Levels	No Offsets	4% Offsets
Emissions from Capped Sources	2,920	2,675	2,786
Emissions from Non-Capped (Offset) Sources	300	300	189
Total Emissions	3,220	2,975	2,975
Reductions from Capped Sources	0	245	134
Reductions from Offsets	0	0	111
Total Reductions	0	245	245

Now consider a case with offsets. Assuming the 4 percent of compliance obligation could be met using offsets, the total emissions from capped sources for all years from 2012–2020 could not be greater than 2,786 $MMTCO_2e$ (because emissions from capped sources could be matched with 2,675 million allowances and 111 million offset credits).

Capped source emissions increase relative to the “no offsets” case, but these increases are offset by reductions occurring at non-capped sources. Therefore, the total emission reductions achieved (at both capped and non-capped sources) will be 245 $MMTCO_2e$—identical to the total reductions achieved in the no offsets case.

In the offsets case the majority of reductions come from action at capped sources (134 $MMTCO_2e$), and the minority of reductions come from action at non-capped sources that generate offset credits (111 $MMTCO_2e$). Offset credits represent 4 percent of the total number of instruments that must be surrendered by capped sources (the sum of expected program-wide compliance obligations).

2. Price Containment Mechanism

In response to stakeholder comments received after the release of the PDR, staff considered additional ways to expand program flexibility while meeting or exceeding AB 32’s rigorous environmental requirements. One way to add flexibility to the program and enhance investment certainty for covered sources is to increase the supply of compliance instruments at high prices and decrease supply at low prices. Staff has developed such an allowance price containment mechanism to help contain allowance prices within an anticipated price band.

Academic literature suggests various approaches to price containment mechanisms (also called "price collars") that attempt to mitigate allowance prices above a ceiling price or below a floor price.[14] Staff has rejected proposals to set firm maximum price controls, known as "hard collars" or "safety valves." These mechanisms introduce an unlimited supply of allowances at a given price which could result in not meeting the AB 32 2020 economy-wide target. Staff is proposing a "soft collar" mechanism to adjust the supply of compliance instruments in the market if specified price levels are reached.

a. Creation of the Allowance Price Containment Reserve

Staff recommends creating an allowance price containment reserve by placing 4.6 percent of the total 2012–2020 allowances (123.5 million allowances) into a reserve account that would be available to the covered entities. To prevent this reserve from increasing the stringency of the program, staff recommends allowing use of a matching number of additional offsets. These offsets would be in addition to the previously proposed offset levels.

The allowances from this reserve will only be deployed as described below. The proposed regulation will implement this mechanism by setting the quantitative limit on offsets to 8 percent of compliance obligation for the 2012–2020 period (allowing up to 232 million offsets) and by allocating 123.5 million allowances to create the reserve. Staff proposes allowances will be earmarked in the following manner to fill the reserve:

- 4.9 million allowances will be dedicated to this use from the 2012–2014 budgets (1 percent of allowances from the first compliance period),
- 45.9 million allowances will be dedicated to this use from the 2015–2017 budgets (4 percent of allowances from the second compliance period), and
- 72.7 million allowances will be dedicated to this use from the 2018–2020 budgets (7 percent of allowances from the third compliance period).

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[14] For example see:

Strategic Carbon Reserve: Nicholas Institute Discussion Memo on H.R. 2454, American Clean Energy and Security Act of 2009. B. Murray. August 2009. http://nicholasinstitute.duke.edu/climate/aces2009/Strategic%20Carbon%20Reserve (accessed 9/19/10) or

Climate Policy Design with Correlated Uncertainties in Offset Supply and Abatement Cost. H. Fell, D. Burtraw, R. Morgenstern, and K. Palmer. Resources for the Future Discussion Paper. January 2010. http://www.rff.org/documents/RFF-DP-10-01.pdf (accessed 9/19/10).

The rationale for withdrawing greater amounts of the allowances to create the reserve from the later years of the program is because the stringency of the program in the early years of the program is an area of concern to many covered entities. Removing fewer allowances from earlier years provides additional flexibility as the program is being phased in.

The targeted range of prices chosen for the reserve mechanism and appropriate reserve size was established based on expected allowance price ranges from the following documents and the analysis contained in Appendix G: Allowance Price Containment Reserve Analysis.

- Economic modeling of the proposed California cap-and-trade program[15]
- Economic analysis of the proposed WCI market[16]
- Economic analysis of proposed U.S. federal greenhouse gas emissions trading legislation[17]
- Historical data on the range of EU ETS allowance prices[18]
- Established level of British Columbia's carbon tax of $30 in 2012[19]

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[15] *Updated Economic Analysis of California's Climate Change Scoping Plan*. California Air Resources Board. March 2010. http://www.arb.ca.gov/cc/scopingplan/economics-sp/economics-sp.htm (accessed 9/18/10).

[16] *Updated Economic Analysis of the WCI Regional Cap-and-Trade Program*, Western Climate Initiative. July 2010. http://www.westernclimateinitiative.org/component/remository/func-startdown/265/ (accessed 9/18/10).

[17] *Congressional Budget Office Cost Estimate: H.R. 2454 American Clean Energy and Security Act of 2009*. Congressional Budget Office. June 2009. http://www.cbo.gov/ftpdocs/102xx/doc10262/hr2454.pdf (accessed 9/19/10);

EPA Analysis of the American Clean Energy and Security Act of 2009: H.R. 2454 in the 111th Congress. United States Environmental Protection Agency. June 2009. http://www.epa.gov/climatechange/economics/pdfs/HR2454_Analysis.pdf (accessed 9/19/2009);

Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009. U.S. Energy Information Administration. August 2009. http://www.eia.doe.gov/oiaf/servicerpt/hr2454/index.html (accessed 9/19/10).

[18] *Point Carbon EUA OTC Assessment*. Point Carbon. September 2010. http://www.pointcarbon.com/news/marketdata/euets/forward/eua/ (accessed 9/19/10).

[19] *British Columbia Carbon Tax Notice.* BC Ministry of Small Business and Revenue. February 2008. http://www.sbr.gov.bc.ca/documents_library/notices/British_Columbia_Carbon_Tax.pdf (accessed 10/9/10).

The level of access to the reserve will provide a direct indicator of how well the cap-and-trade program is doing in meeting the desired emission targets within the desired price band.[20]

b. Access to Allowances in Reserve Account

Release of the reserve allowances will be accomplished through a direct sale of allowances to covered entities. These sales would occur in the following fashion:

- ARB will offer to sell the allowances in the reserve at fixed prices to covered entities in three tiers. Initially, one-third of the reserve allowances will be available at $40/metric ton, one-third at $45/metric ton and one-third at $50/metric ton. These prices would be increased annually at a rate of five percent plus inflation.

- This offer to sell reserve allowances will take place six weeks after each quarterly auction.

c. Price Floor Mechanism

A floor price will be set by enforcing a minimum reserve price for allowances sold at auction. This price will begin at $10/metric ton in 2012 and will be increased at a rate of five percent per year plus inflation.

Allowances offered by ARB remaining unsold when an auction settlement price is equal to the reserve price would be placed in the price containment reserve. Allowances offered on consignment for other entities would be returned to the limited use holding accounts of the owners.

3. Summary of Flexibility in Compliance Instrument Supply

In summary, offset usage and the price containment mechanism can add flexibility to the program by increasing or decreasing the supply of compliance instruments if allowance prices reach unanticipated levels. The total supply of compliance instruments under various bookended levels of reserve and offset use is shown graphically in Figure E-4.

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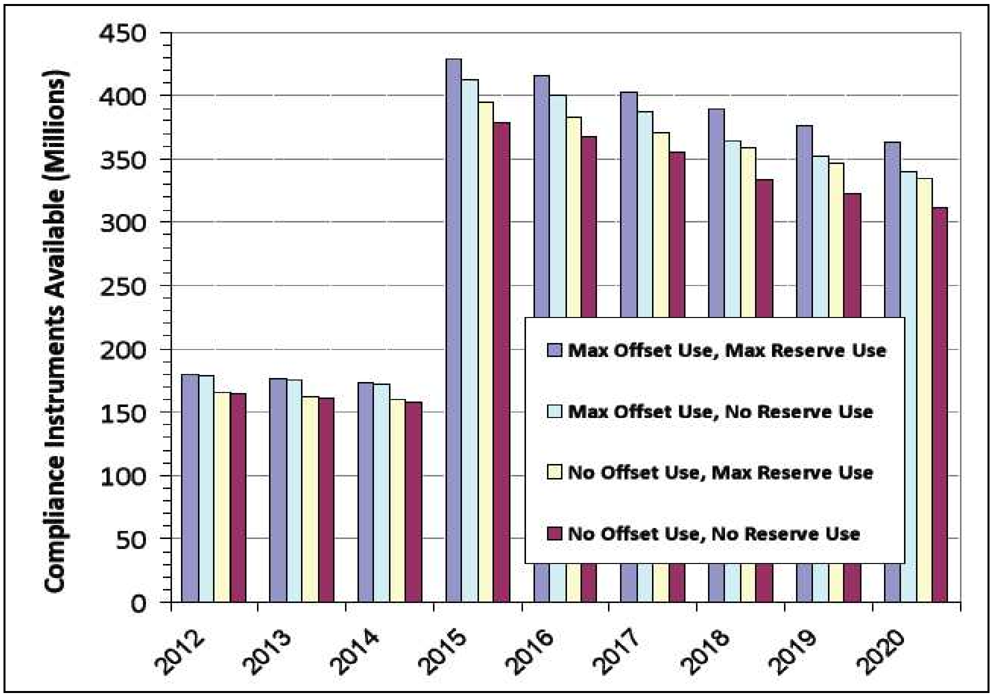
[20] *Strategic Carbon Reserve: Nicholas Institute Discussion Memo on H.R. 2454, American Clean Energy and Security Act of 2009*. B. Murray. August 2009, http://nicholasinstitute.duke.edu/climate/aces2009/Strategic%20Carbon%20Reserve (accessed 9/19/10).

Figure E-4: Flexibility in Compliance Instrument Supply



C. Connection between Economic and Abatement Analyses and Cap Setting

In determining the acceptable level of cap stringency, it is critical to analyze how the cap-and-trade program is anticipated to drive GHG emissions abatement and compliance costs. Within the capped sectors, a significant portion of emission reductions will be achieved through complementary policies such as improved building efficiency standards, renewable electricity requirements, low-carbon fuels, and cleaner vehicle measures. The additional abatement needed to bring emissions within the cap will be driven by the incentives created by the allowance price. Together, direct regulation and the carbon price signal assure that emissions are brought down cost-effectively to the level required by the overall cap.

Staff has undertaken multiple analyses in an attempt to anticipate where emissions abatement might occur in response to the carbon price signal and at what costs.[21] Together these analyses show that the expected emission

[21] See: Appendix F: Compliance Pathways Analysis, Appendix N: Supporting Documentation for the Economic Analysis, and *Updated Economic Analysis of California's Climate Change Scoping Plan*. California Air Resources Board. March 2010. http://www.arb.ca.gov/cc/scopingplan/economics-sp/economics-sp.htm (accessed 9/18/10).

reductions required by the proposed cap trajectory are both technically feasible and cost-effective.

D. Comparison of the California Cap and Offset Levels to Levels in Other Programs

In addition to the work analyzing GHG abatement and economic impacts described above, staff compared the proposed California compliance instrument levels to levels in other GHG cap-and-trade programs, including the Regional Greenhouse Gas Initiative (RGGI) and the EU ETS. RGGI and EU ETS are operational GHG cap-and-trade programs that are functioning without economic harm and little-to-no emissions leakage.[22]

By comparing the stringency of the caps and permissible levels of offset usage to covered emissions in these programs, the California cap-and-trade program cap levels can be placed in some perspective. The results of this comparison are presented in Figure E-5. This figure is normalized to a 2008 reference level from the emissions sources covered in each year of the programs.

RGGI's supply of allowances relative to 2008 levels of emissions is expected to be significantly higher than the comparable values in the EU ETS. This is reflected in allowances prices.[23] As of September 2010 EU ETS allowance transactions occur at approximately $20 (15 €) per metric ton.[24] Current vintages of RGGI allowances trade in the $2 per short ton range.[25]

Figure E-5 shows that the rates of decline in supply of allowances, relative to historical emissions, are in the same general range across these three programs

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[22] *Pricing Carbon: The European Union Emissions Trading Scheme*. A. D. Ellerman, F. J. Convery, C. Perthuis, E. Alberola, and B. Buchner. Cambridge University Press. Cambridge, U.K. 2010, and *RGGI Emissions Trends*, Environment Northeast. June 2010. http://www.env-ne.org/public/resources/pdf/ENE_RGGI_Emissions_Report_20100617_FINAL.pdf (accessed 9/19/10).

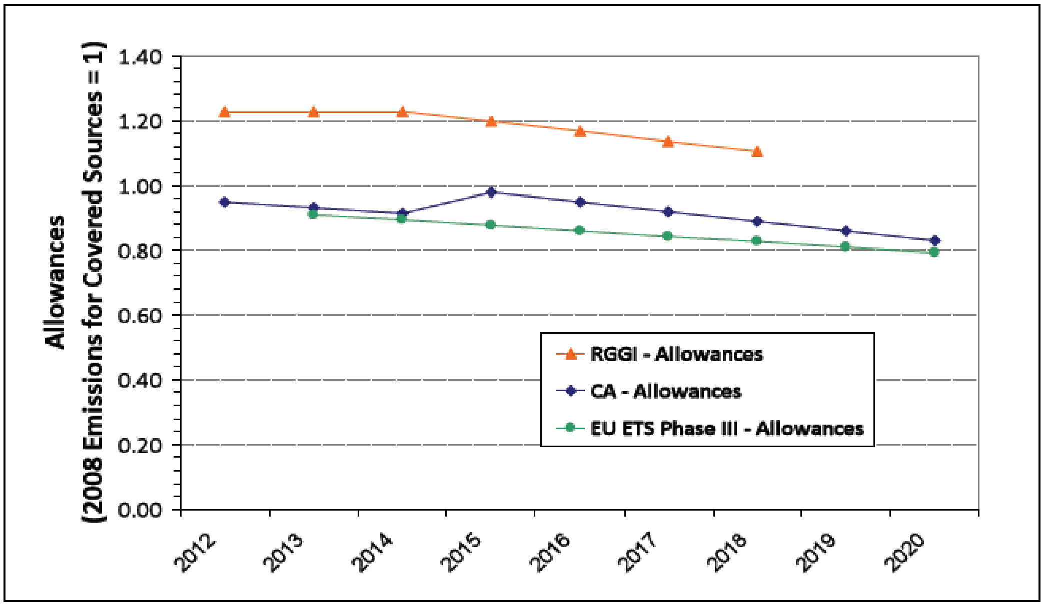
[23] Allowance price and allowance quantity relative to expected abatement are important (and interrelated) metrics that must be considered together when comparing and contrasting the stringency of various greenhouse gas reduction programs.

[24] *Point Carbon EUA OTC Assessment*. Point Carbon. September 2010. http://www.pointcarbon.com/news/marketdata/euets/forward/eua/ (accessed 9/19/10).

[25] Many market analysts consider the RGGI system over-supplied due to this low price; however, this general level of stringency, as indicated by allowance price, is not drastically far from that predicted by the designers of the system (*Frequently Asked Questions: Regional Greenhouse Gas Initiative*. Massachusetts Department of Environmental Protection. September 2009. http://www.mass.gov/dep/air/climate/rggifaq.htm#cost [accessed 9/19/2010]). This is because the RGGI auction reserve price of $1.86 per short ton is containing prices, as intended, on the low end (*RGGI Hovers Above Reserve Price*. Kim Moore. Point Carbon News. September 2010. http://www.pointcarbon.com/news/1.1474552 [accessed 9/19/2010]).

for the post-2015 time period. The total supply is higher in the RGGI system relative to 2008 emission levels. The demand for allowances—and therefore the prevailing allowance price—is unlikely to be equivalent due to the differences in the scopes of program coverage, the abatement opportunities available within each scope, and the fact that a significant bank of allowances has been built up from early compliance years in the RGGI program.[26]

Figure E-5: Comparison of California Allowance Budgets to Budgets in Existing GHG Cap-and-Trade Programs



This simple analysis shows that the California cap trajectory is comparable to those of existing carbon markets. This assessment may help assuage concerns expressed by some stakeholders that ARB is setting targets that are somehow inconsistent with existing well-functioning greenhouse gas cap-and-trade programs. Staff believes the proposed stringency of the California cap is appropriate in relation to the examples set by the well-functioning RGGI and EU ETS systems.

a. Cost Containment and Price Containment Mechanism in Other Programs

i. Regional Greenhouse Gas Initiative

Similar to the approach being taken in California's proposed program, the RGGI member states decided that offset use should initially be limited to 50 percent of

[26] Allowance price is a more appropriate metric for evaluating program stringency due to these issues.

the total emissions abatement expected from the program. The 50 percent goal was not viewed as a hard target, but rather a guiding principle in determining the initial quantitative offset limit to strike an appropriate balance between achieving emissions reductions in covered sectors and providing entities with a flexible compliance option.[27]

RGGI emitters can currently use offsets to cover up to 3.3 percent of their total compliance obligation. This limit would increase to five percent if the RGGI allowance price rises over $7 per short ton, and further increases to 10 percent if the allowance price exceeds $10 per short ton. Offsets in eligible project categories can initially come from any RGGI state. Clean Development Mechanism (CDM) credits can be used if the RGGI price exceeds $10 per short ton.

The price trigger provision described above allows for increased cost containment through the use of offsets at higher allowance prices. This flexibility allows the offset limit to more closely align with RGGI's goal of controlling compliance costs. The price triggers utilize 12-month rolling averages to minimize the impact of very short-term market volatility. Prices are based on 2005 dollars and are adjusted for inflation each year.[28]

To contain prices on the low side, the RGGI system has an auction reserve price of $1.86. This reserve price is currently maintaining a floor price in the RGGI system.[29]

ii. European Union Emissions Trading Scheme

The European Union Emissions Trading Scheme imposes limits on the amount of offset credits that may be used for compliance in both Phase II (2008–2012) and Phase III (2013–2020) of the program. The EU limits apply at the facility level but are slightly different than those proposed in the California and RGGI systems;

[27] *Analysis Supporting Offsets Limit Recommendation*. Regional Greenhouse Gas Initiative Staff Working Group. May 2006. http://www.rggi.org/docs/offsets_limit_5_1_06.pdf (accessed 9/19/10). The RGGI limit references abatement relative to an increasing level of emissions under a business-as-usual scenario.

[28] *Offsets Summary: The Regional Greenhouse Gas Initiative*. Environment Northeast. Summer 2008. http://www.env-ne.org/public/resources/pdf/ENE_RGGI_offset-design.pdf (accessed 9/19/10).

[29] *RGGI Hovers Above Reserve Price*. Kim Moore. Point Carbon News. September 2010, http://www.pointcarbon.com/news/1.1474552 (accessed 9/19/2010).

the EU limits are specified based on a percentage of a facility's free allocation in a given period, rather than as a percentage of compliance obligation.[30]

(1) EU ETS Limits in Phase II

In international climate negotiations, it was agreed that domestic abatement of emissions should take precedent over use of the flexible mechanisms (CDM and Joint Implementation [JI]).[31] This concept of prioritizing domestic action is referred to as "supplementarity." The supplementarity concept was included in the international agreements partially at the behest of European nations, and the concept of prioritizing domestic action from capped sources located in the EU was included in the design of the EU ETS.[32]

In the second phase of the EU ETS, each member state has a different limit on the use of offsets credits from the international flexible mechanisms (CDM and JI credits).[33] These limits are usually specified as a percentage of the total amount of allowances freely allocated to an installation. If fully utilized, the levels set for use of offsets in Phase II likely allow for more than 50 percent of reductions to be met through offsets.[34]

(2) EU ETS Limits in Phase III

Recognizing that the limits on offsets for Phase II were too generous to guarantee that domestic action would represent more than half of the reductions

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[30] *Pricing Carbon: The European Union Emissions Trading Scheme*. A. D. Ellerman, F. J. Convery, C. Perthuis, E. Alberola, and B. Buchner. Cambridge University Press. Cambridge, U.K. 2010.

[31] *Kyoto Protocol to the United Nations Framework Convention on Climate Change*. United Nations. 1998. http://unfccc.int/resource/docs/convkp/kpeng.pdf (accessed 9/19/10).

[32] *Supplementarity in the European Carbon Emissions Market*. J. Eyckmans, J. Cornille. Katholieke Universiteit Leuven Center for Economic Studies Energy Transport and Environment Working Paper. February 2001. http://www.econ.kuleuven.ac.be/ew/academic/energmil/downloads/ete-wp01-05.pdf (accessed 9/19/10).

[33] *Pricing Carbon: The European Union Emissions Trading Scheme*, A. D. Ellerman, F. J. Convery, C. Perthuis, E. Alberola, and B. Buchner. Cambridge University Press. Cambridge, U.K. 2010.

[34] Some environmental groups estimate that between 88%–100% of the emission reductions required under the combined cap for the EU ETS could theoretically take place outside of the EU through the use of offset credits (*Emission Impossible: Access to JI/CDM Credits in Phase II of the EU Emissions Trading Scheme*. World Wildlife Foundation United Kingdom. June 2007. http://assets.panda.org/downloads/emission_impossible__final_.pdf [accessed 9/19/10]). See also, *International Offsets and the EU 2009: An Update on the Usage of Compliance Offsets in the EU Emissions Trading Scheme*. R. Elsworth and B. Worthington, July 2010, http://sandbag.org.uk/files/sandbag.org.uk/offset2009.pdf (accessed 9/19/10).

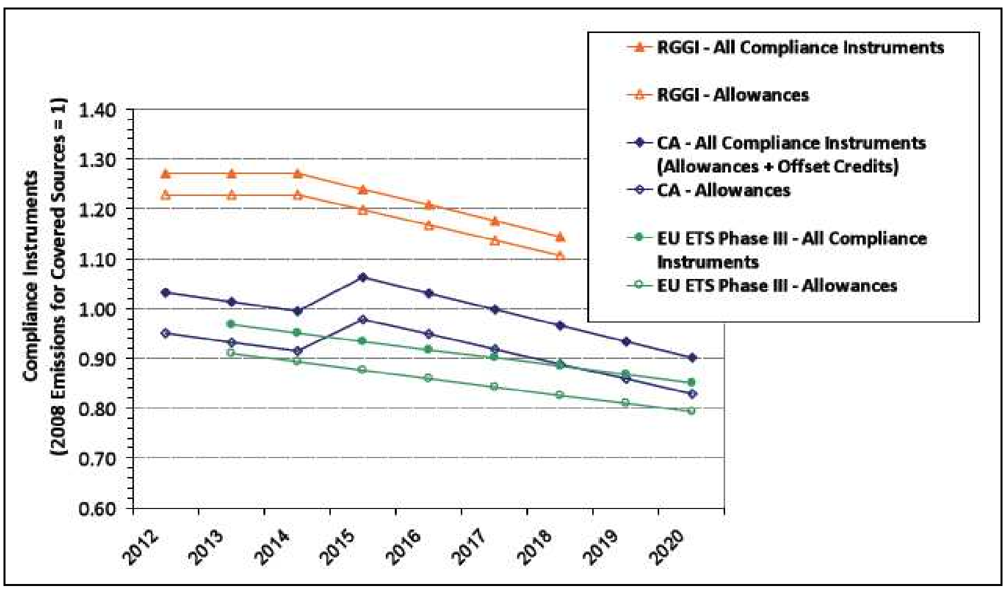
needed to meet the cap levels, the EU Commission is in the process of tightening the limits on the use of offsets in Phase III.

The Phase III limits will not only be more stringent than the Phase II limits, they will also ensure greater harmonization across EU member states.[35] Based on communications with EU ETS experts, staff expects the offset levels in Phase III to be on the order of 6 percent of the compliance obligation.[36]

The EU ETS does not contain any explicit price intervention measures (e.g., allowance reserves, offset level price triggers), but instead relies on the flexibility of the broad emissions trading market (including the use of offsets) to maintain costs at acceptable levels.

Figure E-6 provides a comparison between the maximum levels of compliance instruments (allowances plus offsets) across RGGI, the EU ETS, and the proposed regulation. It shows that staff's approach to setting the total permissible compliance instrument levels in the proposed regulation is consistent with those in existing GHG cap-and-trade programs.

Figure E-6: Comparison of CA Total Compliance Instrument Levels to Levels in Existing GHG Cap-and-Trade Programs



[35] *Questions and Answers on the Revised EU Emissions Trading System*. EUROPA,. December 2008. http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/796&format=HTML&aged=0&language=EN&guiLanguage=en (accessed 9/19/10).

[36] *Personal Communication*. Sam Wade of California Air Resources Board and Matthew Coyne United Kingdom Department of Energy and Climate Change. January 26, 2010.

E. Stakeholder Comments on Cap-Setting and Flexible Compliance Issues

a. Stakeholder Comments on Cap Stringency

In comments received in response to the PDR, stakeholders were generally comfortable with the initial cap levels being set using best estimates of 2012 (narrow-scope) and 2015 (distributed fuel use) emissions, and using linear declining cap trajectories to a 2020 target with the caveats noted below.

First, many commenters pointed out that the cap trajectory should account for long-term economic cycles—specifically, recognizing that the current recession has depressed greenhouse gas emission levels in California. Secondly, some commenters requested additional analysis to demonstrate that the emission reductions required by this cap trajectory are feasible and can be achieved at reasonable cost to the covered entities and to society as a whole. Other commenters asked for assurance that the cap will not be set too loosely and requested demonstration of how ARB will maintain the proper incentive to achieve the greenhouse gas reductions required by AB 32.

Staff believes the proposed cap level will create the correct incentive to achieve AB 32 goals. Staff has included a variety of mechanisms to add flexibility to account for a return to non-recessionary levels of economic activity and to ensure that the AB 32 environmental goal will be met with reasonable costs to the regulated community and with a negligible impact on the economy of California as a whole.

Many stakeholders felt that allowing administrative adjustments in the cap would create undesirable uncertainty in the allowance market. They pointed out that any major change in the scope of the program should be dealt with though the full administrative process required for any revision to an ARB regulation rather than through an adjustment made at the discretion of the ARB Executive Officer. Staff has accepted this suggestion and eliminated all administrative discretion; therefore, any changes to allowance budgets will require a full rulemaking process.

Stakeholders affiliated with environmental organizations and participants in the voluntary market for renewable power expressed support for recognition of voluntary investment in renewable electricity through a cap adjustment. Some covered entities felt that a cap adjustment for voluntary renewable electricity was unnecessary and commented that it was inappropriate to tighten the cap in response to the emissions reductions attributed to voluntary renewable generation. Staff has included a placeholder for an adjustment for voluntary renewable electricity in the proposed regulation and will continue to consider the details of such an adjustment mechanism.[37]

b. Stakeholder Comments on Quantitative Offset Limits and Price Containment Mechanisms

Covered entities, offset project developers, brokers, and other financial entities felt that the 4 percent limit proposed in the PDR was overly restrictive. These stakeholders felt that priority should be placed on ensuring offset quality rather than on quantitative restrictions on offset use. They argued that an increased limit would allow for greater use of low-cost reductions, thus fulfilling the full potential of offset credits as a cost containment mechanism. They protested the arbitrary nature of the limit and cited the cost-effectiveness language found in AB 32. Many environmental and citizen advocate groups called for increased stringency of the limit, arguing that action at capped sources was essential to the environmental and community protection goals of AB 32. Some of these stakeholders called for complete prohibition on the use of offsets.

Some of the stakeholders who called for expanded use of offsets offered thoughts as to how this could be tied to allowance prices and connected to other potential cost containment mechanisms such as allowance borrowing or strategic reserves. Stakeholders requested greater clarity in how the limit was calculated and clearer justification for the 4 percent number.

Staff has raised the offset limit from the PDR level from 4 percent to 8 percent of compliance obligation. However, this increased offset use is coupled with the initial withholding of allowances in the allowance price containment reserve. This Appendix and Appendix G: Allowance Price Containment Reserve Analysis explains the rationale and approach to design of the reserve mechanism and the connection to the offset limit. Staff believes this program design choice manages the risk of unexpectedly high or low allowance prices while maintaining the environmental integrity of the program cap levels.

[37] For a discussion of these issues, see *Voluntary Renewable Energy Market: Issues and Recommendations*. Western Climate Initiative, July 2010. http://www.westernclimateinitiative.org/component/remository/func-startdown/275/ (accessed 9/18/2010).

STATUS OF SCOPING PLAN RECOMMENDED MEASURES

The estimated 2020 greenhouse gas (GHG) emission reductions for measures described in the 2008 Scoping Plan were based on the best available information as of December 2008. ARB staff has since revised the expected 2020 emission reductions in consideration of the economic recession and the availability of updated information from development of measure-specific regulations. For certain measures, ARB staff does not currently expect any anticipated changes to the 2020 reductions compared to the reductions developed for the 2008 Scoping Plan.

The revised emissions reduction estimates for measures included in the 2008 Scoping Plan recognize the following:

- Development of measure-specific regulations. Regulations adopted by the Board include estimates of reductions anticipated by 2020. These regulations, which reflect ARB's progress towards reducing statewide GHG emissions, include comprehensive documentation detailing the data sources and methods used to develop measures recommended in the Scoping Plan. Each regulation's Initial Statement of Reasons (ISOR) contains the information necessary to evaluate how the reduction was calculated. All ISOR documents are available on ARB's website.

- Severe and prolonged economic downturn. The revised measure-specific emission reductions consider the economic downturn through the use of an updated GHG emission forecast. The updated forecast was developed using average emissions over a three-year period (2006-2008) projected to 2020. For energy consuming sectors, the projection is based on future demand for electricity and transportation fuels described in the California Energy Commission's 2009 Integrated Energy Policy Report (IEPR). The IEPR accounts for the recession using economic and demographic data. The 2009 IEPR document is available on the California Energy Commission's website. http://www.energy.ca.gov/2009_energypolicy/documents/

Attachment
2020 Statewide Greenhouse Gas Emissions and the 2020 Target

The 2020 emissions baseline used in the 2008 Scoping Plan is 596 MMTCO2e. This estimate of statewide 2020 emissions was developed using pre-recession 2007 IEPR data and reflects GHG emissions expected to occur in the absence of any reduction measures in 2010. ARB staff re-evaluated the baseline in light of the economic downturn and updated the projected 2020 emissions to 545 MMTCO2e. Two reduction measures (Pavley I and the Renewables Portfolio Standard (12% - 20%)) not previously included in the 2008 Scoping Plan baseline were incorporated into the updated baseline, further reducing the 2020 statewide emissions projection to 507 MMTCO2e.

The updated forecast of 507 MMTCO2e is referred to as the AB 32 2020 baseline. Reduction of an estimated 80 MMTCO2e are necessary to reduce statewide emissions to the AB 32 Target of 427 MMTCO2e by 2020.

ESTIMATED REDUCTIONS FROM CAPPED SOURCES/SECTORS

Pavley

The Scoping Plan estimated Pavley 2020 reductions as 31.7 MMTCO2e, of which 27.7 was identified as Pavley and 4.0 as Advanced Clean Cars. The California Energy Commission (CEC) 2009 Integrated Energy Policy Report (IEPR) fuel forecast was referenced to estimate the potential reduction attributed to the Pavley portion (vehicles model-years 2009-2016) of this measure under post-economic downturn conditions, resulting in an estimated reduction of 26.1 MMTCO2e. Pavley has been incorporated into ARB baseline inventories.
http://www.arb.ca.gov/cc/ccms/ccms.htm

Advanced Clean Cars

In the Scoping Plan this measure was estimated to reduce 4.0 MMTCO2e, which has been adjusted to reflect the economic downturn as described for the Pavley regulation (see above). The resulting estimated reduction is 3.8 MMTCO2e. The Advanced Clean Car measure is under development and focuses on vehicles model-years 2017-2025.
http://www.arb.ca.gov/msprog/clean_cars/clean_cars.htm

Renewables Portfolio Standard (RPS, 20% by 2020)

In the 2008 Scoping Plan, renewables were estimated to achieve 21.3 MMTCO2e of GHG reductions in 2020, of which 7.9 MMTCO2e would be achieved by the RPS (12%-20%) and 13.4 MMTCO2e would be achieved by the Renewable Electricity Standard (RES, 20%-33%). Estimated RPS reductions in 2020 have been updated to reflect changed economic conditions based on the 2009 IEPR demand forecast and are 12.0 MMTCO2e. The updated RPS reduction has been incorporated into ARB baseline inventories. The RPS program is administered by the California Public Utilities Commission (CPUC).
http://www.cpuc.ca.gov/PUC/energy/Renewables/

Renewable Electricity Standard (RES, 33%)

The RES measure was estimated to provide 13.4 MMTCO2e of reductions in the Scoping Plan (see above). Estimated emission reductions are presumed to be equivalent to those identified in a Staff Report (ISOR) prepared by ARB in 2010 which estimated reductions as 12.0 MMTCO2e. Reductions associated with unbundled Renewable Energy Credits (RECs) were subtracted from the ISOR value, yielding a value of 11.4 MMTCO2e. This measure is being implemented by the CEC and CPUC under SBX1-2, signed by Governor Brown in April 2011.
http://www.energy.ca.gov/renewables/
http://www.arb.ca.gov/regact/2010/res2010/res10isor.pdf
http://leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.pdf

Low Carbon Fuel Standard (LCFS)

In the Scoping Plan, the LCFS was estimated to achieve 15.0 MMTCO2e reductions in 2020. Based on the proposed regulation, the reduction in the ISOR was calculated as 15.8 MMTCO2e. In order to reflect changed economic conditions, the estimated reduction from the regulation was recalculated using the same methodology as the Scoping Plan but with more recent data, resulting in an estimated reduction of 15.0 MMTCO2e.
http://www.arb.ca.gov/fuels/lcfs/lcfs.htm

Energy Efficiency

Energy efficiency consists of several measures that include building and appliance efficiency, increased combined heat and power (CHP) generation, and solar water heating (AB 1470 goal).

The energy efficiency and conservation measures have been adjusted to reflect changed economic conditions using the methodology in the Scoping Plan but with more current data from the 2009 IEPR. The estimated reduction is updated from 19.5 MMTCO2e to 11.9 MMTCO2e. Achievement of these emission reductions is dependent on continued funding and implementation of efficiency programs.

The CPUC recently approved a settlement designed to increase the amount of CHP operated by Independently Owned Utilities (IOUs) in the State. The settlement identifies a 4.8 MMTCO2e incremental GHG emission reduction goal by 2020. However, due to accounting differences between the Scoping Plan and the settlement, actual reductions in 2020 may differ from the 4.8 MMTCO2e.

The reduction attributed to Solar Water Heating in the Scoping Plan, 0.1 MMTCO2e, has been adjusted to reflect the changed economic conditions, but because the change is small, the resulting value (to one decimal place) is unchanged. The Solar Water Heating measure is being implemented and funded by the CPUC as a component of the California Solar Initiative, Thermal Development Program.
http://www.cpuc.ca.gov/PUC/energy/Solar/thermhistory.htm

Regional Transportation-Related GHG Targets

The Scoping Plan identified 5.0 MMTCO2e as a placeholder for what could be achieved by the Sustainable Communities and Climate Protection Act of 2008 (SB 375) through sustainable regional transportation and local land use planning. The SB 375 Staff Report identifies 3.0 MMTCO2e, which is the aggregate from the regional passenger vehicle GHG reduction targets established for the 18 Metropolitan Planning Organizations approved in 2010.
http://arb.ca.gov/cc/sb375/staffreport_sb375080910.pdf

Vehicle Efficiency Measures

Vehicle efficiency measures in the Scoping Plan include Low Friction Oil, Tire Pressure Regulation, Tire Tread Program, and Solar Reflective Automotive Paint and Window Glazing. In the Scoping Plan, these measures were estimated to achieve a combined reduction of 4.5 MMTCO2e in 2020.

The Tire Pressure Regulation is approved and the estimated reduction identified in the ISOR is unchanged from the Scoping Plan estimate of 0.6 MMTCO2e. The Tire Tread Program (0.3 MMTCO2e in the Scoping Plan) is under evaluation and potential reductions are uncertain at this time. Low Friction Oil has been achieved in practice (2.8 MMTCO2e in the Scoping Plan). Potential reductions through cool car design are to be considered as part of the Advanced Clean Cars measure.
http://www.arb.ca.gov/regact/2009/tirepres09/tireisor.pdf

Goods Movement

Goods Movement includes measures to reduce emissions from shipping and port operations including such actions as reducing vessel speed and electrifying port equipment. The Scoping Plan attributed 3.5 MMTCO2e to these system-wide measures. System-wide efficiency improvements are in progress but are not likely to provide significant GHG reductions by 2020.
http://www.arb.ca.gov/planning/gmerp/gmerp.htm

The Scoping Plan attributed 0.2 MMTCO2e of reductions to the Shore Power for Ocean-going Vessels measure. The ISOR for this regulation estimated potential reductions to range between 0.12 and 0.24 MMTCO2e. The estimated reduction of 0.2 MMTCO2e identified in the Scoping Plan is considered representative of this measure.
http://www.arb.ca.gov/ports/shorepower/shorepower.htm

Million Solar Roofs

The Scoping Plan estimated the Million Solar Roofs measure could reduce 2.1 MMTCO2e emissions in 2020. The estimated reduction has been recalculated using the same methodology as that presented in the Scoping Plan with an updated grid emission factor, then proportionally adjusted to reflect the economic downturn, resulting in an estimated reduction of 1.1 MMTCO2e in 2020. The Million Solar Roofs measure is being implemented and funded by the CEC and CPUC as a component of the California Solar Initiative program.
http://www.energy.ca.gov/ghg_emissions/index.html
http://www.cpuc.ca.gov/PUC/energy/Solar/aboutsolar.htm

Medium/Heavy Duty Vehicles

The Scoping Plan identified potential reductions of 0.9 MMTCO2e from the Heavy Duty Aerodynamic Efficiency measure and 0.5 MMTCO2e from the Medium/Heavy Hybridization measure.

The Heavy Duty Aerodynamics measure is approved and the ISOR identifies 1.0 MMTCO2e of reductions, which has been adjusted proportional to the economic downturn resulting in an estimated reduction of 0.9 MMTCO2e in 2020. The hybridization measure is under evaluation and potential reductions are uncertain at this time.
http://www.arb.ca.gov/regact/2008/ghghdv08/ghgisor.pdf

High Speed Rail

The 1.0 MMTCO2e estimated GHG reduction attributed to High Speed Rail is unchanged from that identified in the Scoping Plan. This measure is being implemented under an approved bond measure and Federal grant; GHG reductions in 2020 are dependent upon the implementation of High Speed Rail in 2020.

Industrial Measures (for sources covered under cap-and-trade program)

Industrial measures include Refinery Measures and Energy Efficiency & Co-Benefits Audits. The Scoping Plan identified potential reductions of 0.3 MMTCO2e in 2020. These measures are under evaluation, so potential reductions are uncertain at this time.
http://www.arb.ca.gov/cc/energyaudits/energyaudits.htm

Cap-and-Trade

The cap-and-trade regulation would establish a declining limit (cap) on 85-percent of statewide GHG emissions. The declining cap established in the regulation would ensure that all necessary reductions occur to meet the 2020 target, even if the estimated reductions from other measures fall short.
http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm

ESTIMATED REDUCTIONS FROM UNCAPPED SOURCES/SECTORS

High Global Warming Potential (GWP) Gas Measures

The Scoping Plan identified seven high GWP measures with the potential to reduce an estimated 20.2 MMTCO2e.

H-1: Motor Vehicle Air/Conditioning was estimated to achieve 0.3 MMTCO2e in the Scoping Plan. This regulation is adopted. The Scoping Plan value has been adjusted proportional to the economic downturn, resulting in an estimated reduction of 0.2 MMTCO2e.

H-2: The SF_6 Reductions Non-Utility and Non-Semiconductor Applications measure is adopted. However, SF_6 reductions are not in the ARB inventory and therefore cannot be tracked, so potential reductions are considered uncertain.

H-3: Semiconductor manufacturing was estimated to achieve 0.2 MMTCO2e in the Scoping Plan. This regulation is adopted. The Scoping Plan value has been adjusted proportional to the economic downturn, but the resulting change is so small that the reported value (to one decimal place) remains 0.2 MMTCO2e.

H-4: Consumer Products was estimated to achieve 0.3 MMTCO2e in the Scoping Plan. This regulation is adopted and the ISOR calculated 0.2 MMTCO2e.

H-5: High GWP reduction from mobile sources was estimated to achieve 3.3 MMTCO2e in the Scoping Plan. The mobile air conditioning component of this measure will be considered in the Advanced Clean Cars measure. The leak test, refrigerant recovery, and Federal ban components are under evaluation and potential reductions are uncertain at this time.

H-6: High GWP reduction from Stationary Sources includes refrigerant management, foam recovery and destruction, SF_6 leak reduction, the use of alternative suppressants in fire protection, and early retirement of residential refrigerators, which combined were estimated to achieve 10.9 MMTCO2e of reductions in the Scoping Plan. The estimated reduction identified in the Refrigerant Management Program ISOR is 7.2 which adjusted proportionally to the economic downturn results in an estimated reduction of 5.8 MMTCO2e. The ISOR for SF_6 leak reduction identifies a potential reduction of 0.1 MMTCO2e. The remaining components of H-6 are under evaluation and potential reductions are uncertain at this time.

H-7: Mitigation Fee on High GWP Gases was estimated to achieve 5.0 MMTCO2e in the Scoping Plan. Implementation of a mitigation fee on high GWP gases is not considered feasible at this time.
http://www.arb.ca.gov/regact/2009/semi2009/semiisor.pdf
http://www.arb.ca.gov/regact/2008/cp2008/cpisor08.pdf
http://www.arb.ca.gov/regact/2009/gwprmp09/isorref.pdf

Sustainable Forests

The Scoping Plan estimated that sustainable forest practices could achieve 5.0 MMTCO2e of reduction through sequestration. The currently recognized reduction is unchanged from that identified in the Scoping Plan.
http://www.arb.ca.gov/cc/forestry/forestry.htm

Industrial Measures (sources not covered under cap-and-trade program)

Industrial measures implemented by sources not covered under cap-and-trade program address emissions from oil and gas extraction and transmission operations. The Scoping Plan identifies a potential reduction of 1.1 MMTCO2e for these measures. These measures are under review and potential reductions are uncertain at this time.
http://www.arb.ca.gov/cc/oil-gas/oil-gas.htm
http://www.arb.ca.gov/cc/gas-trans/gas-trans.htm

Recycling and Waste (landfill methane capture)

The Scoping Plan estimated the potential reduction from landfill methane capture as 1.0 MMTCO2e. The ISOR estimated the potential reduction to be 1.5 MMTCO2e.
http://www.arb.ca.gov/regact/2009/landfills09/isor.pdf

Attachment
2020 Statewide Greenhouse Gas Emissions and the 2020 Target

			Forecasted Statewide GHG Emissions (MMTCO2e)
2020 Baseline (2008 Scoping Plan) Pre-economic downturn, Business-As-Usual			**596**
		Economic Downturn	
Recalculated 2020 Baseline from the Scoping Plan After economic downturn, Business-As-Usual			**545**
Measures newly incorporated into inventory (baseline)			
Pavley (vehicles model-years 2009-2016)	26 MMTCO2e	Measures incorporated into baseline	
Renewables Portfolio Standard (12%-20%)	12 MMTCO2e		
	38 MMTCO2e		
2020 AB 32 Baseline (adjusted in 2010)			**507**
Reductions Necessary to Achieve the 2020 Emissions Target	80 MMTCO2e	Needed Reductions	
2020 Emissions Target			**427**

2020 Statewide Greenhouse Gas Emissions and the 2020 Target

(base years for forecasting: 2009-2011 emissions)

This document was developed to support the Updated Scoping Plan

			Forecasted Statewide GHG Emissions (MMTCO2e)
2020 Baseline (2008 Scoping Plan)			**596**
Pre-economic downturn, Business-As-Usual			
		Economic Downturn	
Recalculated 2020 Baseline from the Scoping Plan			
After economic downturn and AR4 GWP update, Business-As-Usual			**539**
Measures newly incorporated into inventory (baseline)			
Pavley (vehicles model-years 2009-2016)	27 MMTCO2e	Measures incorporated into baseline	
Renewables Portfolio Standard (20%)	3 MMTCO2e		
	30 MMTCO2e		
2020 AB 32 Baseline (adjusted in 2014)			**509**
Remaining Reductions to Achieve the 2020 Emissions Limit			
Energy	25 MMTCO2e	Remaining Reductions to Achieve 2020 Limit	
Transportation	23 MMTCO2e		
High-GWP	5 MMTCO2e		
Waste	2 MMTCO2e		
Cap-and-Trade	23 MMTCO2e		
	78 MMTCO2e		
2020 Emissions Limit (updated to AR4 GWP)			**431**

Greenhouse Gas Reductions from Ongoing, Adopted and Foreseeable Scoping Plan Measures

This document was developed to support the Updated Scoping Plan

Million tonnes of CO2 equivalent (Using AR4 GWP)

Total of All Measures	**55.2**
Measures in Capped Sectors	**49.0**
Transportation	***22.9***
T-1 Advanced Clean Cars	3.1
T-2 Low Carbon Fuel Standard	15.2
T-3 Regional Targets (SB375)	3.0
T-4 Tire Pressure Program	0.6
T-5 Ship Electrification	0.2
T-7 Heavy Duty Aerodynamics	0.9
T-8 Medium/Heavy Hybridization	0.0
Electricity and Natural Gas	***25.0***
E-1 Energy Efficiency and Conservation	7.8
CR-1 Energy Efficiency and Conservation	4.4
CR-2 Solar Hot Water (AB 1470)	0.1
E-3 Renewable Electricity Standard (20%-33%)	11.5
E-4 Million Solar Roofs	1.1
Industry	
I-1 Energy Efficiency and Co-Benefits Audits for Large Industrial Sources	0.0
Measures in Uncapped Sources/Sectors	**7.2**
H-1 Motor Vehicle A/C Refrigerant Emissions	0.2
H-3 Reduce Perfluorocarbons in Semiconductor Manufacturing	0.1
H-4 Limit High GWP use in Consumer Products	0.2
H-6 Refrigerant Tracking/Reporting/Repair Deposit Program	4.9
H-6 SF6 Leak Reduction and Recycling in Electrical Applications	0.1
RW-1 Landfill Methane Control Measure	1.8

Last Updated: 03/14/2014

2020 Forecast Update

Method Summary

- No significant change in method from previous forecast made for cap & trade;
- Base year used to forecast is an average of emissions from 2009 thru 2011. Data for 2009, 2010, and 2011 are actual emissions, not back-casted estimates;
- Forecast for a given year developed from base year emissions multiplied by a category-specific growth factor;
- Growth factors are calculated using future year activity surrogates, including fuel demand, expected equipment turnover, head of cattle, amount of waste, etc., and the average activity surrogate values for 2009 – 2011:

  Example:

  $$\text{2020 BAU Forecast (MMT) = Base Year (MMT) x } \overbrace{\text{[Surrogate (2020) / Avg Surrogate (2009-2011)]}}^{\text{Growth factor}}$$

- Reductions from individual measures were scaled by the ratio of new forecast value to previous forecast value to update reductions in new forecast “currency”.

Forecast Surrogates

Forecast Surrogate	Elements Impacted	% of Base Year
2011 IEPR Transportation Fuels	Transportation categories using gasoline, diesel, jet fuel, aviation gas, propane, and CNG	36%
(No growth)*	Stationary categories using non-natural gas fuels; electricity imports; other minor categories	26%
2011 IEPR Natural Gas	Non-Electricity Categories using natural gas	15%
ARB Electricity Model	In-state electricity generation using natural gas	9%
FAPRI Forecast**	Livestock and livestock-related emissions	4%
High GWP Model***	ODS substitutes	3%
ARB CEPAM	Fugitive emission categories	2%
ARB Landfill Model	Landfill emissions	2%
ARB Offroad Model	OGV & harborcraft, construction & mining categories	1%
(Extrapolation of historical trend)	Associated gas use in Oil & Gas category	1%
[Forestry]	[No longer in inventory]	0%

*Non-natural gas fuels for stationary sources assumed not to grow due to local air district restrictions on the use of higher polluting fuels (diesel, coke, etc.). Electricity imports not expected to grow substantially in the future due to limited transmission capacity. Other minor categories include fertilizer use, ag burning, etc., in which no substantial growth is anticipated.

** Food and Agricultural Policy Research Institute (FAPRI) is associated with Iowa State and the University of Missouri. FAPRI projections generally assume continuation of current agricultural policies and practices and are based on average weather conditions and historical rates of technological change.

*** Uses New High GWP Model created by Research Division (replaces previous use of USEPA Model)

- High, mid, and low demand forecast scenarios were included in the 2011 IEPR;

- High demand case incorporates relatively high economic/demographic growth, low electricity and natural gas rates, and low efficiency program and self-generation impacts. Low demand case includes lower economic/demographic growth, higher assumed rates, and higher efficiency program and self-generation impacts. Mid-case uses input assumptions at levels between the high and low cases;

- The mid case demand was chosen for the current and new 2020 forecasts—assumes mid-range economic and demographic growth.

Current & New Forecast Comparison

Category	**Previous 2020 Forecast (MMT-SAR) [C&T Reg (2010) Version]**	**New 2020 (MMT-AR4)**
BAU Baseline (mid case)	506.8	509.4
Included in Baseline	Pavley I & RPS 20%	Pavley I & RPS 20%
Complimentary Measures	62.0	55.2*
Cap & Trade	18.2	23.5
2020 Target	426.6	430.7

*Does not include -5.0 from Sustainable Forests—forest sector removed from the inventory

Status of Scoping Plan Recommended Measures

The estimated 2020 greenhouse gas (GHG) emission reductions for measures described in the 2008 Scoping Plan were based on the best available information as of December 2008. In support of the 2014 scoping plan update, ARB staff has revised the expected 2020 emission reductions in consideration of the economic recession and the availability of updated information from development of measure-specific regulations. The revised emissions reduction estimates for measures included in the 2008 Scoping Plan recognize the following:

- Development of measure-specific regulations. Regulations adopted by the Board include estimates of reductions anticipated by 2020. These regulations, which reflect ARB's progress towards reducing statewide GHG emissions, include comprehensive documentation detailing the data sources and methods used to develop measures recommended in the Scoping Plan. Each regulation's Initial Statement of Reasons (ISOR) contains the information necessary to evaluate how the reduction was calculated. All ISOR documents are available on ARB's website. If a more detailed explanation (beyond the brief description contained herein) of methods used to update any of the measure reductions is desired, this can be provided by ARB staff.

- Severe and prolonged economic downturn. The revised measure-specific emission reductions consider the economic downturn through the use of an updated GHG emission forecast. In most cases, the reduction was simply scaled (multiplying the original reduction by the ratio of the Updated 2020 Forecast/Old 2020 Forecast of those categories for which the reduction applies). The updated forecast was developed using average emissions over a three-year period (2009-2011) projected to 2020. For energy consuming sectors, the projection is based on future demand for electricity and transportation fuels described in the California Energy Commission's 2011 Integrated Energy Policy Report (IEPR). The IEPR accounts for the recession using economic and demographic data. The 2011 IEPR document is available on the California Energy Commission's website. http://www.energy.ca.gov/2011_energypolicy/documents/

- Use of the Forth Assessment Report (AR4) of Global Warming Potentials. The revised reductions updated the Global Warming Potentials (GWPs) from the Second Assessment Report (SAR) to the Forth Assessment Report (AR4) consistent with the Updated Scoping Plan and the Updated Forecast.

Attachment
2020 Statewide Greenhouse Gas Emissions and the 2020 Target

The 2020 Business-As-Usual (BAU) emissions baseline used in the 2008 Scoping Plan was 596 MMTCO2e. This estimate of statewide 2020 emissions was developed using pre-recession 2007 IEPR data and reflects GHG emissions expected to occur in the absence of any reduction measures in 2010. ARB staff re-evaluated the baseline in light of the economic downturn and updated the projected 2020 emissions using AR4 GWPs to 539 MMTCO2e. Two reduction measures (Pavley I and the Renewables Portfolio Standard (12% - 20%)) not previously included in the 2008 Scoping Plan baseline were incorporated into the updated baseline, further reducing the 2020 statewide emissions projection to 509 MMTCO2e. The updated forecast of 509 MMTCO2e is referred to as the AB 32 2020 baseline. Reduction of an estimated 78 MMTCO2e are necessary to reduce statewide emissions to the AR4 updated AB 32 Target of 431 MMTCO2e by 2020.

ESTIMATED REDUCTIONS FROM CAPPED SOURCES/SECTORS

T-1: Pavley

The Scoping Plan estimated Pavley 2020 reductions as 31.7 MMTCO2e, of which 27.7 was identified as Pavley and 4.0 as Advanced Clean Cars. The California Energy Commission (CEC) 2011 Integrated Energy Policy Report (IEPR) fuel forecast was referenced in combination with the ARB's EMFAC 2011 model of on-road vehicle activity and emissions to estimate the reduction attributed to the Pavley portion (vehicles model-years 2009-2016) of this measure under post-economic downturn conditions, resulting in an estimated reduction of 26.8 MMTCO2e. Pavley has been incorporated into ARB baseline inventories.
http://www.arb.ca.gov/cc/ccms/ccms.htm

T-1: Advanced Clean Cars

In the Scoping Plan this measure was estimated to reduce 4.0 MMTCO2e, which has been adjusted to reflect the economic downturn as described for the Pavley regulation (see above). The resulting estimated reduction is 3.1 MMTCO2e. The Advanced Clean Car measure is under development and focuses on vehicles model-years 2017-2025.
http://www.arb.ca.gov/msprog/clean_cars/clean_cars.htm

T-2: Low Carbon Fuel Standard (LCFS)

In the Scoping Plan, the LCFS was estimated to achieve 15.0 MMTCO2e reductions in 2020. Based on the proposed regulation, the reduction in the ISOR was calculated as 15.8 MMTCO2e. In order to reflect changed economic conditions, the estimated reduction from the regulation was recalculated using the same methodology as the Scoping Plan but with more recent data, resulting in an estimated reduction of 15.2 MMTCO2e.
http://www.arb.ca.gov/fuels/lcfs/lcfs.htm

T-3: Regional Transportation-Related GHG Targets

The Scoping Plan identified 5.0 MMTCO2e as a placeholder for what could be achieved by the Sustainable Communities and Climate Protection Act of 2008 (SB 375) through sustainable regional transportation and local land use planning. The SB 375 Staff Report identifies 3.0 MMTCO2e, which is the aggregate from the regional passenger vehicle GHG reduction targets established for the 18 Metropolitan Planning Organizations approved in 2010.
http://arb.ca.gov/cc/sb375/staffreport_sb375080910.pdf

T-4: Vehicle Efficiency Measures

Vehicle efficiency measures in the Scoping Plan include Low Friction Oil, Tire Pressure Regulation, Tire Tread Program, and Solar Reflective Automotive Paint and Window Glazing. In the Scoping Plan, these measures were estimated to achieve a combined reduction of 4.5 MMTCO2e in 2020.

The Tire Pressure Regulation is approved and the estimated reduction identified in the ISOR is unchanged from the Scoping Plan estimate of 0.6 MMTCO2e. The Tire Tread Program (0.3 MMTCO2e in the Scoping Plan) is under evaluation and potential reductions are uncertain at this time. Low Friction Oil has been achieved in practice (2.8 MMTCO2e in the Scoping Plan). Potential reductions through cool car design are to be considered as part of the Advanced Clean Cars measure.
http://www.arb.ca.gov/regact/2009/tirepres09/tireisor.pdf

T-5: Ship Electrification

The Scoping Plan attributed 0.2 MMTCO2e of reductions to the Shore Power for Ocean-going Vessels measure. The ISOR for this regulation estimated potential reductions to range between 0.12 and 0.24 MMTCO2e. The estimated reduction of 0.2 MMTCO2e identified in the Scoping Plan is considered representative of this measure.
http://www.arb.ca.gov/ports/shorepower/shorepower.htm

T-6: Goods Movement

Goods Movement includes measures to reduce emissions from shipping and port operations including such actions as reducing vessel speed and electrifying port equipment. The Scoping Plan attributed 3.5 MMTCO2e to these system-wide measures. System-wide efficiency improvements are in progress but are not likely to provide significant GHG reductions by 2020.
http://www.arb.ca.gov/planning/gmerp/gmerp.htm

T-7 & T-8: Medium/Heavy Duty Vehicles

The Scoping Plan identified potential reductions of 0.9 MMTCO2e from the Heavy Duty Aerodynamic Efficiency measure and 0.5 MMTCO2e from the Medium/Heavy Hybridization measure.

The Heavy Duty Aerodynamics measure is approved and the ISOR identifies 1.0 MMTCO2e of reductions, which has been adjusted proportional to the economic downturn resulting in an estimated reduction of 0.9 MMTCO2e in 2020. The hybridization measure is under evaluation and potential reductions are uncertain at this time.
http://www.arb.ca.gov/regact/2008/ghghdv08/ghgisor.pdf

T-9: High Speed Rail

The Scoping Plan attributed 1.0 MMTCO2e of reductions to the development of High Speed Rail. This measure is being implemented under an approved bond measure and Federal grant; but is not likely to provide significant GHG reductions by 2020.

E-1: Energy Efficiency

Energy efficiency consists of several programs that include building and appliance efficiency. The measure has been adjusted to reflect changed economic conditions using the methodology in the Scoping Plan but with more current data from the 2011 IEPR. The updated forecast includes the E-3: Renewable Portfolio Standard (20%) as part of the baseline and this causes the updated reductions to decrease. The estimated reduction is updated from 15.2 MMTCO2e to 7.8 MMTCO2e. Achievement of these emission reductions is dependent on continued funding and implementation of efficiency programs.

CR-1 & CR-2: Conservation and Solar Hot Water

These measures include building and appliance efficiency and solar water heating (AB 1470 goal).

The reduction attributed to Conservation and Solar Water Heating in the Scoping Plan, 4.4 MMTCO2e, has been adjusted to reflect the changed economic conditions, resulting in an estimated reduction of 4.5 MMTCO2e in 2020. The Solar Water Heating measure is being implemented and funded by the CPUC as a component of the California Solar Initiative, Thermal Development Program.
http://www.cpuc.ca.gov/PUC/energy/Solar/thermhistory.htm

E-2: Increasing Combined Heat and Power

The reduction attributed to this measure in the Scoping Plan was 6.7 MMTCO2e. The CPUC recently approved a settlement designed to increase the amount of CHP operated by Independently Owned Utilities (IOUs) in the State. The settlement identifies a 4.8 MMTCO2e incremental GHG emission reduction goal by 2020. However, due to accounting differences between the Scoping Plan and the settlement, actual reductions in 2020 may differ from the 4.8 MMTCO2e. Actual reductions associated with this measure remain uncertain at this time.

E-3: Renewables Portfolio Standard (RPS, 20% by 2012)

In the 2008 Scoping Plan, renewables were estimated to achieve 21.3 MMTCO2e of GHG reductions in 2020, of which 7.9 MMTCO2e would be achieved by the RPS (12%-20%) and 13.4 MMTCO2e would be achieved by the Renewable Electricity Standard (RES, 20%-33%). Estimated RPS reductions in 2020 have been updated to reflect changed economic conditions based on the 2011 IEPR demand forecast, but most importantly, to reflect that this program has almost achieved its 2012 goal. The updated forecast begins with a base year of 2009-2011, and that means very little

remains for this program to obtain by 2012, having already obtained the majority of its impact. The reductions yet to be obtained are 3.1 MMTCO2e. The updated RPS reduction has been incorporated into ARB baseline inventories. The RPS program is administered by the California Public Utilities Commission (CPUC).
http://www.cpuc.ca.gov/PUC/energy/Renewables/

E-3: Renewable Electricity Standard (RES, 33%)

The RES measure was estimated to provide 13.4 MMTCO2e of reductions in the Scoping Plan (see above). Estimated emission reductions are presumed to be substantially equivalent to those identified in a Staff Report (ISOR) prepared by ARB in 2010 which estimated reductions as 12.0 MMTCO2e. Reductions associated with unbundled Renewable Energy Credits (RECs) were subtracted from the ISOR value and then adjustments were made to reflect changed economic conditions based on the 2011 IEPR demand forecast, yielding a final value of 11.5 MMTCO2e. This measure is being implemented by the CEC and CPUC under SBX1-2, signed by Governor Brown in April 2011.
http://www.energy.ca.gov/renewables/
http://www.arb.ca.gov/regact/2010/res2010/res10isor.pdf
http://leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.pdf

E-4: Million Solar Roofs

The Scoping Plan estimated this measure, part of The California Solar Initiative, could obtain 2.1 MMTCO2e of reductions in 2020. The estimated reduction has been recalculated using the same methodology as that presented in the Scoping Plan with an updated grid emission factor, then proportionally adjusted to reflect the economic downturn, resulting in an estimated reduction of 1.1 MMTCO2e in 2020. The measure is being implemented and funded by the CEC and CPUC as a component of the California Solar Initiative program.
http://www.energy.ca.gov/ghg_emissions/index.html
http://www.cpuc.ca.gov/PUC/energy/Solar/aboutsolar.htm

I-1 Through I-5: Industrial Measures (for sources covered under cap-and-trade program)

Industrial measures include Refinery Measures, Oil & Gas Extraction and Transmission Measures, and Energy Efficiency & Co-Benefits Audits. The Scoping Plan identified potential reductions of 1.4 MMTCO2e in 2020. These measures are under evaluation, so potential reductions are uncertain at this time.
http://www.arb.ca.gov/cc/energyaudits/energyaudits.htm
http://www.arb.ca.gov/cc/oil-gas/oil-gas.htm
http://www.arb.ca.gov/cc/gas-trans/gas-trans.htm

Cap-and-Trade

The cap-and-trade regulation would establish a declining limit (cap) on 85-percent of statewide GHG emissions. The declining cap established in the regulation would ensure that all necessary reductions occur to meet the 2020 target, even if the estimated reductions from other measures discussed above fall short. http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm

ESTIMATED REDUCTIONS FROM UNCAPPED SOURCES/SECTORS

High Global Warming Potential (GWP) Gas Measures

The Scoping Plan identified seven high GWP measures with the potential to reduce an estimated 20.2 MMTCO2e. The Scoping Plan value now reflects only feasible measures, adjusted proportional to the economic downturn and corrected to reflect AR4 GWPs, resulting in an estimated overall reduction of 5.4 MMTCO2e.

H-1: Motor Vehicle Air/Conditioning

The Scoping Plan estimated this measure to achieve 0.3 MMTCO2e of reductions by 2020. This regulation is adopted. The Scoping Plan value has been adjusted proportional to the economic downturn and corrected to reflect AR4 GWPs, resulting in an estimated reduction of 0.2 MMTCO2e.

H-2: SF6 Reductions from Non-Utility and Non-Semiconductor Applications

This measure is adopted, and was estimated by the Scoping Plan to achieve 0.3 MMTCO2e of reductions in 2020. However, these particular SF_6 emissions are not in the ARB inventory and therefore cannot be tracked, so potential reductions are considered uncertain.

H-3: Semiconductor Manufacturing

Semiconductor manufacturing was estimated to achieve 0.2 MMTCO2e of reductions by 2020 in the Scoping Plan. This regulation is adopted. The Scoping Plan value has been adjusted proportional to the economic downturn and corrected to reflect AR4 GWPs, resulting in an estimated reduction of 0.1 MMTCO2e.

H-4: Consumer Products

Consumer Products was estimated to achieve 0.3 MMTCO2e of reductions by 2020 in the Scoping Plan. This regulation is adopted and the ISOR calculated value, adjusted proportional to the economic downturn and corrected to reflect AR4 GWPs, is 0.2 MMTCO2e.

H-5: High GWP Reductions from Mobile Sources

High GWP reductions from mobile sources were estimated to achieve 3.3 MMTCO2e of reductions by 2020 in the Scoping Plan. The mobile air conditioning component of this measure will be considered in the Advanced Clean Cars measure. The leak test, refrigerant recovery, and Federal ban components are under evaluation and potential reductions are uncertain at this time.

H-6: High GWP Reductions from Stationary Sources

High GWP reductions from Stationary Sources includes refrigerant management, foam recovery and destruction, SF_6 leak reduction, the use of alternative suppressants in fire protection, and early retirement of residential refrigerators, which combined were estimated to achieve 10.9 MMTCO2e of reductions by 2020 in the Scoping Plan. The estimated reduction identified in the Refrigerant Management Program ISOR is 7.2 which adjusted proportionally to the economic downturn and corrected to reflect AR4 GWPs results in an estimated reduction of 4.9 MMTCO2e. The ISOR for SF_6 leak reduction corrected to reflect AR4 GWPs identifies a potential reduction of 0.1 MMTCO2e. The remaining components of H-6 are under evaluation and potential reductions are uncertain at this time.

H-7: Mitigation Fee on High GWP Gases

The Mitigation Fee on High GWP Gases was estimated to achieve 5.0 MMTCO2e of reductions by 2020 in the Scoping Plan. Implementation of a mitigation fee on high GWP gases is not considered feasible at this time.
http://www.arb.ca.gov/regact/2009/semi2009/semiisor.pdf
http://www.arb.ca.gov/regact/2008/cp2008/cpisor08.pdf
http://www.arb.ca.gov/regact/2009/gwprmp09/isorref.pdf

RW-1: Recycling and Waste (landfill methane capture)

The Scoping Plan estimated the potential reduction from landfill methane capture as 1.0 MMTCO2e. The ISOR estimate corrected to reflect AR4 GWPs is 1.8 MMTCO2e by 2020.
http://www.arb.ca.gov/regact/2009/landfills09/isor.pdf

F-1: Sustainable Forests

The Scoping Plan estimated that sustainable forest practices could achieve 5.0 MMTCO2e of reduction through sequestration. The forestry sector now resides in the forest and natural land inventory apart from the GHG Inventory focused on anthropogenic emissions, and is in process of incorporating much improved emissions estimates. Until the studies underway undergirding these improvements are completed and updated estimates can be made, revised reductions from this measure are unavailable.
http://www.arb.ca.gov/cc/forestry/forestry.htm

Supporting Material for Assessment of Post-2020 Caps

Introduction

Assembly Bill (AB) 398 (Chapter 135, Statutes of 2017) provides legislative direction on the role of the Cap-and-Trade Program (Program) between 2021 and 2030.[1] AB 398 contains a specific provision directing the California Air Resources Board (CARB or Board) to *evaluate and address concerns related to overallocation in the state board's determination of the available allowances for years 2021 to 2030, inclusive, as appropriate.* In addition, some commenters have raised concerns that early reductions beyond those needed to achieve the 2020 target, which have resulted in unused allowances to date, will hinder the ability of the post-2020 period of the Program to deliver the necessary GHG reductions needed to achieve the 2030 target.

This staff paper provides a comprehensive evaluation, in response to legislative direction, using **public data** and the most recent information provided by modeling to support the 2017 Scoping Plan Update adopted by the Board in December 2017.[2] This paper provides additional information to help inform on this topic.

This paper is organized in specific topic areas as follows:

- Background on Cap Setting for 2013 through 2020
- Current Framework for Post-2020 Caps
- Distribution of Allowances
- Allowance Banking Limits and Other Constraints
- Evaluation of Potential Pre-2021 Unused Allowances and Post-2020 Cap Setting
- Discussion: Post-2020 Caps
- Attachment A: Uncertainty

Process

This paper, and Attachment A, offers additional information for stakeholders to review and consider when providing comments for where, per AB 398, staff will need to develop recommendations for the Board's consideration later this year. There are no specific regulatory proposals included in this paper. Staff is seeking specific comments from stakeholders on the following topics and questions:

- Are there other uncertainties not mentioned in this paper or in Attachment A that should be considered when evaluating the post-2020 caps?
- What additional abatement opportunities and cost data should staff evaluate?
- Stakeholder thoughts on the staff analysis approach/methodology
- What additional information can stakeholders share to evaluate for windfall profits?
- What additional adjustments should staff consider to further reduce price volatility?

[1] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398
[2] https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm

Background on Cap Setting for 2013 through 2020

AB 32 mandated CARB to "determine what the statewide greenhouse gas emissions (GHG) level was in 1990, and… [set an equivalent] statewide greenhouse gas emissions limit to be achieved by 2020."[3] Initially, the GHG emissions to be covered by the Cap-and-Trade Regulation (Regulation) were estimated as 365 million metric tons of carbon dioxide equivalent (MMTCO2e) for 2020. Facility level GHG emissions data available from the Mandatory Greenhouse Gas Emissions Reporting Regulation (MRR) allowed staff to improve on top-down estimates of the emissions from covered sectors included in the GHG top-down inventory developed for use in the 2008 Scoping Plan. In establishing the Program caps for 2013 through 2020, staff proposed, and the Board adopted in 2011, the 2020 cap to equal 334.2 $MMTCO_2e$. The 2013 through 2020 annually declining allowance caps represented the limit on the GHG emissions that could occur for the State to achieve its 2020 GHG reduction target. CARB issues a quantity of allowances equal to each year's caps.

Current Framework for Post-2020 Caps

The 2016 Cap-and-Trade rulemaking, adopted in 2017, created the framework for the 2021 through 2030 annual allowance budgets in Program.[4] To establish the post-2020 annual allowance budgets, staff calculated the ratio of mandated 2020 covered emissions (334.2 $MMTCO_2e$) relative to the 2020 GHG statewide target established by AB 32 (431 $MMTCO_2e$).[5] Then, staff multiplied the 2030 GHG statewide target mandated by SB 32 (258.6 $MMTCO_2e$) by this ratio (77.5 percent) to establish a 2030 annual allowance budget of 200,500,000 allowances. Staff then set a straight-line path of emissions reductions from the 334.2 $MMTCO_2e$ 2020 budget to the 200.5 $MMTCO_2e$ 2030 target.

Distribution of Allowances

The Cap-and-Trade Regulation stipulates distribution of allowances and including removing some allowances from general circulation for cost containment purposes and to recognize purchases of voluntary renewable electricity generation that is not used to meet mandatory renewable energy requirements in California or any other jurisdiction. For the years 2013 through 2020, section 95870(a) designates 121,883,000 allowances to the Allowance Price Containment Reserve (Reserve),[6] and section 95870(c)

[3] http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf
[4] Elements of the 2016 rulemaking's creation of a post-2020 framework require harmonization with AB 398's legislative direction. This harmonization will be achieved through the 2018 rulemaking.
[5] 2016 ISOR https://www.arb.ca.gov/regact/2016/capandtrade16/isor.pdf p. 26
[6] As in previous staff concept papers, the term "current Reserve" means the existing allowance price containment reserve with the three price tiers, "post-2020 Reserve" means the collapsed single tier reserve as currently included in the Cap-and-Trade Regulation, and "new post-2020 Reserve" means the two tier reserve structure as directed in AB 398. See https://www.arb.ca.gov/cc/capandtrade/meetings/20180302/ct_price_concept_paper.pdf.

designates 7,077,750 allowances from to the Voluntary Renewable Electricity Reserve Account.

For the post-2020 period of the Program, Section 95871(a) and Table 8-2 designate 52,400,000 allowances from the years 2021 through 2030 to the post-2020 Reserve. These allowances would be removed from general circulation and only available at higher prices. These allowances reflect what CARB believes should be removed from general circulation to account for the fact that the 2020 emissions will be lower than the 2020 annual cap based on the most recent modeling completed for the 2017 Scoping Plan Update. In other words, this amount of allowances reflects staff's accounting for expected emissions in 2021 with a straight line to the cap in 2030. The 52,400,000 allowances account for approximately 2 percent of post-2020 allowances. Importantly, the pre- and post-2020 methodologies are consistent in that allowances are allocated to the Reserve from within established caps. This means that allowances are taken from within the caps and general circulation to populate the Reserve. This ensures that even if the Reserve is utilized, emissions will still be within the cap.

Similarly, as indicated in the first staff concept paper,[7] staff is considering whether it would be appropriate to allocate an additional two percent of allowances from budget years 2026 through 2030 into the price ceiling or new post-2020 Reserve tiers. This is because AB 398 increases the offset usage limit in 2026 to six percent from the four percent limit it imposes for compliance years 2021 through 2025. A removal of an additional two percent of allowances from the 2026 through 2030 annual allowance budgets would be consistent with the policy decision made in the current program to remove allowances from the annual allowance budgets to effectively represent allowance budgets with a four percent offset usage limit. This additional two percent of the 2026 to 2030 budgets is equal to 22,726,000 allowances.

Table 1 depicts annual allowance distribution for 2013 through 2030. The total quantity of allowances already designated for the current Reserve totals approximately 174.2 million allowances. Staff is considering adding an additional 22.7 million allowances to the new post-2020 Reserve, which would remove approximately 195 million allowances from general circulation and only make them available in either the new post-2020 Reserve or price ceiling.

[7] See https://www.arb.ca.gov/cc/capandtrade/meetings/20180302/ct_price_concept_paper.pdf.

Table 1. Distribution of Allowances

Year	Total Budget	Non-APCR	Existing Regulation APCR	Under Consideration Additional APCR
2013	162,800,000	161,172,000	1,628,000	0
2014	159,700,000	158,103,000	1,597,000	0
2015	394,500,000	378,720,000	15,780,000	0
2016	382,400,000	367,104,000	15,296,000	0
2017	370,400,000	355,584,000	14,816,000	0
2018	358,300,000	333,219,000	25,081,000	0
2019	346,300,000	322,059,000	24,241,000	0
2020	334,200,000	310,806,000	23,394,000	0
2021	320,800,000	308,027,400	10,500,000	2,272,600
2022	307,500,000	295,927,400	9,300,000	2,272,600
2023	294,100,000	283,727,400	8,100,000	2,272,600
2024	280,700,000	271,427,400	7,000,000	2,272,600
2025	267,400,000	259,327,400	5,800,000	2,272,600
2026	254,000,000	247,027,400	4,700,000	2,272,600
2027	240,600,000	234,827,400	3,500,000	2,272,600
2028	227,300,000	222,727,400	2,300,000	2,272,600
2029	213,900,000	210,427,400	1,200,000	2,272,600
2030	200,500,000	198,227,400	0	2,272,600

<u>Allowance Banking Limits and Other Constraints</u>

AB 398 directs staff to *[e]stablish allowance banking rules that discourage speculation, avoid financial windfalls, and consider the impact on complying entities and volatility in the market*.

The existing Regulation contains banking provisions designed to reduce allowance purchase costs and allowance price variability. Three-year compliance periods allow entities flexibility in when to acquire allowances, giving them time to adjust to unanticipated changes in either emissions or allowance prices. Entities may purchase allowances when prices are low for surrender at a later date if they expect that prices will increase. Alternatively, they may postpone purchases if they expect future prices to be less than current prices plus their cost of “carrying” allowance purchases to future periods. These banking provisions help smooth prices over time.

Most covered entities will have financial constraints which prevent them from purchasing and holding allowances, especially up to the holding limit. This may prevent them from undertaking purchases that would otherwise allow them to reduce their allowance acquisition costs. Voluntarily associated entities (VAE) help provide allowances to covered entities when they need them. VAEs include entities with financial resources that allow them to bank at lower carrying costs compared with many covered entities. These VAEs can buy allowances, hold them, and then sell them to covered entities at a later date. This helps prevent a few large entities from controlling allowance prices and exerting market power.

CARB staff included VAEs in the Program to increase the number of entities to increase liquidity and efficiency in the market. Increased liquidity allows entities to purchase and sell allowances in the market quickly without causing a drastic change in the allowance price. However, both staff and stakeholders recognized that circumstances could arise which could result in market manipulation.

The existing Regulation also contains banking rules designed to prevent purchases by entities to accumulate sufficient allowances to manipulate market prices. Specifically, the Regulation imposes a holding limit, which sets the maximum number of allowances an entity (or group of entities that are corporate affiliates) may hold, or bank, at any one time. The holding limit applies separately to holdings of current vintage and future vintage allowances. Current vintage allowances have a vintage year corresponding to the current or previous calendar years, or are allowances purchased from the Reserve. Future vintage allowances have a vintage year later than the current calendar year. The current vintage holding limit applies to all current vintage allowances as one group. The holding limit is based on the annual allowance budget of all the jurisdictions in the linked market; it decreases as the jurisdictional caps decline. For 2018, the current vintage holding limit is approximately 15.7 million allowances. Table 2 shows the holding limits for all market participants in the linked market.

Table 2. Holding Limits (2018-2030)

Year	Holding Limit
2018	15,717,500
2019	15,217,650
2020	14,715,200
2021	14,302,950
2022	13,848,950
2023	13,392,700
2024	12,936,200
2025	12,482,200
2026	12,025,950
2027	11,569,475
2028	11,115,725
2029	10,659,225
2030	10,202,975

The Regulation allows covered entities to exempt allowances they must accumulate to meet their compliance obligations from inclusion within the holding limit.[8] As a result, all entities, voluntary or covered, have the same holding limit in the Program across the linked program.

It is important to note that not all entities have the financial capacity to purchase up to their holding limits. Smaller covered entities with low emissions and small compliance obligations do not need to hold much in their holding accounts. They also will have little interest in providing banking services for other entities. And, the VAE category includes a large number of entities, such as offset project operators, that do not hold or transact in allowances.

To date, staff and the market monitor have not observed any evidence of financial windfalls. Speculative behavior in the allowance market is limited by the existing holding limits and the inclusion of voluntary entities and linkages increases the liquidity and efficiency of the market – mitigating price volatility. More importantly, the majority of market participants are not availing themselves of the maximum holding limit. For any entity to utilize the maximum current holding limit, it would cost approximately $235 million (15,717,500 * $15 – the approximate market price for 2018 allowances). And, to the extent State-owned allowances are unsold at auction and held by CARB on behalf of the State, those allowances are not in circulation and cannot be applied towards emissions.

Evaluation of Potential Pre-2021 Unused Allowances and Post-2020 Cap Setting

To date, annual emissions from covered sectors have been below annual allowance caps. Based on analysis of the recent 2017 Scoping Plan Update modeling, GHG inventory, and MRR GHG emissions data, California will achieve the 2020 target before 2020 – meaning the covered GHG emissions may remain below the annual caps through 2020. This means that some of the 2013 through 2020 allowances will be unused and will carry over into the post-2020 period of the Program. Some view the unused allowances as a positive signal of over-compliance resulting from early-action responses, carbon pricing, better-than-expected performance of complementary measures, and broad economic conditions. Others believe this quantity of unused allowances may hinder the State's ability to achieve the 2030 target as these pre-2021 allowances could increase the supply of compliance instruments above the post-2020 caps and allow for GHG emissions to exceed the amount needed to achieve the target, while enabling entities to remain in compliance with the Regulation.

[8] For more information on limited exemptions, see here: https://www.arb.ca.gov/cc/capandtrade/limited_exemption.pdf.

Some observers and the Legislative Analyst's Office (LAO) estimate the magnitude of the cumulative vintage 2013 through 2020 unused allowances to be in the range 100-300 million. The LAO estimate indicates the most likely estimate to be about 200 million allowances.[9] For the purposes of this analysis, staff begins with the LAO estimate as it is comparable to previous third-party papers that looked at the same issue, and accounts for Program features like the Reserve. In the LAO estimate, offset usage rate and emissions reductions are two uncertain factors cited as contributing to the large range of unused allowance projections. Staff's understanding is the LAO estimate of 200 million allowances does not account for the following factors:

- The mechanism of moving into the Reserve allowances that remain unsold for eight consecutive auctions – which is particularly important during sustained periods of low demand for allowances
- Allowances set aside for the Voluntary Renewable Electricity Program
- Retirement of allowances to account for "missing" imported electricity emissions in the Energy Imbalance Market
- Abatement opportunities in linked programs
- Does not differentiate as to what quantity of unused allowances would be held in private accounts versus held by CARB on behalf of the State, and thus not available for compliance

Each of these factors would decrease the unused quantity of allowances to a value that is smaller 200 million.

To better reflect the current status of the Program, staff refined the estimate of unsold allowances to account for several of the factors detailed above that have not previously been included in many of the estimates that looked at supply versus demand of allowances. Staff refinements are as follows:

- Movement of allowances into the Reserve: Approximately 40 million unsold auction allowances transferred to the Reserve[10]
- Allowances for the Voluntary Renewable Energy Program: Approximately 7 million allowances set aside for the Voluntary Renewable Energy Program
- Other known Allowance Retirements: Approximately 5 million allowances to be retired in response to a recent bankruptcy[11]

[9] Cap-and-Trade Extension: Issues for Legislative Oversight (December 2017): http://www.lao.ca.gov/reports/2017/3719/cap-trade-extension-121217.pdf
[10] The quantity of unsold allowances that would be transferred to the Reserve can be estimated using public information on this page: https://www.arb.ca.gov/cc/capandtrade/auction/auction_archive.htm
[11] The recent bankruptcy relates to the La Paloma Generating Company, which was acquired by LNV Corporation through bankruptcy proceedings. The generating facility at issue emitted approximately 2 million $MTCO_2e$ per year (1.6 million in 2015 and 2.07 million in 2016). La Paloma submitted compliance

These adjustments reduce the estimated 200 million unused allowances to approximately 150 million, but this number still does not account for:

- Abatement opportunities in linked programs
- Retirements for ensuring environmental integrity for missing emissions from transfers within the Energy Imbalance Market. This latter retirement of allowances could be several million allowances a year from 2018 through 2020.

Further, as noted above, the Program places holding limits on banked allowances and entities have financial constraints that put practical limits on allowance banking in private accounts. Allowances that remain held by CARB on behalf of the State are not in circulation and cannot be used against emissions by covered entities. So, while these allowances may be available post-2020, they are not in circulation or available for compliance use until purchased from the State.

CARB staff evaluated whether the currently established caps will be binding on emissions during the next decade given refined estimates of the unused allowances for the 2013 through 2020 period. To estimate the emissions reductions that may be achieved by the Program, staff relied on modeling presented in the 2017 Scoping Plan Update.[12] Staff compared the cumulative 2021 through 2030 covered emissions projected in the modeling for a scenario that excludes the Cap-and-Trade Program to a scenario that includes the Cap-and-Trade Program under a representative compliance scenario. This modeling comparison is detailed in the follow subsections.

Cumulative 2021-2030 Modeled GHG Emissions with No Cap-and-Trade Program

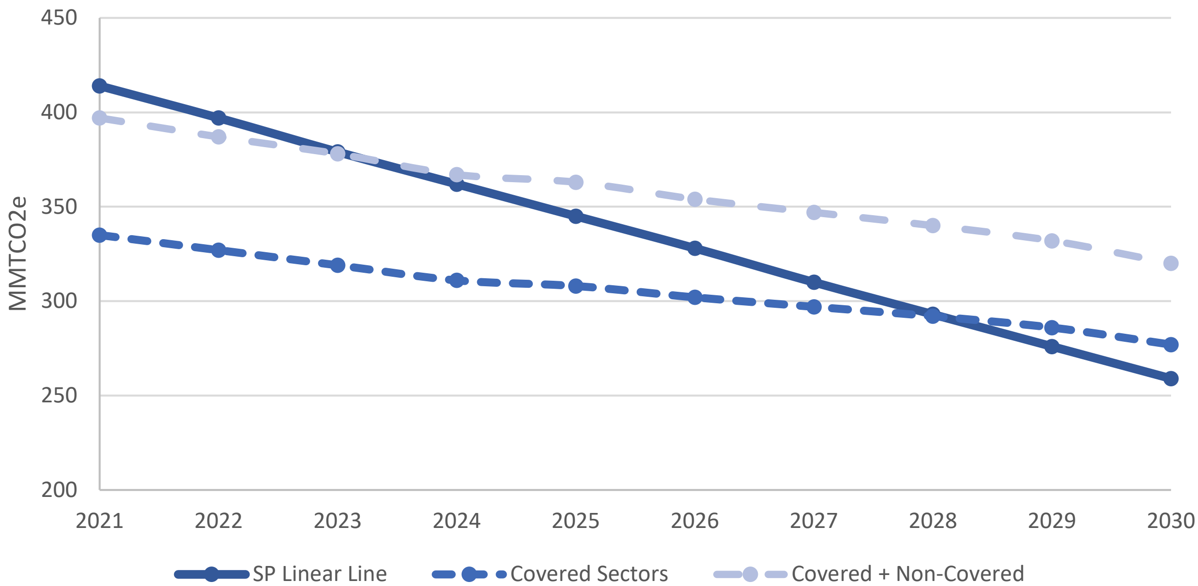
The Scoping Plan Scenario modeled using PATHWAYS projects statewide emissions under the full range of California's GHG reduction policies identified as key measures to achieve the 2030 target (e.g., Renewables Portfolio Standard, Low Carbon Fuel Standard, Mobile Source Strategy, Short-Lived Climate Pollutant Strategy, etc.), but does not model the impact of the Cap-and-Trade Program. The PATHWAYS model

instruments to satisfy the 30 percent annual surrender obligation for its 2015 and 2016 emissions, leaving a remainder of 2.6 million tons plus any emissions from 2017 still unaccounted for. If 2017 emissions are approximately the same as in 2016, this results in approximately 4.6 to 5 million metric tons of GHG emissions that will have to be accounted for through the retirement of allowances. *See* CARB 2016 Compliance Report, https://www.arb.ca.gov/cc/capandtrade/2016compliancereport.xlsx; CARB Updated 2015 Compliance Report, https://www.arb.ca.gov/cc/capandtrade/2015compliancereport.xlsx; and CARB Staff Report: Initial Statement of Reasons, Appendix B (January 30, 2018), at p. 14, *available at* https://www.arb.ca.gov/regact/2018/capandtradeghg18/appb.pdf (citing estimated 2 million metric tons per year of GHG emissions).

[12] California's 2017 Climate Change Scoping Plan Update (December 2017): https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm

provides sector-specific estimates of statewide emissions, and staff believes this to be the most recent and best available projection of statewide emissions. Cap-and-Trade covered emissions include the transportation, electricity, residential and commercial, and industrial sectors, and non-covered emissions are from the agricultural, recycling and waste, and high global warming potential gas sectors.

Figure 1. 2021 - 2030 Estimated Statewide GHG Emissions Scoping Plan Scenario without Cap-and-Trade



In Figure 1, the combined GHG emissions from the covered sectors and the non-covered sectors are above the Scoping Plan linear path from 2020 to 2030. The SP Linear Line represents a linear decrease in GHG emissions from the 2020 target of 431 to the 2030 target of 260. While GHG emission from any year can be above or below any of the trend lines in Figure 1, the linear line provides a reference for tracking progress towards achieving the 2030 target, assuming there is the same year-over-year decrease in GHG emissions over time. The total GHG emissions estimated to occur between 2021 and 2030 without accounting for the effect of the Cap-and-Trade Program are 3,586 $MMTCO_2e$. Table 3 breaks out the total estimated cumulative emissions between the covered and non-covered sectors.

Table 3. Estimated Cumulative 2021-2030 Emissions in the Absence of the Cap-and-Trade Program - PATHWAYS Model of Scoping Plan Scenario#

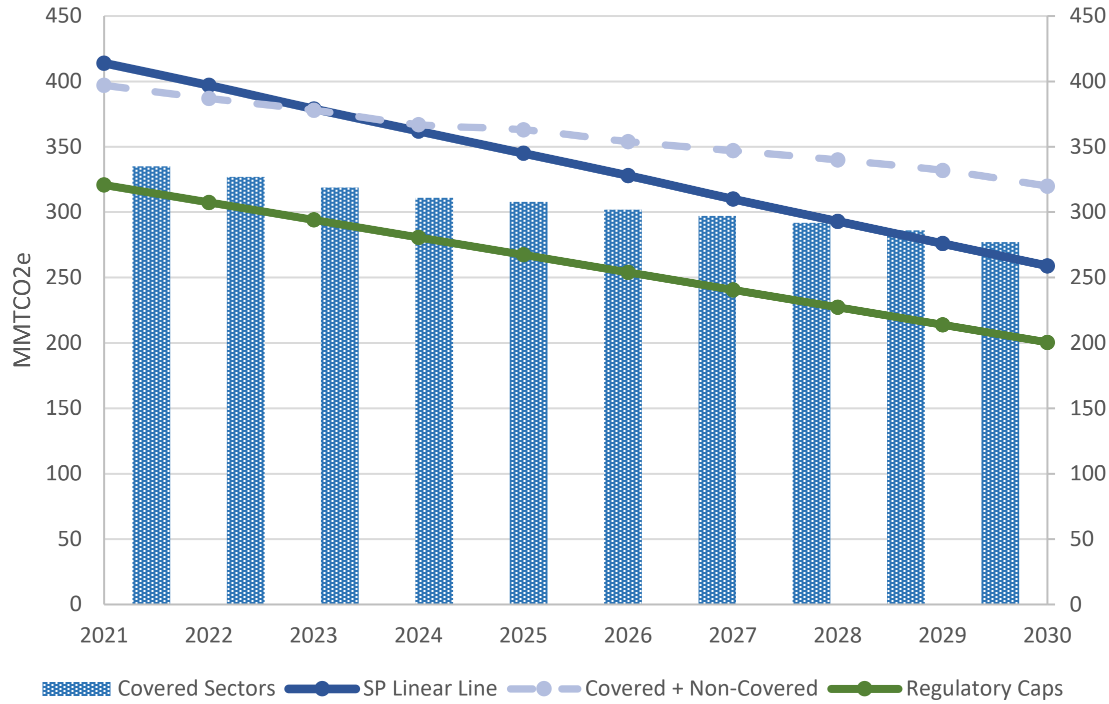
	Cumulative 2021-2030 Emissions (million MT CO_2e)##
Covered Emissions w/out Cap-and-Trade Program###	3,054
Non-Covered Emissions	532
Total GHG Emissions	**3,586**

The Scoping Plan Scenario accounts for all key GHG reduction policies except the Cap-and-Trade Program.
https://www.arb.ca.gov/cc/scopingplan/comparison_graphs_6cases101817.xlsm
###Covered Emissions w/out Cap-and-Trade Program refers to the estimates of the GHG emissions in the Cap-and-Trade covered sectors while reflecting the impact of the complimentary policies only and not including any changes in GHG emissions due to the impact of a Cap-and-Trade Program. This number may also include some limited fugitive emissions not covered by the Cap-and-Trade Program.

In the 2017 Scoping Plan Update, the Cap-and-Trade Program is one of several measures identified in achieving the 2030 target and covers a large portion of the economy. The post-2020 caps will need to reduce GHG emissions to ensure sufficient reductions are delivered to achieve the statewide GHG reduction target.

Figure 2 is essentially the same as Figure 1, but it now includes the post-2020 caps in the Regulation. This figure clearly shows that the post-2020 caps, shown by the green line, are lower than the estimated emissions in the covered sectors, shown in the shaded dark blue bars.

Figure 2. Comparison of Post-2020 Caps and 2021 - 2030 Estimated Statewide GHG Emissions in the Covered Sectors without Cap-and-Trade



2021 through 2030 Cap-and-Trade Compliance Scenario and Post-2020 Caps

In approaching this analysis, staff had to design a post-2020 compliance scenario to understand if the amount of allowances and offsets available would limit GHG emissions from 2021 through 2030. This scenario allows for the comparison of what the compliance needs may be by the covered sectors against the amount of compliance instruments available. To be sure, there are an infinite number of compliance scenarios for post-2020 that could be constructed. Staff chose to build a scenario that is based on observed patterns that are informed by public information. While historical trends may not be indicative of future actions, this analysis requires some type of characteristic demand for compliance instruments to understand how any pre-2021 unused allowances factor into a post-2020 program.

Staff designed a 2021 through 2030 compliance scenario that includes use of offsets consistent with the limits for offset use directed in AB 398 and expected availability of offsets based on compliance offset issuance information to date. AB 398 directs the offset usage limit to be reduced from the current eight percent to four percent in 2021 through 2025 and up to six percent in 2026 through 2030.

To date, CARB has issued approximately 105 million compliance offsets. Of those, approximately 20 million offsets were issued for projects in-state, or approximately 20 percent. For the representative compliance scenario, staff included the assumptions that there would be sufficient out-of-state offsets to count towards the offset usage limit, but the availability of in-state offsets that met the requirements of providing direct environmental benefits in the state would be limited. At this time, staff is continuing to develop what is within the scope of “direct environmental benefits in the state” and for the purposes of this analysis relied on stakeholder comments to define only those offsets that originate within the state to qualify as those with direct environmental benefits. In-state offsets may be constrained by several factors. First, identification of new compliance offset project protocols will be limited as the Program covers approximately 80 percent of the State’s emissions and offsets cannot be generated within covered sectors. Second, for many potential new project types, further research is needed to support accurate quantification of GHG benefits in complex biological systems such as those in the natural and working lands sector. Third, a significant amount of offsets (~17 million) have been generated under the Compliance Offset Protocol for Ozone Depleting Substances and as those banks of existing materials are destroyed, there will be less available for future offset projects. While the existing information to date indicates there has not been full utilization of the offset limit within the Program, CARB staff will continue to look for new offset project types[13] and increased utilization of existing protocols to ensure this cost-containment mechanism supplies sufficient offsets to maximize the cost benefits of this design feature.

The following information was used to develop a representative Cap-and-Trade Program compliance scenario post-2020:

- 2021 through 2025 offset usage: three percent
- 2026 through 2030 offset usage: four and a half percent

Table 4 provides information on how the post-2020 caps limit GHG emissions under this compliance scenario with, and without, the use of the 150 million 2013 through 2020 unsold auction allowances.

[13] AB 398 requires the establishment of a Compliance Offset Task Force. This Task Force will provide guidance to CARB in establishing new offset protocols for the Cap-and-Trade Program with direct environmental benefits in the state while prioritizing disadvantaged communities, Native American or tribal lands, and rural and agricultural regions.

Table 4. Estimate of Total Compliance Instruments Used in the 2021-2030 Program and Cumulative 2021-2030 Reductions Achieved by the Program

	No Vintage 2013-2020 Unused Allowances	150 Million Vintage 2013-2020 Unused Allowances
Total allowances available 2021-2030	2,607	2,757
Total post-2020 Reserve allowances	75	75
Estimated offsets used	96	103
Total compliance instruments available	**2,628**	**2,784**
Cumulative post-2020 Cap-and-Trade Program GHG reductions ($MMTCO_2e$)	426 (3054-2628)	269 (3054-2784)

In Table 4, the total allowances available represent the caps in the Regulation summed from 2021 through 2030 with the addition of the 150 pre-2021 unsold allowances to the aggregate cap value in the right column (2607+150). The post-2020 Reserve allowances are the same in each column as they represent the 52 million in the post-2020 Reserve and additional 22.7 million under discussion for the Reserve and price ceiling (52+22.7). The estimated offsets represent the offset usage limits described above, but they are different across the two columns. For this analysis, we assume GHG emissions are equal to the allowances available and since the offset usage limits are tied to the compliance obligation, the higher the compliance obligation—GHG emissions—the higher the quantity of offsets, even though the total offset usage percent is the same for both columns. The total compliance instruments available (offsets + allowances, excluding any allowances in the Reserve/Price Ceiling) is 2,628 $MMTCO_2e$ and 2,784 $MMTCO_2e$. We will assume these are the maximum cumulative GHG emissions for 2021 through 2030.

In looking at Table 3, we know the estimated emissions in the covered sectors for 2021 through 2030 is 3,054 $MMTCO_2e$. But, we know from Table 4, the estimated number of compliance instruments available is 2,628 $MMTCO_2e$ and 2,784 $MMTCO_2e$. If the number of compliance instruments available in Table 3 is assumed to be the maximum amount of emissions that can occur, the Program does limit cumulative GHG emissions to be lower than the 3,054 $MMTCO_2e$ with, and without, the availability of the pre-2021 unused allowances by 426 and 269 $MMTCO_2e$, respectively. Even though both scenarios reduce emissions to help achieve the 2030 target, compliance costs will be higher for the scenario without the 150 allowances as it reduces allowance supply, which increases allowance scarcity relative to allowable emissions.

In this compliance scenario, none of the Reserve allowances are accessed between 2021 and 2030, including the 40 million allowances placed into the price ceiling per AB 398. This compliance scenario does include some implicit assumptions that abatement can be achieved without accessing the two post-2020 Reserve tiers and price ceiling.

The following factors each make it likely that the vintage 2013 through 2030 unused allowances are less than third-party estimates available publicly:

- Mechanism of moving into the APCR allowances that remain unsold for eight auctions, which will move at least 40 million unsold auction allowances to the Reserve
- Allowances set aside for the Voluntary Renewable Electricity Program
- Retirement of allowances to account for imported electricity emissions in the Energy Imbalance Market
- Uncertainties of emission reductions in linked programs
- Retirement of allowances to ensure environmental integrity in situations of bankruptcy

Beyond the reduction in unused allowances available for post-2020, when all of the factors above are known and implemented, there still remains the limit to how many unused allowances will actually be held in private accounts due to the existing holding limits and carrying cost associated with the purchase and private banking of allowances.

Discussion: Post-2020 Caps

This staff evaluation is prepared in response to direction in AB 398 and relies on the best available and currently available public data. Staff has identified uncertainties and unknowns that are important considerations in evaluating if unused allowances – those not retired for compliance-- from 2013 through 2020, when considered in the context of the post-2020 allowances budgets, would hinder the ability of the Program to achieve reductions needed to meet the 2030 target.

Current unknowns include knowing the full range of abatement for different prices across all sectors covered by the Cap-and-Trade Program. Staff has requested stakeholders to provide information or references to help understand this better. Staff did make some assumptions about abatement opportunities as part of the uncertainty analysis in the development of the 2017 Scoping Plan Update and did not receive data or comments on those assumptions. As a regulator, CARB does not have full knowledge of abatement opportunities for each sector and individual regulated entities, which is mitigated, in part, by a Cap-and-Trade Program where covered businesses can look within their own operations to identify the most cost-effective opportunities to reduce their GHG emissions. This also means the Cap-and-Trade Program can deliver reductions at lower costs than other prescriptive alternatives. We do know that some sectors will respond more quickly to a carbon price than others. For example, the electricity sector is already responding to today's carbon price since the price has been incorporated into dispatch models in response to the Cap-and-Trade Program. CARB staff will continue to evaluate existing and emerging technology that can reduce GHG emissions without merely reducing production to continuously inform on magnitudes of reductions and which sectors are expected to be responsive to escalating carbon prices.

To address uncertainty and support a price signal at the annually escalating floor price, the Program was initially designed with a self-ratcheting mechanism to remove unsold auction allowances from circulation during periods of low demand. But, these unsold allowances can be reintroduced into circulation through auctions in a measured amount each time during periods of high demand. In August 2016, CARB staff included a proposed amendment that if these unsold auction allowances do not come back to auction within eight consecutive auctions, they be transferred to the Reserve. This amendment was approved by the Board in July 2017. Additionally, AB 398 includes legislative direction on this topic and the recently adopted amendment is consistent with legislation. This mechanism has already proven to be effective. Due to low demand for allowances through 2017, approximately 40 million allowances will be transferred to the Reserve and removed from general circulation. Depending on auction results for this year, additional previously unsold allowances may also be transferred to the Reserve.

To ensure we are making progress towards the State's statutory GHG reduction targets, each year CARB posts an annual GHG inventory, which is publicly available on our website. To further understand how GHG emissions may change year-to-year CARB tracks other factors like economic activity, fuel use, climate conditions, growth in renewables, deployment of cleaner vehicles, and others. All of these metrics, including the GHG inventory, are publicly available data. Cap-and-Trade is just one of several policies in the Scoping Plan to chart the path to 2030. Thus, in addition to Cap-and-Trade, we need to track all of the policies and sectors to ensure we stay on track with the reduction needed to meet our targets and, if necessary, make adjustments.

If it appears statewide emissions are not declining as needed, recognizing that year-to-year variability due to climate, global fuel prices, or economic factors can influence emissions, CARB staff would evaluate which sectors are not responding as anticipated, review all programs that cover those sectors, and ascertain why as well as assessing the best path forward to ensure California stays on track to meet its legislatively established GHG targets. Periodic reviews of progress toward achieving the 2030 target and the performance of specific policies will also provide opportunities for the State to consider any changes to ensure we remain on course to achieve the 2030 target. The need for this periodic review process was anticipated in AB 32, as it calls for updates to the Scoping Plan at least once every five years. Additionally, there are annual oversight hearings by the Joint Committee on Climate Change Policies and CARB Board updates to review and discuss progress on achieving the State's GHG targets.

Next Steps

Staff will also continue discussions on this topic, as well as other modifications required by AB 398, with our linked partners in Québec and Ontario. Any proposed changes to California's Program will be carefully assessed in terms of many factors including potential impacts on the ability to meet our GHG reduction targets, leakage, and impacts on the linked programs. As staff develops more refined proposals for potential amendments, additional analyses and discussion with stakeholders is planned ahead of any formal regulatory proposal.

Attachment A
Uncertainty

Staff recognizes and notes the uncertainty within the analysis inputs and assumptions. Descriptions of the uncertainty related to PATHWAYS modeling and future emissions and market conditions are provided in this attachment.

Scoping Plan Modeling Uncertainty

It is equally important to note the 2017 Scoping Plan Update identified several types of uncertainty in both forecasting future emissions and estimating the benefits of emissions reductions policies. In developing the 2017 Scoping Plan Update, staff forecasted the estimated the GHG emissions outcome of the Scoping Plan using PATHWAYS. Inherent in the modeling is the expectation that many of the existing GHG reduction programs will continue in their current form, and the expected drivers for GHG emissions such as energy demand, population growth, and economic growth will match our current projections. However, it is unlikely that the future will precisely match our projections, leading to uncertainty in the forecast, both of future economic conditions and the GHG reductions achieved by existing programs. Thus, the estimates in Table 3 of the staff paper should be understood to represent one possible future in a range of possible outcomes.

To generate future emissions scenarios, PATHWAYS relied on assumptions that are external to the model. PATHWAYS utilized the best available inputs related to California's capital and energy usage through 2030, such as energy demand over time, the start years for specific policies, and the penetration rates of associated technologies. Each of the assumptions provided to PATHWAYS has some uncertainty, which is also reflected in the modeling results. Thus, while the results presented in the 2017 Scoping Plan Update and Table 3 of the staff paper may seem precise, these results are estimates with ranges of uncertainty.

Future Emissions and Market Conditions

Table A-1 below summarizes the key factors that will influence to what extent the post-2020 GHG emissions will be limited by the quantity of compliance instruments available.

Table A-1. Key Factors Influencing Post-2020 GHG Reductions from the Cap-and-Trade Program

Key Factor	Description	Impact on Post-2020 Program
Abatement opportunities in linked programs	The full range of abatement possible for different prices by entities from linked programs is unknown.	The degree to which entities from linked programs abate emissions will influence the demand for allowances from California, potentially reducing the amount of unused allowances before 2021. *If this were the case, there would be fewer pre-2021 unused allowances available to put towards emissions after 2021.*
Post-2020 offset supply	It is unknown at this time if sufficient offsets will be available for post-2020 demand for the full offset usage limits.	If full offset supply is not available for post-2020, *there are fewer compliance instruments available to put towards emissions after 2021.*
Pre-2021 offset use	Current offset use is about four percent.	If entities continue with the current trend and do not maximize their offset use pre-2021, they will continue to rely more on allowances –*there would be fewer pre-2021 unused allowances available to put towards emissions after 2021*.
Energy Imbalance Market (EIM)	CARB is currently retiring allowances to account for the full GHG emissions associated with energy transfer through the EIM.	This value is currently unknown for the period between 2018 and 2020, but could be tens of millions of allowances. Thus, it is anticipated that there will *be fewer pre-2021 unused allowances available to help with meeting post-2020 obligations.*
Bankruptcy Environmental Integrity	To ensure environmental integrity of the Program, CARB will retire allowances against any outstanding emissions for which compliance instruments have not been surrendered. The Board recently	There is one currently known instance where this requirement will apply. That is expected to require CARB to retire approximately 5 million allowances. *There would be fewer pre-2021 unused allowances available to put towards emissions after 2021*.

	voted on amendments to ensure there was absolute clarity on the ownership of outstanding compliance obligations in such situations moving forward.	
Post-2020 Allowances placed into the Reserve or Price Ceiling	The current Regulation places 52 million allowances into the Reserve. Staff is taking comment on where to place an additional 22.7 million to account for the six percent offset usage limit for 2026-2030.	For post-2020, depending on the price of the Reserve tiers and price ceiling and how the 52 and 22.7 million are distributed among those will play a role in whether or not these instruments are readily available to use against post-2020 emissions.
Price Setting for the Post-2020 Reserve Tiers and Price Ceiling	Staff is currently taking public comments on where to set the Reserve tiers and price ceiling values.	If these values are placed too low, the allowances in the Reserve and price ceiling mechanism will be accessed early and the Program may not be able to constrain emissions to levels needed to achieve the 2030 target. Alternatively, if reserve tiers and the price ceiling are placed too high it may lead to higher prices than are necessary to attain the reduction targets and could promote leakage.
Performance of Complimentary Policies	The covered sectors in the Program are also subject to complementary policies such as the RPS and LCFS.	Depending on how well the policies perform between now and 2030 will influence how many compliance instruments are unused and available for other sectors to use against emissions through 2030.
Reference Scenario for post-2020 in the Scoping Plan	GHG emissions could be higher or lower than projected for post-2020 than modeled for the Reference Scenario in the 2017 Scoping Plan Update.	Depending on actual emissions post-2020, the cumulative reductions needed to achieve the 2030 target will change. Since the complementary policies and non-covered sector policies are set at specific performance levels, the demand on the Program to deliver reductions will vary.

AB 32 Discussion Series

Information Needs for Analysis of Effectiveness of the Cap-and-Trade Regulation

Charles D. Kolstad and Emily Wimberger, UC Santa Barbara[1]
April 2012

Abstract

In April 2012, a select group of environmental regulators and economic researchers convened in Santa Barbara to discuss the *ex post* economic analysis of California's Cap-and-Trade regulation. The symposium entitled "Information Needs for Analysis of the Effectiveness of the Cap-and-Trade Regulation" focused on the data, information, and types of analyses needed to monitor economic impacts throughout the implementation of the Cap-and-Trade regulation that went into effect January 1, 2013.

Discussions within the two-day event focused on the standard dimensions of the economic performance of a regulation. Researchers and regulators defined performance measures necessary to evaluate a regulation as well as the analytical methods, models, and data required to support program evaluation. Additional discussion focused on employment, health impacts, and the health of California's economy as implementation of the regulation unfolds.

[1] At the time this paper was prepared, authors were Professor of Economics and Professional Researcher, respectively, University of California Center for Energy and Environmental Economics (UCE[3]), University of California, Santa Barbara (www.uce3.org). Current affiliations (2018) are different: Kolstad is Professor of Economics and Senior Fellow at Stanford University (ckolstad@stanford.edu); Wimberger is Chief Economist at the California Air Resources Board (ewimberg@arb.ca.gov). Financial support from the California Air Resources Board and the UC Office of the President is gratefully acknowledged.

In April 2012 the University of California Center for Energy and Environmental Economics (UCE[3]) at UC Santa Barbara convened a symposium of leading economic experts and environmental regulators to discuss the analytic and data needs to support *ex post* analysis of the effectiveness of AB 32, California's Global Warming Solutions Act. Thus the purpose of the event was twofold: to define the performance metrics necessary to assess the potential economic impact of California's Cap-and-Trade program, and discuss the analytical methods, models, and data required to support a comprehensive evaluation of AB 32 as its portfolio of programs (including Cap-and-Trade) are implemented.

The symposium, titled *Information Needs for Analysis of Effectiveness of the Cap-and-Trade Regulation,* was held April 2-3, 2012, at the Bren School at the University of California at Santa Barbara. The event was sponsored by UCE[3] in conjunction with the California Air Resources Board (ARB) and the Bren School and was organized by Charles Kolstad and Emily Wimberger of UCSB. The 34 invited attendees included academic and research economists as well as federal and state environmental regulators.[2] The first day of the symposium focused on the metrics necessary to assess the economic impacts of the Cap-and-Trade program while the second day of the event focused on specific topics thought to be of critical importance in the *ex post* analysis of the regulation. Each day consisted of panels that included topic introductions by a moderator, three presentations on the panel's topic, and substantive discussion between all symposium participants.

This report provides a summary of the symposium, focusing on the presentations and discussions contained within the five panels, as well and the research recommendations proposed by participants. This report will be followed by a call for research proposals as well as a work plan for the California Air Resources Board to use as a guide as the *ex post* analysis of AB 32 and the Cap-and-Trade program begins.

<u>Introductory Remarks: Framing the Symposium</u>

Chairman Mary D. Nichols of the California Air Resources Board opened the symposium with a brief overview of AB 32 and the current status of the Cap-and-Trade program.

Chairman Nichols began by tracing the origins of the symposium back to 2006 and the signing of AB 32 which set a mandate for California to reduce Greenhouse Gas (GHG) emissions to 1990 levels by 2020 and gave ARB the task of implementing the statute by designing a portfolio of complimentary programs which could include a market mechanism such as Cap-and-Trade. The Air Resources Board has thrice approved the use of a Cap-and-Trade program as part of AB 32's portfolio though the scope and mechanics of the program have received much scrutiny.[3]

[2] Appendix A includes a complete list of participants and their affiliations. Appendix B contains a schedule for the symposium.

[3] The Board first adopted a preliminary Cap-and-Trade regulation in 2008, reaffirmed their support in 2010, and again in 2011.

In developing the Cap-and-Trade program and assessing its potential economic impacts, ARB has been advised by an Economic Advisory Committee, primarily composed of outside experts. There have also been six full-scale analyses detailing the impacts of the Cap-and-Trade program on the California economy. Estimated changes in gross state product range from an increase of 1.0% to a decline of 2.2% depending on the study.[4] And while these macroeconomic studies have found the overall impact of the Cap-and-Trade program to be relatively small compared to California's overall economy, much uncertainty remains as to the impacts of the program on California's industries and consumers. In an effort to reduce the economic uncertainty surrounding the program, identify the economic impacts of the regulation of Californians, and help provide mid-course corrections as needed, leading economists with experience in environmental regulation were convened to identify the methodologies that are required for ARB to conduct rigorous *ex post* analyses of the Cap-and-Trade program as well as the data that must collected to support these analyses.

Implementation of AB 32 and the Cap-and-Trade program has begun. The first allocation auction occurred in November 2012 and the first compliance period, covering the largest industrial sectors, will run through 2014. Natural gas and other fuels will then move into the program in 2015, along with an influx of auction revenue. Now is the time to identify the metrics and methodologies that will lead to substantive *ex post* analysis of the Cap-and-Trade program. The analyses have implications not only for the state of California but the nation and world as all eyes are on California to determine the feasibility of similar climate change regulations on an even larger scale.

<u>Organization</u>

The symposium was comprised of six panels: five were each oriented around a specific topic while the final panel presented a brief summary of the preceding panels. The first day of the symposium was comprised of three panels focused on defining the standard metrics of an economic analysis: costs, incidence, and leakage. The two topic panels on the second day of the symposium centered around the type of data and analyses relevant to estimating the impact of Cap-and-Trade on employment as well public health. Each panel included an introduction by a moderator as well as three presentations within the panel topic. The remainder of the panel was devoted to discussion among all symposium attendees. The following provides a summary of the individual panels.

[4] The six analyses include two conducted by the California Air Resources Board, two analyses by David Roland-Holst of UC Berkeley, and two analyses conducted by Electric Power Research Institute and Charles River Associates. All analyses were conducted between 2008 and 2010.

Defining and measuring the cost of the regulation

The first panel[5] of the day addressed the question of how to quantify the costs of regulation. The discussion began with the presentation of a taxonomy of potentially affected parties, describing the channels through which regulatory costs could be transmitted. The panel emphasized the challenges inherent in quantifying costs, noting that determining the costs to entities directly regulated under similar programs has been elusive. Panelists noted that identifying the benefits and costs of implementing the Cap-and-Trade program in California could require researchers and policymakers to redefine the scope of analysis. One panelist reflected that previous estimates of the cumulative effects of the AB 32 programs have fixed many parameters, which are in fact likely to vary in the longer run. A panelist also noted that simulation models do not fully capture the coordinating role of policymakers in promoting innovation. Another panelist addressed the question of scope, emphasizing that a full analysis must set costs against policy outcomes. The panelist also stated that the impacts of specific design elements of the program should be evaluated in order to demonstrate that implementation can effectively be achieved elsewhere. Another panelist presented a discussion of the potential gains that could come from efficiently utilizing permit value and addressing preexisting tax distortions. The panelist cautioned ARB against the instinct to use permit revenue to over fund programs, which might seem in-line with the goals of AB 32, but may not otherwise be cost effective.

Key points

- The costs of the Cap-and-Trade regulation cannot be separated from those of AB 32 as a whole
- There is value in demonstrating that agents respond to carbon pricing and that allowance markets are functional and effective at achieving low-cost emissions reductions
- Before-the-fact estimates often overstate the costs of regulations
    - Existing distortions influence firms' responses to markets
    - General equilibrium models are limited in their ability to predict long-run economy-wide effects as well as sectoral and policy interactions, and the role of policymakers in promoting coordination
- Econometric models are required for *ex post* program evaluation
    - Establishment-level analyses based on revealed data are most useful for quantifying both short- and medium-run regulatory effects

Defining and measuring incidence and burden of costs

The measurement of incidence (i.e., who bears costs and benefits), the topic of the symposium's second panel, is closely related to the measurement of the costs of regulation. Incidence was framed as encompassing direct costs and also the distribution of allowance value and costs. This is inherently tied to the concept of baseline setting, in

[5] This report, for the most part, refrains from identifying statements as coming from specific individuals. Rather, attribution is made to the group of presenters. Obviously, opinions attributed to a group are not necessarily shared by all members of the group. The identities of the panelists are found in Appendix B.

the sense that one's philosophical view of property rights determines how the incidence of the program is measured. The panel also echoed the sentiment of the previous panel, that it could be quite difficult to isolate the effects of the Cap-and-Trade program from the suite of complimentary programs nested within AB 32. One of the panelists discussed several national analyses that estimated the industrial regulatory impact over varying timeframes and identified sectors likely to be at risk of emissions leakage. One panelist noted that data from the Annual Census of Manufacturers could provide key inputs to a similar California-specific analysis. Another panelist then described several methods of performing after-the-fact program evaluations that can be used to isolate specific program effects, noting that these techniques would be useful for evaluating the cost-effectiveness of programs funded with allowance value. A third presenter concluded the panel with a discussion on the relative merits of general-equilibrium and econometric models for identifying indirect program effects and distribution, noting that survey data could provide valuable insights into how consumers respond to price changes resulting from AB 32 programs.

Key points

- Direct regulatory costs will be small relative to total allowance value
- The use of auction revenue will have a large impact on incidence and the efficiency of the Cap-and-Trade program
    - Addressing pre-existing distortions Is highly desirable from an efficiency perspective
    - Cap-and-Trade revenue may potentially be classified as a 'mitigation fee' which would require that any use of revenue to satisfy the Sinclair Nexus test implying that revenue can only be used to mitigate harm caused by GHG emissions
- Isolating program effects requires experimental design and data collection
    - Survey data can be useful in describing consumer response
- Incidence depends on the heterogeneity of responses to prices and programs
    - Estimates of the effects should be differentiated by income group as well as geographic region

<u>Measuring and monitoring leakage</u>

The first day of the symposium closed with a panel on leakage. The moderator opened the panel with an overview of emissions leakage and the issues relevant to academic researchers and California regulators as the Cap-and-Trade program is implemented. He identified the importance of defining the geographic market for California sectors at risk for leakage as well as the need for monitoring and guarding against leakage risk in future compliance periods. Panelist presentations focused on the modeling and monitoring of emissions leakage in a variety of regulatory settings. The first panelist described the ideal empirical application for estimating leakage as an exogenously-timed discontinuity in policy. He then identified the potential challenges to this first-best model, including data deficiencies on out-of-region emissions and trending variables that can potentially be correlated with emissions and regulations. Another panelist summarized lessons gathered from previous simulation and econometric models of emissions leakage, including the importance of modeling market structure and changes in factor inputs, the impact of indirect leakage, and the role of updating output-based allocations in mitigating leakage. In the final presentation of the panel, the focus was on the challenges of measuring and monitoring potential leakage and re-shuffling within the electricity sector, a sector that with its rich and readily available data can be used as a model for data compilation.

Key Points

- Assessment of leakage risk is based upon identification of the relevant geographic market and a uniformly acceptable and a measurable definition of leakage
    - The Department of Justice Merger Guidelines use effective competition and the cost of switching between regional suppliers to determine relevant geographic markets
    - The definition of leakage may vary by industry but clear terminology facilitates transparent monitoring and data collection
- Leakage mitigation is revealed in policy design
    - Updating output-based allocation can be an effective mitigation method, however monitoring is necessary to prevent overcompensation of firms
    - Free allowances can help preserve the competitiveness of affected sectors
- *Ex post* leakage assessment combines simulation and regression analyses to identify both the potential expected effects as well as the revealed impacts of leakage
    - *Ex post* analysis requires establishment-level data before and after the regulatory event
    - Difficulty in obtaining out-of-region emissions variables may require proxy variables such as net imports and exports or production variables
- The definition of additional outcome measures such as jobs, output, and tax revenue can be used to assuage political as well as environmental leakage concerns

<u>Employment, wages, and effects on state industries</u>

Opening the second day of the symposium, the fourth panel identified the effect of the Cap-and-Trade regulation on employment and wages within state industries. The moderator opened with a call for a universal definition of ‘green jobs’ and stated the need to establish a common set of assumptions on which to base business-as-usual forecasts of employment and economic activity within the state. One of the panelists described an empirical framework, data needs, and assumptions for evaluating the effects of the Cap-and-Trade program, while another provided a theoretical framework for describing how firms adjust to relative price changes, demonstrating that analyses of historical energy price changes could be used to construct a reasonable range of future impacts of the Cap-and-Trade program. Another panelist provided advice on best practices from EPA’s recent analysis of the employment impacts resulting from several of their environmental regulations, presenting results suggesting that the adverse effects of environmental regulations on employment have been somewhat overstated.

Key points

- Analytical frameworks for evaluating employment and intra-industry effects exist and suggests that environmental regulation has impacted employment
  - Decompose employment effects of pricing GHG emissions into higher costs and factor substitution as well as changes in demand for green and brown services
  - Labor supply may change as a consequence of higher consumption prices and changes in air quality while changes in environmental quality may impact productivity
- Additional data sources and employment classifications are required to estimate future employment demand effects
  - It is very difficult to link product demand to employment
  - More refined employment metrics may better reflect employment quality and long-run substitution in sector employment
- A balanced empirical strategy will compare estimates taken from historical prices changes with *ex post* analyses
  - Ongoing work will provide ex ante estimates using recent changes in energy prices and investments
  - Similar *ex post* analysis is possible for estimating the effects of costs and factor substitution

Public health and California's air quality

The final panel, on public health and California's air quality, opened with a discussion highlighting the challenges in obtaining access to health-related data and assessing the health impacts of AB 32. Panel presenters then discussed the data requirements and difficulties faced in their work estimating the health impacts of various environmental policies. The first panelist presented his work estimating the health effects of the NOx Budget Trading Program. The analysis required six individual-level data sets on health and pollution outcomes both pre-and post- regulation and found that the program health benefits were twice as large as abatement costs. Another panelist then discussed the spatial health effects of the SO_2 Cap-and-Trade program and the potential similarities to California's program, finding that the aggregate benefits of the SO_2 program greatly outweighed the costs and that trading drove the distributional effects of the policy, though no local environmental justice effects were found. A third panelist concluded with a summary of AB 32 early action items and a discussion of his work estimating the local health effects of airport congestion and taxi time in which he show that daily fluctuations in pollution impact hospital admissions and that airplane congestion impacts local air pollution.

Key Points

- Given the relative magnitude of emissions reductions from AB 32 and California's Cap-and-Trade program, the health impacts of GHG reduction will likely be too small to observe, however criteria pollutant co-benefits may potentially be identified
    - Dose response functions, despite potential non-linearity and variance by cohort, may be better suited to identify co-benefits than econometric estimation resulting in sector-specific pollution impacts
- There are gaping holes in the literature pertaining to environmental justice and distributional health impacts
- The scope and scale of data required for *ex post* analyses of the health implications of environmental regulation is a barrier
    - Availability of both public and private data presents a limitation to potential analyses

<u>Recurring Themes and Conclusions</u>

Two main issues that arose repeatedly throughout the symposium discussions highlighting the challenges inherent to regulatory *ex post* analysis and the divide between economic theory and the political world of policy.

- Defining the scope of the analysis
    - The economic impacts of the Cap-and-Trade program cannot and should not be parsed separately from those of AB 32
    - Identifying the correct policy counterfactual is critical
    - Identifying the political as well as economic evaluation metrics is necessary for comprehensive analyses
- Facilitating the identification, collection, and dissemination of data from regulated entities to researchers is necessary for substitutive *ex post* analysis of the regulation
    - Collecting establishment and individual-level data is required for the analysis of emissions leakage and health effects of the Cap-and-Trade regulation
    - Data availability, potentially through an agency-run centralized database is critical in the production of high caliber analyses

Appendix A: Symposium Participants

Researchers

Max Auffhammer, UC Berkeley
Elizabeth Bailey, UC Berkeley
Dallas Burtraw, Resources for the Future
Oliver Deschenes, UC Santa Barbara
Denny Ellerman, MIT
Meredith Fowlie, UC Berkeley
Wayne Gray, Clark University
Michael Hanemann, University of Arizona
Charles Kolstad, UC Santa Barbara
David Lea, UC Santa Barbara
Joshua Linn, Resources for the Future
Richard Morgenstern, Resources for the Future
Erich Muehlegger, Harvard University
Brian Murray, Duke
Paulina Oliva, UC Santa Barbara
Karen Palmer, Resources for the Future
Ian Parry, International Monetary Fund
Paul Portney, University of Arizona
Mar Reguant, Stanford
Wolfram Schlenker, Columbia
Emily Wimberger, UC Santa Barbara
Frank Wolak, Stanford
Catherine Wolfram, UC Berkeley

Participants from Regulatory Agencies

Edie Chang, ARB
Steve Cliff, ARB
Richard Corey, ARB
James Goldstene, ARB
Reid Harvey, EPA
Jason McPhee, ARB
Mary Nichols, ARB
Matthew Rodriquez, Cal EPA
Mark Wenzel, Cal EPA
Stanley Young, ARB
Matthew Zaragoza-Watkins, ARB

Appendix B: Symposium Program

AB 32 Technical Discussion Series
Information Needs for Analysis
of the Effectiveness of the Cap-and-Trade Regulation
UC Santa Barbara
April 2–3, 2012

This symposium is motivated by a need to develop a methodological framework, and identify specific data requirements, to effectively evaluate the performance and economic impacts of the AB 32 cap-and-trade program on an on-going basis.

The first day concerns standard dimensions of the economic performance of a regulation. Each panel will define performance metrics necessary to assess the economic impact of the regulation and discuss relevant analytical methods, models, and data requirements for supporting a comprehensive, on-going evaluation of the program.

The second day will include panels focusing on topics identified by ARB staff and academic researchers to be of critical importance for the on-going analysis of the Cap-and-Trade regulation, as well as highlight areas that need further scrutiny to ensure its success. Within the panels, the discussion will center around the specific methodologies and types of analyses appropriate for the evaluation of the economic impacts of the regulation as well as the development of a work plan to institute panel recommendations.

AB 32 Technical Discussion Series
Information Needs for Analysis
of the Effectiveness of the Cap-and-Trade Regulation
April 2–3, 2012

<u>Monday April 2, 2012</u>

9:00 – 10:00	Welcome and Status of AB 32 Implementation
	Mary D. Nichols, Air Resources Board
10:00 – 12:00	Defining and measuring the cost of the regulation
Moderator:	Meredith Fowlie, UC Berkeley
Presenters:	Denny Ellerman, MIT
	Michael Hanemann, UC Berkeley
	Ian Parry, International Monetary Fund
Rapporteur:	Edie Chang, Air Resources Board
12:00 – 1:00	*Lunch*
1:00 – 3:00	Defining and measuring incidence and burden of costs
Moderator:	Dallas Burtraw, Resources for the Future
Presenters:	Richard Morgenstern, Resources for the Future
	Brian Murray, Duke University
	Catherine Wolfram, UC Berkeley
Rapporteur:	Matthew Zaragoza-Watkins, Air Resources Board
3:00 – 3:30	*Break*
3:30 – 5:30	Measuring and monitoring leakage
Moderator:	Charlie Kolstad, UC Santa Barbara
Presenters:	Erich Muehlegger, Harvard University
	Karen Palmer, Resources for the Future
	Frank Wolak, Stanford, University
Rapporteur:	Mar Reguant, Stanford University
5:30 – 6:30	Reception followed by dinner for invitees

Tuesday April 3, 2012

9:00 – 10:30 Employment, wages, and effects on state industries
Moderator: Paul Portney, University of Arizona
Presenters: Reid Harvey, Environmental Protection Agency
Paulina Oliva, UC Santa Barbara
Josh Linn, Resources for the Future
Rapporteur: Elizabeth Bailey, UC Berkeley

10:30 – 11:00 *Break*

11:00 – 12:30 Public health and California's air quality
Moderator: Max Auffhammer, UC Berkeley
Presenters: Olivier Deschenes, UC Santa Barbara
Wayne Gray, Clark University
Wolfram Schlenker, Columbia and UC Berkeley
Rapporteur: Steve Cliff, Air Resources Board

12:30 – 1:30 *Lunch*

1:30 – 3:00 Presentation of panel summaries
Moderator: Emily Wimberger, UC Santa Barbara
Edie Chang, Air Resources Board
Matthew Zaragoza-Watkins, Air Resources Board
Mar Reguant, Stanford University
Elizabeth Bailey, UC Berkeley
Steve Cliff, Air Resources Board

3:00 – 3:30 Closing remarks
Charlie Kolstad, UC Santa Barbara

Definition of Panel Roles

For each panel, there will be a moderator, rapporteur, and three presenters. As can be inferred by the list of participants, these roles are equal in terms of contributing to the substance of the symposium.

Day 1 panel structure:

Moderator introduction:	15 min
Presentation 1	15 min
Presentation 2	15 min
Presentation 3	15 min
Discussion	60 min

Day 2 panel structure:

Moderator introduction: 15 min Presentation 1 15 min

Presentation 2	15 min
Presentation 3	15 min
Discussion	30 min

General Guidance

Keep in mind that the purpose of this symposium is two-fold. We wish to identify analytic approaches to conducting *ex post* analysis of the efficacy of AB 32's Cap-and-Trade program. We also wish to identify data needs, particularly ones that are not currently being met, in order to accomplish the analytic goals. This is truly a working symposium with a goal of producing a tangible research and analysis agenda.

Moderator

A moderator will facilitate each panel and will be responsible for keeping the discussion on topic and flowing in a timely manner. The primary purposes of the moderator are (1) to define and highlight the breadth of the issues in the session and (2) to focus the discussion on substance in terms of identifying data and analysis needs. The moderator will begin the panel by introducing the panel participants, framing the topic, and identifying the main issues that are relevant to the ensuing discussion. The moderator will also be responsible for introducing the presentations and how they are relevant within the scope of the panel. After the presentations, the moderator will also facilitate discussion among panelists and the audience for the remainder of the panel.

Presenters

Each presenter will prepare a 10-15 minute presentation on a topic of relevance and import within the scope of the panel. PowerPoint slides are encouraged. This should not simply be a report of the presenter's research but rather an offer of tangible proposals for conducting *ex post* analysis. Presenters are then encouraged to participate in the discussion following the presentations.

Rapporteur

The rapporteur is responsible for distilling the session (moderator's comments, the presentations, and ensuing discussion) into one PowerPoint slide. The rapporteur will then present the panel summary slide at the end of the symposium and participate in the discussion of how the symposium discussions can be translated into a work plan for the analysis of the Cap-and-Trade regulation.

June 26, 2017

Hon. Cristina Garcia
Assembly Member, 58th District
Room 2013, State Capitol
Sacramento, California 95814

Dear Assembly Member Garcia:

You recently asked our office to provide various analyses related to an oversupply of allowances in the state's cap-and-trade program. Specifically, in this letter, we:

- Estimate the range of the cumulative allowance oversupply in the cap-and-trade program through 2020.
- Assess the impact of allowing this oversupply to carry over into a post-2020 program on (1) future greenhouse gas (GHG) emissions and (2) near- and long-term allowance prices.
- Assess the impact of alternative approaches to addressing the oversupply of allowances and the connection between the current program and a post-2020 program.

Below, we provide some brief background on the ability to use allowances issued in earlier years to comply in later years (commonly referred to as "banking"), as well as discuss the oversupply issues identified above. As you are aware, these are complex issues, and there is substantial uncertainty about the future business-as-usual scenario, as well as impacts under different alternatives. Throughout our analysis, we describe some of the key areas of uncertainty, our assumptions, and/or potential limitations of our analysis. For example, our analysis of the oversupply of allowances focuses on California and does not include current (Quebec) or potential (Ontario) linked jurisdictions. Emissions and allowances in California make up the large majority (about 85 percent) of the current market, so our analysis likely provides a general sense of the magnitude of the oversupply and the basic issues and tradeoffs associated with different policy options. However, to the extent there is a significant imbalance between supply and demand for allowances in linked jurisdictions, it could have a significant effect on the analysis provided below.

LAO Bottom-Line. We estimate that the cumulative oversupply of allowances in California's cap-and-trade program through 2020 could range from 100 million to 300 million allowances, with it most likely being roughly in the middle of that range. Relative to a scenario where this oversupply is not available for compliance in a post-2020 program, the oversupply makes the post-2020 program less stringent, which potentially increases emissions and puts downward pressure on prices. The ultimate magnitude of this effect would largely depend on future emissions scenarios,

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which are subject to considerable uncertainty. In a scenario where there is otherwise a low demand for allowances, there would be a cumulative oversupply of allowances of about 150 million tons through 2030 and allowance prices could remain relatively low. In contrast, under a high demand scenario, the program would encourage a substantial number of GHG reductions from covered entities and allowance prices would likely be substantially higher than they are now. There are a variety of alternative program designs that could affect the oversupply—each of which has tradeoffs related to future emissions and near- and-long term prices.

Background

Current Program Allows Banking. The current cap-and-trade program allows banking. For example, a covered entity can use a 2016 vintage allowance to comply in 2020. Under certain conditions, banking does not change the *cumulative* level of emissions over the course of the entire period. However, it can change when emissions (and emission reductions) occur. Since the cap on emissions becomes more stringent in later years, banking gives firms an incentive to obtain extra allowances in early years as a way to protect against the risk of higher prices in later years when allowances are more scarce.

Relative to a program without it, banking has the effect of increasing allowance prices (and incentives for reductions) in early years, while reducing prices (and incentives for reductions) in later years. Some of the primary advantages of banking include (1) less short- and long-term price volatility and (2) incentivizing lower cost emission reduction activities in early years. However, one potential downside associated with banking is that it increases the risk that an *annual* emissions target in later years is not met because entities can comply in the later years by using banked allowances, rather than reducing emissions.

Cap-and-Trade and Emissions Certainty. Relative to other GHG reduction strategies, cap-and-trade can provide greater emissions certainty because the state controls the cumulative number of allowances issued. However, there are limitations to the amount of emissions certainty that the current cap-and-trade program provides—particularly as it relates to meeting an *annual* state emissions target, such as the 2030 GHG target established by SB 32. For example, as discussed above, allowing a significant amount of banking increases the risk that a future annual emissions target is not met. Furthermore, offsets that reduce emissions in other states can be used to comply with the cap-and-trade program, but these reductions are not currently counted in the *state* GHG inventory that is used to assess the state's progress toward meeting its GHG goals. Thus, while offsets might be a cost-effective way to reduce GHGs in other jurisdictions, they do not help keep GHG emissions from within the state below the limits established in law.

California Oversupply Likely 100 Million to 300 Million Metric Tons Through 2020

An *annual* oversupply occurs when the total number of allowances issued in a given year is greater than the number of allowances covered entities need to comply. This would result in allowances going unsold and/or being banked by private entities. There was an oversupply of allowances in the first three years of the program for which data is available (2013 through 2015) and there will very likely be an annual oversupply of allowances for the next few years of the program. In addition, since banking is allowed, there will very likely be a *cumulative* oversupply of allowances that builds up through the first several years of the program. Under various assumptions about factors that affect the demand for allowances (specifically, future annual emissions that would occur even in the absence of cap-and-trade and the number of offsets used), we estimate that the oversupply of allowances in California's cap-and-trade program through 2020 could range from 100 million to 300 million allowances, with it most likely being roughly in the middle of that range. This is roughly the same magnitude of oversupply projected from other researchers and market participants. Again, these estimates do not include the supply and demand for allowances from current (Quebec) or potential (Ontario) linked jurisdictions. Including these other jurisdictions could either increase or decrease the estimate of oversupply. In addition, this estimate does not include the roughly 121 million allowances that are available in the Allowance Price Containment Reserve. (Four percent of allowances are placed in the Allowance Price Containment Reserve and made available at predetermined prices—a strategy intended to moderate potential spikes in allowance prices.)

Allowing Use of Oversupply Post-2020 Reduces Prices and Increases Emissions

We assessed the impact of allowing this oversupply to be used for compliance in the post-2020 program. For the purpose of this analysis, we assume the state (1) allows banking from the current program to the post-2020 program and (2) makes no adjustment to the amount of allowances that are available to decrease the oversupply. Below, we discuss how such an approach could affect emissions and allowance prices given the magnitude of the oversupply and potential scenarios affecting the demand for those allowances. We then discuss how alternative design options that reduce the ability to bank allowances or affect the magnitude of the oversupply could affect emissions and prices.

Makes Post-2020 Program Less Stringent and Reduces Allowance Prices. Relative to a scenario where there is no oversupply carried into a post-2020 program (either by limiting banking or removing the oversupply from the market), allowing some or all of the oversupply carry forward effectively makes the program less stringent. This is because it would increase the total supply of allowances in the post-2020 period, and companies could emit more than the post-2020 caps established by the Air Resources Board (ARB). Therefore, a policy to allow the oversupply to carry over would allow more *cumulative* emissions over the post-2020 period. It also makes it less likely that the state would meet its 2030 *annual* emissions target.

This increase in allowance supply in a post-2020 program also would affect allowance prices both in the near and long term. Higher supply of allowances could lead to lower near- and long-term allowance prices. Since some models predict that allowance prices are likely to be either near the price floor or price ceiling, the oversupply could simply increase the likelihood of prices being at the floor and decrease the likelihood of prices being at the ceiling.

Magnitude of Effects Depends on Future Emissions Scenarios. While we would expect that making an additional supply of allowances available post-2020 generally would reduce program stringency and allowance prices, the magnitude of these effects would depend in large part on the demand for allowances, as described below. Consequently, we assessed the difference between supply and demand for allowances through 2030 under two different demand scenarios. (We assume the supply of allowances is the amount of allowances ARB currently plans to issue through 2030, including the pre-2020 oversupply discussed above, minus the allowances that are expected to be in the Allowance Price Containment Reserve [APCR].) The two scenarios are:

- ***Low Demand Scenario.*** In this scenario, we estimated the demand for allowances assuming that future emissions without the cap-and-trade program would decline significantly, in large part driven by various other GHG reductions policies, consistent with ARB's Scoping Plan emissions projections. We also assume that the percent of total statewide emissions from capped sources remains constant at 78 percent, and offsets are used to cover about 5 percent (250 million tons) of cumulative compliance obligations.

- ***High Demand Scenario.*** Under this scenario, we assumed future emissions without the cap-and-trade program remain flat through the entire period. The comparatively higher emissions could be driven by such things as higher-than-expected economic growth and/or other state GHG policies achieving less reductions than expected. We also assume offsets are used to cover only about 3 percent (176 million tons) of cumulative compliance.

While these scenarios reflect relatively low and high demand for allowances, it is possible that actual demand for allowances could be higher or lower.

Lower Demand Could Result in Cumulative Oversupply of Allowances Through 2030. Figures 1 (see page 6) shows the cumulative oversupply of allowances through 2030 under both scenarios. In the low demand scenario, there would be a cumulative oversupply of allowances of about 150 million tons through 2030. As shown in Figure 2 (see page 6), this means that the cap itself would not drive any reductions in emissions from covered entities. Instead, the GHG reductions from cap-and-trade would come from offsets (about 250 million tons) and whatever reductions are incentivized by the allowance floor price. In contrast, under a high demand scenario where business as usual emissions are high and offset supply is lower, the cap would be needed to encourage about 600 million tons of cumulative GHG reductions from covered entities, in addition to 176 million tons of reductions from offsets. Under this scenario, allowance prices would likely be substantially higher.

Alternative Approaches Have Tradeoffs

We assessed alternative program designs that could affect the oversupply and how those alternatives would affect emissions and prices. Since there are a number of potential alternatives, we have summarized them in Figure 3 (see page 7). Specifically, the figure describes some options that would reduce the degree to which an oversupply would be carried into a post-2020 program, as well as one option that has been discussed that would increase the magnitude of the oversupply that is carried forward. In general, these options fall into one of two categories: (1) strategies that affect the ability to bank allowances and (2) strategies that affect the amount of the oversupply. We also provide a general description of how each option could affect prices and emissions compared to a baseline case where banking is allowed and all of the oversupply is made available in the post-2020 period. These options likely would have different effects on near- and long-term prices and emission levels. While we describe the potential effects of each approach, the actual effects would depend on a variety of factors, including emissions and allowance prices that would occur without these changes, as well as certain programmatic design features. For example, the effects of each of these policies on prices and emissions might depend on whether market prices are at the floor or the ceiling, and whether there is a hard price ceiling.

If you have further questions, please contact Ross Brown at 319-8345 or Ross.Brown@lao.ca.gov.

Sincerely,

Anthony M. Simbol

for Mac Taylor
Legislative Analyst

Figure 1

Cumulative Allowance Oversupply Under Different Scenarios

In Millions of Allowances

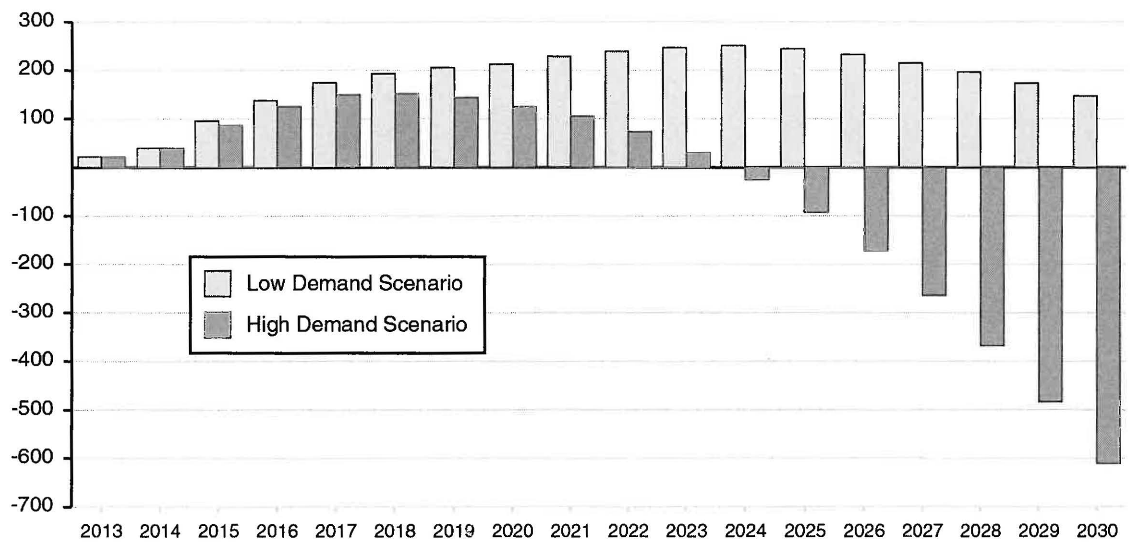

Figure 2

Cumulative GHG Reductions From Cap-and-Trade Through 2030 Under Different Scenarios

(In Million Metric Tons)

	Low Demand Scenario	High Demand Scenario
Reductions from covered entities driven by cap	—[a]	621
Offset reductions	250	176

[a] Since there is a cumulative oversupply of allowances, the cap itself is not driving emission reductions. However, there would be some emission reductions driven by a minimum allowance price.

GHG = greenhouse gas.

Figure 3

Potential Effects of Options to Address Oversupply

Baseline: Allowing Oversupply to Carryover Into Post-2020 Period at Regular Auctions (and No Adjustments to Future Caps)

Alternatives	Effect on Prices	Effect on Emissions
No banking	Lower near-term prices because current allowances cannot be used to comply when cap becomes more stringent.	Higher near-term emissions because lower allowance prices.
	Higher long-term prices because banked allowances not available in future years.	Lower emissions in later years because higher prices.
	Potentially increases price volatility.	
Limited banking (for example, banking allowed for five years)	Lower near-term prices because current allowances cannot be used to comply when cap more stringent in future years.	Higher emissions in near-term because lower prices.
	Higher long-term prices because fewer banked allowances will be available for compliance in later years.	Lower emissions in later years because higher prices.
	Effect on prices would likely be less severe than the "no banking" option.	Effect on emissions would likely be less severe than the "no banking" option.
	Potentially increases price volatility.	
Reduce the number of allowances available by retiring unsold allowances and/or reducing number of allowances issued in future years.	Higher near-term and long-term prices because overall supply of allowances is reduced.	Lower near-term and long-term emissions because prices are higher.
Make oversupply available only at specified prices ("speed bumps," for example)	Higher near-term and long-term prices if prices would otherwise be below speed bumps.	Lower near-term and long-term emissions if prices are higher.
	Effect on prices might be less severe than removing allowances from market entirely.	Effect on emissions might be less severe than removing allowances from market entirely.
	Potentially decreases price volatility.	
Make current APCR allowances available at lower prices (such as offering at regular auction or at "speed bumps")	Lower near-term and long-term prices if prices would otherwise be below the APCR prices.	Higher near-term and long-term emissions if prices are lower.
	Potentially decreases price volatility.	

APCR = Allowance Price Containment Reserve.

RESEARCH NOTE

California's climate emissions are falling, but cap-and-trade is not the cause

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New data show that California's greenhouse gas emissions covered by the state's cap-and-trade system declined sharply in 2016, falling 16.4 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) below 2015 levels—a drop of nearly 5%.

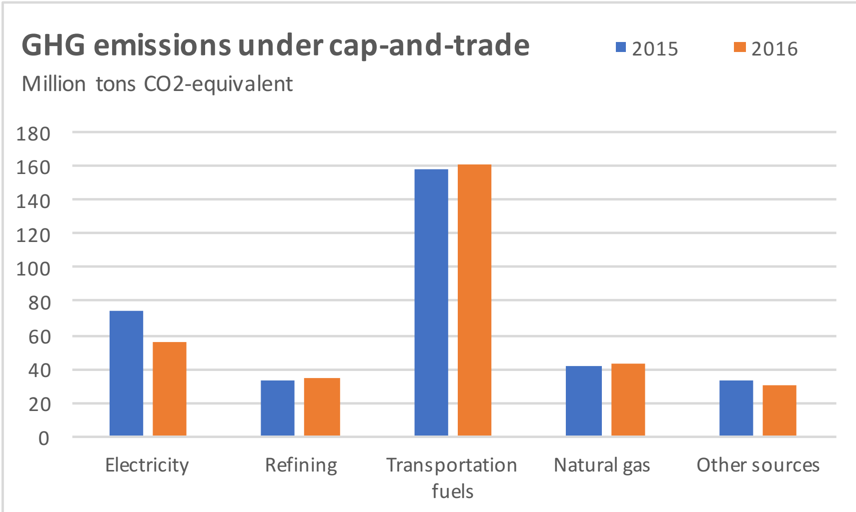
The new data are good news for state climate policy and suggest that California remains on track to meet or modestly exceed the state's 2020 climate target. However, key sectors—notably transportation fuel suppliers and refining—actually reported higher emissions in 2016, indicating potential challenges as the state prepares a strategy to deliver on its more ambitious 2030 target.

We conclude, based on available emissions and electricity data, that the state's cap-and-trade program is not driving observed reductions. The program may need further reforms if it is to make a significant contribution to reducing climate pollution in the coming years.

Progress in electricity, backsliding in fuels

Earlier this week the California Air Resources Board (ARB) released its 2016 Mandatory Reporting Regulation (MRR) data on greenhouse gas emissions under the state's cap-and-trade program. The progress reported in 2016 is almost entirely in the electricity sector, which saw a 17.4 $MMtCO_2e$ decline year-on-year. Oil and gas production emissions also fell 2.1 $MMtCO_2e$, likely reflecting lower market prices for these commodities (BP 2017).

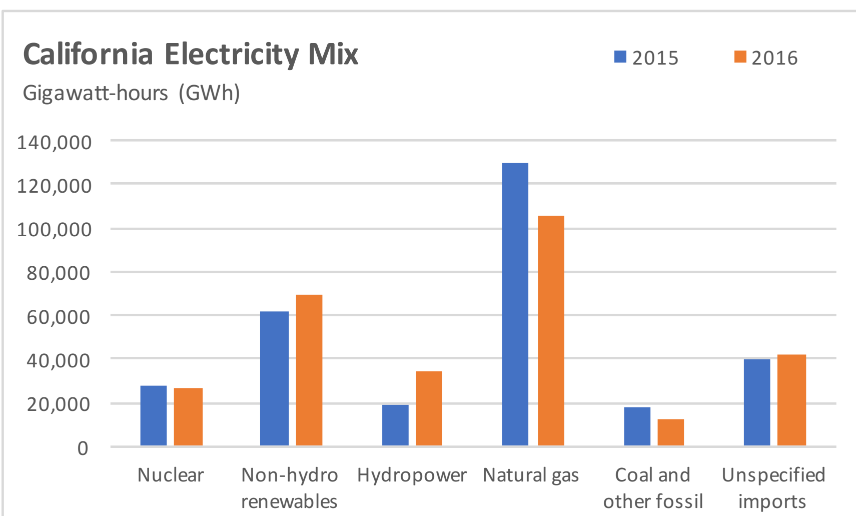
In contrast, transportation-related emissions rose significantly in 2016. Transportation fuel emissions—the largest category of emissions—increased by 1.8 $MMtCO_2e$ in 2016. Similarly, the refining sector reported an increase of 1.2 $MMtCO_2e$. The state needs to reverse these trends and achieve emissions cuts in transportation fuels and refining to reach its ambitious 2030 climate target.



SOURCE: ARB (2017a)

Hydropower and renewable electricity increased in 2016

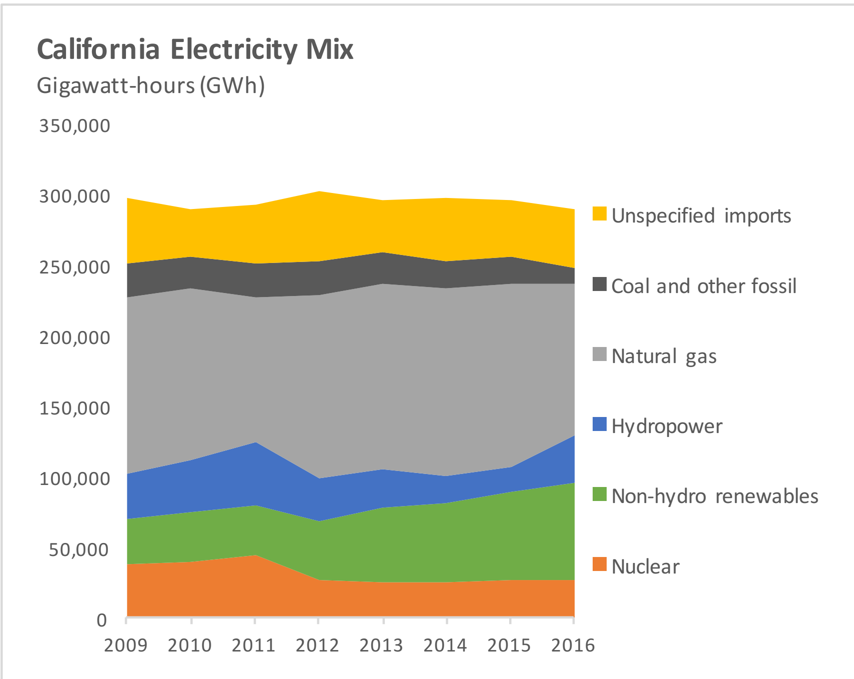
California's electricity sector continued to evolve in 2016. Low-carbon generation from both hydropower and non-hydro renewable energy increased significantly in 2016. In contrast, natural gas-fired electricity generation fell precipitously and imported coal power continued its steady decline.



SOURCE: CEC (2017)

Viewed over a slightly longer time period, the state's electricity sector has continued its transition away from fossil energy.

After the closure of the SONGS nuclear power plant in early 2012, the state experienced a significant decrease in zero-carbon energy and an increase in natural gas consumption. Since then, the share of low- and zero-carbon resources has steadily climbed, buffeted by the inter-annual variability of hydropower. In 2016, hydropower supplies increased significantly as California's record drought eased.



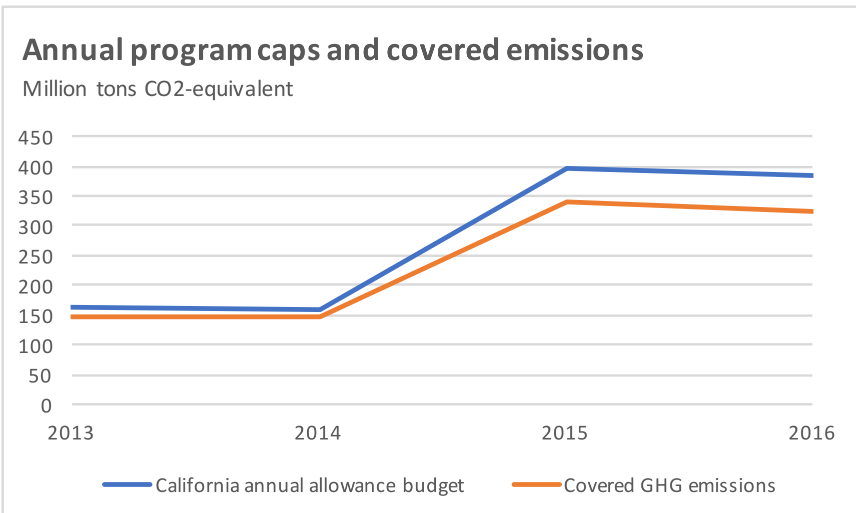
SOURCE: CEC (2017)

At the same time, total electricity generation used to meet California demand declined, likely due to a combination of energy efficiency policies and the growth of behind-the-meter distributed energy resources—most notably solar photovoltaics. Behind-the-meter resources are not explicitly tracked by the CEC and therefore contribute to the reduction in the CEC's generation data.

Cap-and-trade not likely to have driven observed reductions

The reductions in emissions reported under the cap-and-trade program in 2016 are most likely due to factors other than the cap-and-trade program itself. Three reasons explain this conclusion.

First, total emissions under the cap-and-trade program remain far below annual program limits, resulting in the continued buildup of unused allowances in the program (LAO 2017, Busch 2017). As a result, the cap itself is not binding and therefore any impacts from the program would be attributable instead to either (1) expectations about the future stringency of the program or (2) the impact of the market's carbon price on behavior.



SOURCE: ARB (2017a, 2017b)

Second, it is highly unlikely that firms made any financial decisions in 2016 on the basis of expected future program stringency because the post-2020 future of the program was in serious doubt (Coghlan & Cullenward 2016) prior to the July 2017 passage of AB 398. If anything, covered firms exhibited a risk-averse attitude with respect to the future of the program, as evidenced by a collapse in demand at quarterly auctions (Cullenward & Coghlan 2016). These factors make it highly unlikely that the changes in emissions observed in 2016 are attributable to expectation about the program's extension to significantly deeper targets in the post-2020 period.

Third, the impact of the market's explicit carbon price is likely limited because the reductions observed in MRR emissions largely occurred in sectors that are not responsive to California's modest carbon price. The biggest changes in the electricity sector occurred due to larger hydropower supplies, which depend on rainfall and water management, not carbon prices. Similarly, the growth in renewable energy is driven largely by non-pricing policies, such as procurement of utility-scale projects under the state Renewable Portfolio Standard and deployment of behind-the-meter resources that are eligible for the state's Net Energy Metering policy. Any reduced demand from energy efficiency policies is similarly unlikely to be affected by carbon pricing.

In contrast, carbon pricing might have played a role in encouraging additional divestment from imported coal resources. Carbon pricing might also have marginally decreased overall consumption of natural gas in the electricity sector. Because these prices are unlikely to significantly affect the supply of low-carbon non-fossil resources, however, the impact of carbon pricing on electricity sector emissions was likely limited in 2016.

Implications for state climate policy

Emission reductions observed in the 2016 MRR data are excellent news for California and are consistent with the state maintaining a trajectory to meet or modestly exceed its 2020 climate target.

Despite emission reductions in the electricity sector, however, both transportation fuels and refining emissions modestly increased in 2016. The state will need to reverse these trends as it pursues its substantially more ambitious 2030 climate target.

A close look at the data indicates that the cap-and-trade program itself is unlikely to be responsible for the reductions reported in 2016. The primary reason the cap-and-trade program has not played a large role in driving emission reductions to date is that emissions continue to fall below program caps, leading to a buildup of unused allowances in private-sector and ARB accounts that depresses current market prices and enables covered emitters to maintain their emissions farther into the future than post-2020 program caps might nominally suggest. Whether and to what extent ARB addresses the market oversupply problem in its AB 398 rulemaking process will have important implications for the market price and stringency of the overall program going forward.

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OVERSUPPLY GROWS IN THE WESTERN CLIMATE INITIATIVE CARBON MARKET

An adjustment for current oversupply is needed to ensure the program will achieve its 2030 target

December 2017

By Chris Busch

Contents

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Cover photo: Shell refinery, Martinez, CA. Photo credit: James Daisa.

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SUPPORTING DOCUMENTATION

A spreadsheet containing the calculations and details about the analysis is downloadable at:
http://energyinnovation.org/wp-content/uploads/2017/12/WCI_market_balance_evaluation.xlsx

PREFACE

This report was updated in February 2018, principally involving an updated source with respect to the market balance for Ontario.

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EXECUTIVE SUMMARY

2017 has been a landmark year for California's cap-and-trade program. In July, Assembly Bill 398 (AB 398) was passed and signed into law, solidifying legal authority for the state's cap-and-trade program through 2030. In September, California and Quebec, which have operated a linked cap-and-trade program since 2014, welcomed new partner Ontario, to the Western Climate Initiative (WCI)'s carbon market. In another milestone, cap-and-trade has emerged as the single largest policy in California's 2030 climate strategy. It is responsible for 38 percent or more of emission reductions in the California Air Resources Board's analysis of its 2017 Scoping Plan,[1] the strategy for achieving the 2030 target requiring emissions to be at least 40 percent below 1990 emissions.[2]

The increasing importance of cap-and-trade in California's policy portfolio increases the stakes for program design. The cap-and-trade program must be judged a success in the overall context of policies helping the state achieve its 2020 emission reduction target, and is reducing emission thanks to its price floor. The WCI cap-and-trade program is the best designed in the world. However, covered emissions have been consistently lower than the annual cap. Thus the cap-and-trade program is "oversupplied."

Oversupply has emerged due to a mix of economic, technological, and policy factors, which have driven emissions below cap levels. The electricity sector's strong decarbonization performance, spurred on by sector policies and renewable energy innovations, deserves much of the credit. Emissions also dropped sharply in 2009 due to the recession, after the initial program design was established but before the cap-and-trade program had begun operating.

This analysis estimates cumulative oversupply through 2020 for the combined WCI market at 270 million metric tons (MMT) with an uncertainty interval of 200-340 MMT. The emergence of oversupply does not reflect an initial design flaw, but it should be addressed sooner than later. Allowances never expire, so excess allowances can be purchased and saved for later use, a practice known as banking. Unaddressed, oversupply and expected banking is large enough to allow for significantly more emissions than intended under the 2017 Scoping Plan, cutting into planned cumulative emissions and possibly leaving 2030 emissions above the SB 32 target. The same implications hold for the WCI. The accumulation of an expected bank of allowances would substantially cut into reductions that would otherwise be expected to accrue under the cap.

[1] This report uses the abbreviated term, "2017 Scoping Plan," for the document with the full title: 2017 Climate Change Scoping Plan: The Strategy for Achieving California's 2030 Greenhouse Gas Target. https://www.arb.ca.gov/cc/scopingplan/revised2017spu.pdf
We work from the most current version available at the time of release, dated October 27, 2017.

[2] SB 32 bill text at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32

Methodology

The analysis calculates annual balances in the market as the supply of compliance instruments (allowances and offsets) minus compliance demand, with the cumulative balance through any given year as the sum of annual balances. Because Ontario has not released necessary facility-level emission data, the analysis integrates a separate, independent estimate of the market balance for that province.[3]

Emissions are the driver of demand. In the absence of emissions, there is no compliance obligation, allowances would have no value, and there would be no demand. Hence emissions are a reasonable proxy for demand, even though a complex web of causality underlies it. Historical data exist through 2016. In the mid-scenario forecast, the historical emission trend is projected forward at a 1.9 percent reduction per annum over 2017-2020. The high demand scenario models emissions staying constant at the 2016 level. The low demand scenario models emissions falling at four percent annually.

The supply of allowances is known and tracked through compliance instrument reports. Offsets are a secondary compliance option, which can represent up to eight percent of compliance through 2020. Offsets are emission reduction credits from sectors not covered under the cap or from other geographic areas. Historical data on offset use exist for 2013-2014, the first compliance period, when offset use was just over four percent. Forecasting is required for other years. The analysis forecasts offset use as covering five percent of emissions and conducts sensitivity analysis on the offsets variable.

The supply of allowances takes into account a new rule regarding the treatment of allowances that went unsold at auction due to the price floor. Our analysis estimates that about 40 of 118 MMT of unsold allowances will be diverted to the Allowance Price Containment Reserve (APCR) as a result. APCR allowances are excluded from the estimation of oversupply through 2020, though they may become a factor after 2020.

Results

Figure ES-1 shows the year-by-year trends and the division between historical data and forecasts. Emission levels, representing compliance demand, are colored green, with the solid line indicating empirical data and the dotted line representing the mid-scenario forecast, which is the only one shown for simplicity. The blue line shows supply. The difference between the two, the annual balance in the market, is highlighted with a gold bar.

[3] Sawyer, Dave, Jotham Peters, Seton Stiebert. "Overview of Macroeconomic and Household Impacts of Ontario's Cap and Trade Program," EnviroEconomics and NaviusResearch. May 2016.

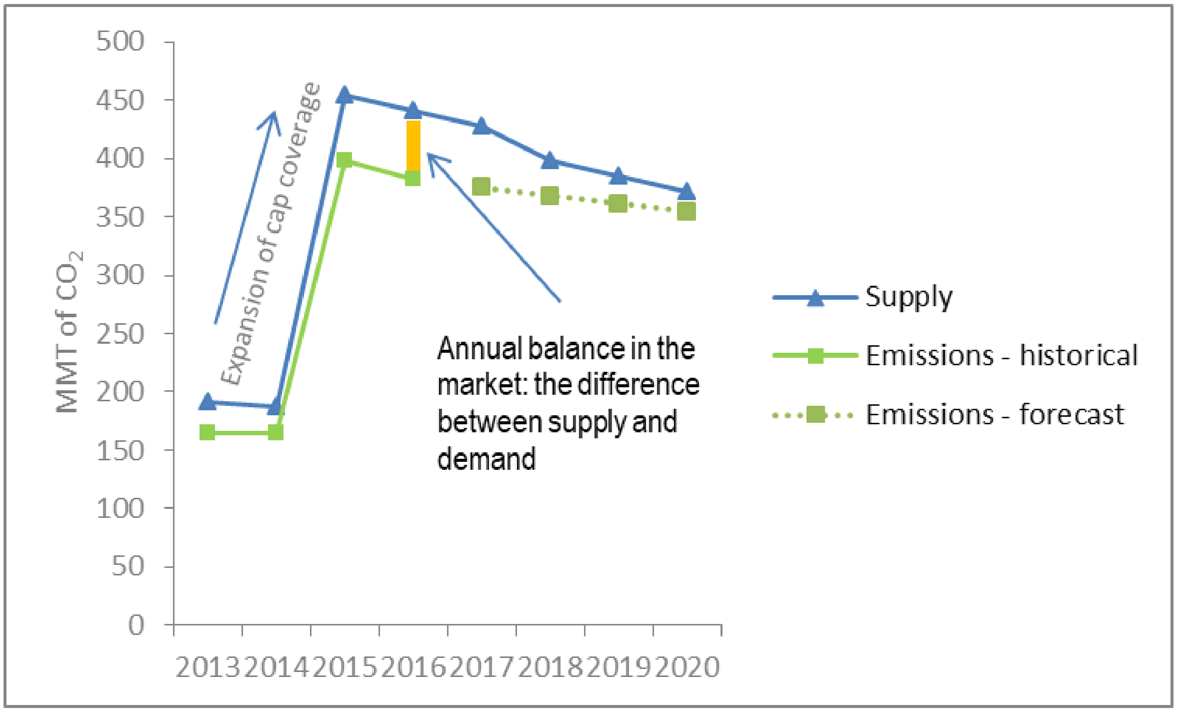

Figure ES-1. Market balance for California and Quebec suggest oversupply continues until 2020.

The next graph tracks the annual balance how it affects the cumulative balance through 2020.

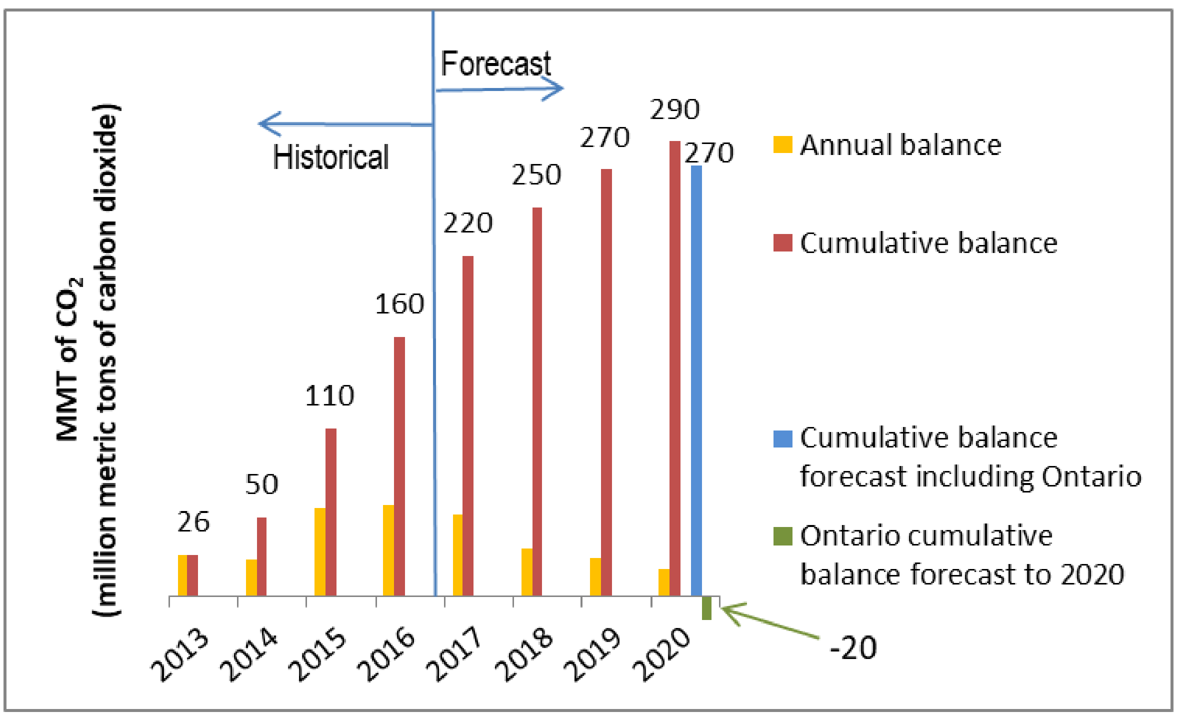

Figure ES-2. Annual oversupply appears to have peaked in 2016 but cumulative oversupply still climbing. Integrating Ontario does not change the basic outlines.

Figure ES-2 shows the annual balance using the same gold bar as Figure ES-1. Recently released data show that oversupply reached a new maximum in 2016, which supports the conclusion that WCI oversupply has grown. This analysis suggests the extent of oversupply will decline in coming years, though emissions are not likely to fall below cap levels until 2020 or later. The cumulative market balance for California-Quebec is shown in red, and climbs to 290 MMT in 2020. An estimate of the cumulative balance through 2020 in the Ontario market, negative 20 MMT, is shown in green.[4] The blue bar provides an integrated estimate of 270 MMT in oversupply for the WCI, which ranges from 200-340 MMT in the high and low emission sensitivities.

Implications

Because unused allowances, the tradable emissions permits at the core of the program, can be saved and used later, this oversupply will very likely be banked. Banked allowances enable higher emissions than would otherwise occur by effectively raising future cap levels above those established by regulation. The California Air Resources Board's (CARB) analysis expects reductions from cap-and-trade over 2021-2030 to be in the range of 236-305 MMT. The problem is that CARB's analysis does not account for the likelihood of banked allowances held over from before 2021. Given the magnitude of oversupply, if ignored, the impact of banked allowances would certainly result in significantly fewer cumulative emission reductions from 2021-2030, and creates the potential for California to end up above the 2030 statewide emission limit. These implications hold even if prices stay near the price floor.

In a fully linked market, allowances are fungible. The forecasted bank of allowances could be used in any WCI jurisdiction and it makes the most sense to consider the implication within that context. The estimate effect is measured against the intended decline in WCI cap levels over time. The forecasted bank accumulated through 2020 at the mid-scenario level of oversupply would effectively raise WCI caps 35 percent over 2021-2030 and could effectively negate WCI cap reductions until 2025 or 2026.

Recommendations

To account for oversupply, California and the WCI should adjust caps for 2021-2030 downward in an amount equal to the sum of 2020 and earlier vintage allowances that remain privately held after emitters have finished submitting allowances for compliance through the end of 2020.

This straightforward adjustment to program design can resolve the issue. Because it involves adjusting future caps downward to account for the amount of allowances banked, this approach does not harm private holdings of allowances and it does not involve a change in banking rules. It does not encourage greater volatility and it only increases the incentive for early action. In

[4] Sawyer, Dave, Jotham Peters, and Seton Stiebert. "Overview of Macroeconomic and Household Impacts of Ontario's Cap and Trade Program," EnviroEconomics and NaviusResearch. May 2016.

2014, this modification to program design was successfully used by the Regional Greenhouse Gas Initiative, a cap-and-trade program in Eastern U.S. states, to address oversupply.

CARB and the WCI should also adopt a specific schedule for program review. These regular reviews – we suggest at the end of each compliance period – should evaluate cap-and-trade program performance. The October draft of the 2017 Scoping Plan increases the emphasis on periodic reviews but is short on specifics, beyond noting the five-year Scoping Plan cycle.

Some might protest that reducing allowance supply would increase carbon prices. While a higher carbon price indicates higher compliance costs for emitters, it does not necessarily equate to higher social costs. Higher carbon prices offer two important benefits almost invariably left out of economic analyses: (1) greater public health benefits, including reduced health care costs, better student performance, and higher worker productivity, and (2) greater competitiveness for domestic clean technology companies, which are then more likely to capture a larger share of the fast growing international market for clean tech.

In addition, California's initial experience points to the positive coexistence of declining carbon emissions and robust economic growth. And despite the cost bias inherent in economic modeling, some studies indicate meeting the 2030 target will have overall economic benefits.[5] Nonetheless, since the 2030 target is much more aggressive than the 2020 target, it is appropriate for policy design to acknowledge uncertainty. AB 398 is helpful in this regard, requiring the establishment of a hard price ceiling, guaranteeing carbon prices will rise no higher than that ceiling. This should provide policymakers the confidence to correct for early oversupply.

Conclusion

While early oversupply itself does not represent a mistake, it would be a mistake not to adjust for it. For California, cap-and-trade is playing an increasingly important role in the state's climate strategy to achieve the emission reductions in statute. The program is well suited to providing the firm cap needed to successfully hit the target, but if early oversupply rolls forward unaddressed, emissions will be significantly higher than intended caps. There is no guarantee that the price floor will deliver the intended emissions reductions. California and the WCI should course correct, lowering future caps to account for early oversupply.

[5] For an example, see David Roland-Holst. 2015. *California Climate Policy to 2050: Pathways for Sustained Prosperity.* Next 10 report. Table ES-3 shows carbon pricing plus a strong vehicle electrification push to hit the 2030 target increases both Gross State Product and employment by two percent above the business-as-usual scenario.

INTRODUCTION

2017 has been a landmark year for California's cap-and-trade program, including new statutory authority and partners. Assembly Bill 398 (AB 398) was passed and signed into law in July, solidifying the legal and policy framework for the state's cap-and-trade program through 2030.

In another major step, California and the Canadian Province of Quebec, which have operated a linked cap-and-trade program since 2014, welcomed a new partner, Ontario. On September 22nd, 2017, the three jurisdictions signed a new linkage agreement establishing a common carbon market among the three jurisdictions.

In a third milestone, cap-and-trade has emerged as the single largest policy in California's 2030 strategy. It is responsible for 38 percent or more of emission reductions in the California Air Resources Board's analysis of its 2017 Scoping Plan,[6] the strategy for achieving the Senate Bill 32 target for 2030 requiring emissions to be at least 40 percent below 1990 emissions.[7]

The new importance of cap-and-trade in California's policy portfolio increases the stakes for program design. While the cap-and-trade program must be judged a success in the context of the package of policies helping the state achieve its 2020 emission reduction target, and the return to strong auction sales is a positive result, the issue of oversupply threatens to depress its future effectiveness. Oversupply is defined as occurring when the supply of compliance instruments exceeds demand for them.

The WCI cap-and-trade program is the best designed in the world, not least because its price floor is the highest. Oversupply has emerged due to a mix of economic, technological, and policy factors, which have driven emissions below cap levels. The electricity sector's strong decarbonization performance, spurred on by sector policies and renewable energy innovations, deserves much of the credit. Emissions also dropped sharply in 2009 due to the recession, after initial program design was established and before the cap-and-trade program had begun operating. While cap-and-trade is reducing emissions thanks to the price floor, most emissions reductions are due to other factors.

Left unchecked, oversupply threatens to significantly erode the reductions from cap-and-trade predicted in the analysis underlying California's 2017 Scoping Plan. Fortunately, a straightforward adjustment to program design, tested and proven effective by the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade program in nine Eastern U.S. states, can resolve the issue. Essentially, this involves adjusting future caps downward to account for the amount of

[6] This report uses the abbreviated term, "2017 Scoping Plan," for the document with the full title: 2017 Climate Change Scoping Plan: The Strategy for Achieving California's 2030 Greenhouse Gas Target. https://www.arb.ca.gov/cc/scopingplan/revised2017spu.pdf

We work from the most current version available at the time of release, dated October 27, 2017.

[7] SB 32 bill text at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32

allowances banked. This recommendation does not negatively affect private holdings of allowances, while eliminating he risk that banked allowances could significantly knock the state off the course as it drives toward the aggressive SB 32 target for 2030, which requires emissions to be 40 percent below 1990 emissions.[8]

AB 398 CONTEXT AND NEXT STEPS

For a period of about 18 months, until May of 2017, the California-Quebec program's auctions were buffeted by erratic demand. For example, the February 2017 auction sold less than 20 percent of allowances made available, meaning there was not enough demand at the auction floor price. Low demand had occurred because of questions around legal authority as well as oversupply. On the topic of oversupply, AB 398 directs regulators to: "Evaluate and address concerns related to over-allocation in the state board's determination of the number of available allowances for years 2021 to 2030, inclusive, as appropriate."[9]

The adoption of AB 398 by a two-thirds supermajority resolved legal uncertainties surrounding the program. Even earlier, an April decision in California's Supreme Court declared that auctioning allowances was legal, and not the illegal tax petitioners had claimed. Together, these developments have firmed up confidence in the program's longevity.

As a result, the August auction returned a record settlement price of $14.75 per ton, which was surpassed by a new record auction price in November of $15.06 per ton. The November auction began the reintroduction of previously unsold allowances to supply. Regulation calls for unsold allowances to be returned to the market through auctions over time after the settlement price exceeds the floor at two consecutive auctions.

AB 398 gives CARB discretion over many program aspects, while requiring some specific changes, for example establishment of a true price ceiling. The cap-and-trade program currently relies on a supply of allowances (the Allowance Price Containment Reserve, or APCR) that would be sold if prices reached pre-determined thresholds. In theory, the APCR could be depleted, allowing prices to rise higher than desired.   However, AB 398 directs CARB to make available an unlimited number of permits at the ceiling price if demand at auction reaches that level, ensuring the price ceiling will never be exceeded. Revenue from sales of allowances created at the price ceiling will go to procure additional emission reductions, in an effort to neutralize the additional emissions enabled by the creation of allowances above the original intended cap level. At least two-thirds of allowances in the APCR will be put into analogous new reserve accounts to be made available at prices, to be determined by CARB, below the price ceiling.

[8] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32

[9] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398

METHODOLOGY

Oversupply is defined as a situation in which demand, represented by emission levels, is below the supply of compliance instruments. The methodology can be summarized as an equation:

Oversupply = Supply of compliance instruments – Demand

Emissions stand as a proxy for demand. While a variety of underlying factors ultimately determine demand, emissions are the main causal driver. Emissions create the need to acquire allowances. Put differently, without emissions, there would be no demand for allowances, and allowances would have no value.

The supply of compliance instruments includes both allowances and offsets. Offsets are emission reduction credits from sectors not covered under the cap or from other geographic areas. While most demand must be covered with allowances, offsets are an alternative compliance option. For the purpose of evaluating market status, offset use reduces the demand for allowances, so it makes sense to include offsets as an element of supply.

Oversupply can occur in a single year and it is also building over time. As well, it is necessary that the opposite of oversupply, shortage is also expected to emerge. So, a more neutral terminology, market balance, is appropriate. Define the annual balance as the sum of compliance instruments in the market (allowances distributed and offsets used) less compliance demand. The cumulative balance through a given year adds the annual balances up to and including that year.

The mathematical definition can be extended to differentiate annual and cumulative balance as follows:

Annual balance = Supply of compliance instruments in a given year – Demand in that year

Cumulative balance = sum of annual balances

In addition to the more detailed discussion below, the appendix walks through each component of the analysis in detail, providing an annotated discussion of underlying calculations. The spreadsheet itself is publicly available and provides sources for underlying data.

The analysis directly calculates the market balance in California and Quebec, but was unable to integrate Ontario into the framework because it has not released the necessary facility level emission data we use to evaluate the demand side of the market. Such data is currently only provided for: "Facilities in the electricity generation sector, manufacturing sectors and large institutional energy users are captured by the reporting regulation."[10] Ontario's cap-and-trade regulation also covers fuel distributors and natural gas distributors, as do the programs in California and Quebec.

[10] Greenhouse Gas Reporting by Facility, https://www.ontario.ca/data/greenhouse-gas-emissions-reporting-facility

Other analysts have estimated that Ontario's cap-and-trade program will be 18.7 million metric tons (MMT) short (undersupplied) through 2020.[11] These results are integrated into the analysis. The integration of Ontario does not fundamentally change the results and narrative that emerges from the analysis with California and Quebec data.

Quick methods summary

Demand

> Main scenario forecasts using past trend, i.e. emission reductions at, 1.9 percent per annum

> Uncertainty range: 0 – 4 percent annual reductions

High demand = emissions plateau; emissions remain steady at 2016 level through 2020

About 2 percent per annum higher than the historical rate

Low demand = emission under the cap decline at 4 percent annually

About 2 percent per annum lower than the historical rate

Supply

> Allowances as listed on compliance instrument report

> APCR allowances are not expected to be released before 2020, and hence are excluded from oversupply through 2020 estimation. APRC allowances could be a factor after 2020

> Offset use assumed at 5 percent 2015-2020 and at empirical level (~4 percent) 2013-2014

> Takes into account allowances sent to APCR due to new treatment of allowances unsold after 24 months

Ontario

> Ontario is integrated indirectly. Insufficient data exist for direct inclusion.

[11] Sawyer, Dave, Jotham Peters, and Seton Stiebert. "Overview of Macroeconomic and Household Impacts of Ontario's Cap and Trade Program," EnviroEconomics and NaviusResearch. May 2016.

Analysis from the advisory firm Clear Blue Markets suggests that Ontario will do less to help absorb oversupply. Their evaluation of the Ontario market indicates it will be less than one MMT short (0.7) cumulatively through 2020: "Without taking offsets into account, ClearBlue now expects the Ontario market to be short by 21.9 mt for the first compliance period (2017-2020), down from their previous forecast of 23.5 mt. However, as offsets begin to be issued in Ontario and as entities start using imported credits following the markets' linkage, this overall shortage is expected to be reduced to just 0.7 mt amid 21.2 million surrendered offsets by Ontario emitters."

Sophie Yeo. 29 November 2017. "Declining Emissions Forecast Points to an Even Longer Market in 2017," *Carbon Pulse*.

DEMAND

Emissions drive demand as allowances have no value without a compliance obligation. A range of future forecasts are used to capture uncertainty about future emission trends. 2016 emissions data was released in November 2017, but four years of future emissions must be forecasted to estimate oversupply through 2020.

We use a simple extrapolation of the past trends as the basis for future emission forecasts. Our main scenario uses the historical trend (1.9 percent annual reductions) to forecast future emissions. In 2014 and 2015, emissions dropped about one percent, then in 2016 emissions dropped four percent. This was driven by a decline of five percent in California, where electricity sector reductions led the way.[12]

Given substantial uncertainties about future emissions, the analysis tests a wide range of future emission scenarios, adding or subtracting roughly two percent to the trend assumed in the main scenario. So, the high demand scenario investigates the implications of flat emissions levels at the 2016 level over 2017-2020. The low demand scenario considers emission reductions of four percent per year.

SUPPLY

The supply of allowances is fixed and known according to regulation. It takes some work to interpret the compliance instrument reports, but these lists in precise detail the status of all allowances created.[13] These reports show all allowances that have already been retired; those held by private entities (emitters and speculative purchasers), and those still slated for distribution. For reasons explained below, allowances in the ACPR are excluded from this analysis.

Offsets are less straightforward. Any given emitter can cover up to eight percent of emissions with offsets through 2020. However, less than maximum allowable amount is being used. The amount used is known for the first compliance period, 2013-2014, when only about half of the maximum use occurred, a fraction over four percent.[14] The next compliance period ends this year (2015-2017), but emitters have until November 1, 2018 to complete their submissions. Hence, some forward-looking scenario analysis is required for the years 2016-2020.

[12] Danny Cullenward, Mason Inman, and Michael Mastrandrea. 2017. *California's climate emissions are falling but cap-and-trade is not the cause.* http://www.nearzero.org/wp/2017/11/10/californias-climate-emissions-are-falling-but-cap-and-trade-is-not-the-cause/

[13] The latest compliance instrument report is also posted at: https://www.arb.ca.gov/cc/capandtrade/complianceinstrumentreport.xlsx

[14] In the first compliance period (2013-2014), 95.6 percent of California's covered emissions were covered through allowances and 4.4 percent from offsets, with a boost in offsets evident in the first filing of the second compliance period. An even smaller fraction of Quebec's emissions were covered through offsets. 2013-2014 compliance instrument report available at: https://www.arb.ca.gov/cc/capandtrade/2013-2014compliancereport.xlsx

The central assumption assumes five percent offset use on average going forward, and sensitivity analysis explores other levels. Ultimately, sensitivity analysis shows that different assumptions around future emission levels matter more than offset use. The five percent assumption is intended to reflect somewhat increasing use in practice, which would be expected as the market tightens, and this level comports with expectations of carbon traders. To reflect the uncertainty around offset use, we provide oversupply estimates for different levels of use at four, six, and eight percent.

While full second period compliance will not be completed until November 1, 2018 with public release of the date after that, we do have partial information. Emitters must submit compliance instruments to account for 30 percent of their annual emissions. The 2015 compliance report shows offset use of 7.9 percent, but traders closer to market participants and daily transactions expect that this will not be representative of overall offsets usage for the second compliance period (2015-2017). At the same time, reasons exist to expect increasing offsets usage along with higher prices, due to recent auction results, strong legal certainty through 2030, and the aggressive reduction targets called for under SB 32. Higher allowance prices increase the attractiveness of offsets. Finally, new products removing buyer risk have been introduced.[15]

ACCOUNTING FOR NEW TREATMENT OF UNSOLD ALLOWANCES

This section explains the approach to estimating how new treatment of allowances that have gone unsold at the price floor would be expected to affect allowance supply. CARB has adopted a rule that will send some unsold allowances to the ACPR. While the Canadian provinces may follow suit, we do not know so with certainty, and implement this only for the California allowances that went unsold.

The price floor held back 118 MMT in current vintage California state-owned allowances (or, "ARB allowances"), a term used to differentiate allowances distributed by the state through auctions from allowances consigned on behalf of utilities.[16] If allowances consigned on behalf of utilities are unsold, these are eligible for reintroduction immediately at the next auction. However, ARB allowances are only reintroduced at auction after two consecutive auctions have cleared (sold all available allowances) at a settlement price above the price floor (technically called the auction reserve price).[17] The same is true for allowances created under Quebec's

[15] Under California's system, buyers assume the risk of invalidation. But new products offer insurance that does away with the risk for a small price premium over other offsets. For more reading: http://www.ecosystemmarketplace.com/articles/invalidation-risk-still-shadows-california-offsets-market/

[16] For more information, see: CARB. "Guidance for Allowance Consignment to Auction." https://www.arb.ca.gov/cc/capandtrade/auction/consignment_guidance.pdf

[17] For more information, see: CARB. "Guidance on Treatment of Unsold Allowances Following an Undersubscribed Auction." https://www.arb.ca.gov/cc/capandtrade/guidance/guidance_unsold_allowances.pdf

regulation.[18] In both California and Quebec, previously unsold allowances recommence roll back into auctions at a rate of 25 percent of the originally intended auction amount for both California and Quebec.[19]

AB 398 enshrines in law changes to the treatment of unsold ARB allowances in California that had been developed in the most recent Cap and Trade amendment rulemaking, sending these to the APCR if they have gone unsold for more than 24 months.[20] This rule is expected to be implemented retroactively starting in January 2018, meaning that the clock for the amount of time an allowance has gone unsold will date back to the original date it was unsold.[21]

Our updated analysis integrates the expected impact of this new treatment of unsold allowances and includes an assumption that auction clearing prices will remain above the floor through at least 2020. The numerical results show that, if the forecast that fully subscribed auctions continue to be the norm, then approximately 42 MMT from regular auction supply would be diverted to the APCR. This should be thought of as a lower bound of the impact. If auction

[18] Quebec's implementing regulation states: "Emission units of the vintage of the current or a previous year that remain unsold after an auction may be put up for sale as soon as the final sale price of the emission units has been above the minimum price for 2 auctions. Emission units of the vintage of a year subsequent to the year of the auction are put up for sale again when their vintage becomes the vintage of the current year. However, the quantity of emission units put up for sale again in accordance with the first paragraph cannot exceed 25% of the quantity of emission units initially planned for the auction." O.C. 1297-2011, s. 54; O.C. 1184-2012, s. 34; O.C. 902-2014, s. 35.

http://legisquebec.gouv.qc.ca/en/ShowDoc/cr/Q-2,%20r.%2046.1

While this leaves some question as to whether the number will be 25 percent or less, CARB's asserts that the value will be 25 percent.

"The Québec cap-and-trade regulation uses the same 25 percent limit on the return of unsold Québec provincial-owned allowances. Under the Québec regulation, Québec would be able to re-designate 2,500,000 allowances (25 percent of the 10 million allowances indicated in Table 1) that remained unsold from prior auctions." See page 4 of CARB's "Guidance on Treatment of Unsold Allowances Following an Undersubscribed Auction." https://www.arb.ca.gov/cc/capandtrade/guidance/guidance_unsold_allowances.pdf

[19] In the case of California, the 25 percent is calculated in relation to the sum of both ARB and consigned allowances.

[20] "Requires that current vintage allowances designated by the state board for auction that remain unsold in the auction holding account for more than 24 months to be transferred to the allowance price containment reserve." https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398

[21] Based on personal communication with Jason Gray, Chief of the Climate Change Program Evaluation Branch at CARB. This aligns with the timing CARB had previously stated, as at p. 17 of the Initial statement of Reason https://www.arb.ca.gov/regact/2016/capandtrade16/isor.pdf): "Staff is proposing amendments to the Regulation to include a method for transferring State-owned (not consigned) allowances that remain unsold at auction for a significant period of time to the Reserve with the amendments taking effect by January 1, 2018. The proposed method would specify that allowances that remain unsold for more than 24 months would be transferred to the Reserve. The proposed amendment can also be viewed as requiring the completion of eight auctions before the transfer could be effected. This means that beginning in 2018, any previously unsold allowances owned by the State that have been in ARB's Auction Holding Account for 24 months would be transferred to the APCR."

demand falters unexpectedly before then, it is possible that a greater number of allowances would end up being sent to the reserve.

Figure 1 shows the buildup in unsold allowances to the current total of 118 MMT starting with the Q1 2016 auction and the forecasted future rate of re-introduction to the market at auction and diversion to the APCR.

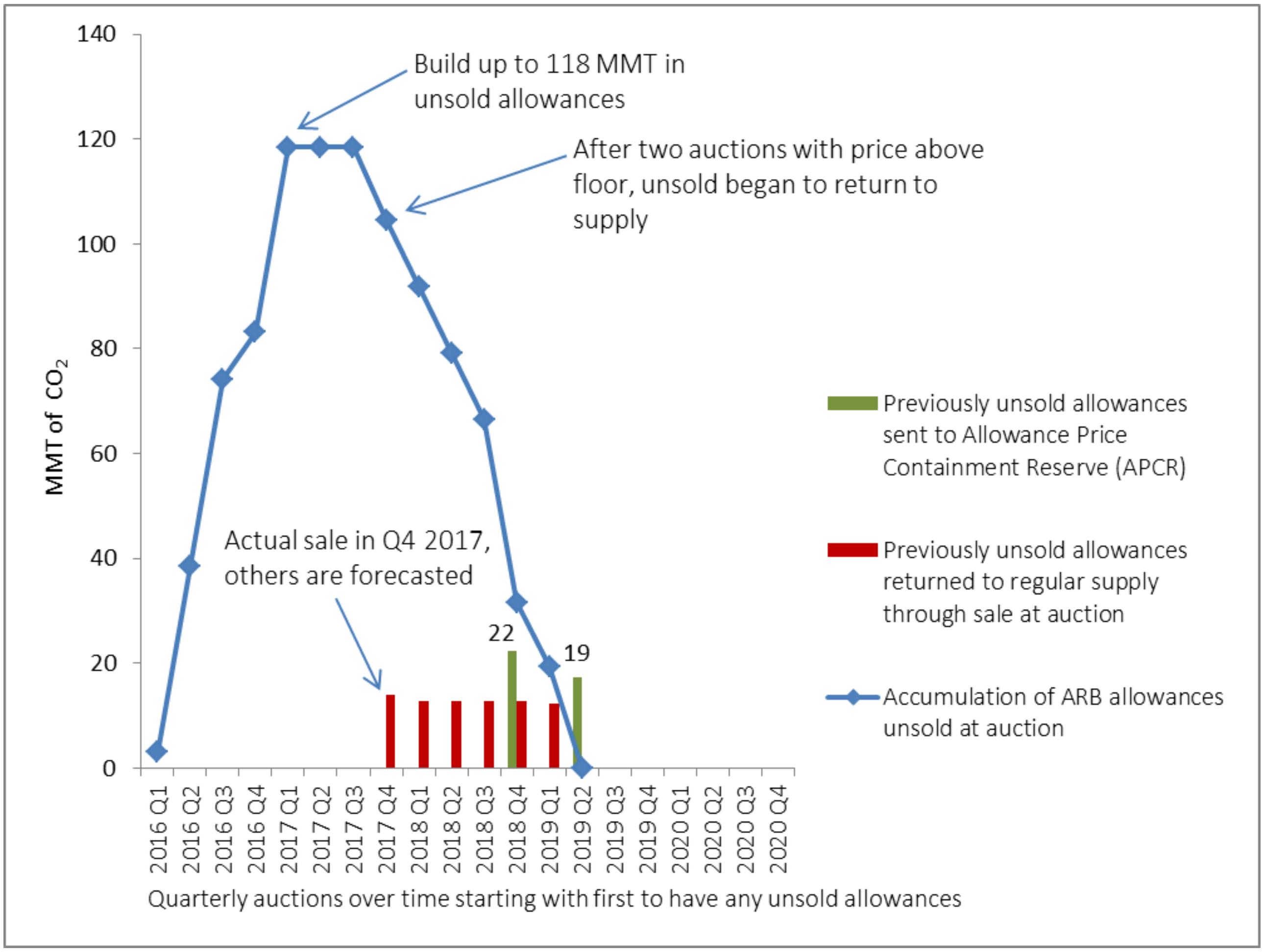

Figure 1. Accumulation and forecasted future disposition of currently unsold allowances

One nuance related to the effect of new rules on the future fate of unsold allowances that accumulated before the recent surge in demand involves CARB's announced plans to retire some allowances due to estimated emission leakage from the Energy Imbalance Market (EIM), which enables inter-state trading of electricity. While the EIM allows more efficient integration of high shares of renewable electricity, CARB's greenhouse gas accounting has not yet caught up to this mechanism. At a July California Senate hearing, CARB Deputy Executive Officer Steve Cliff said that CARB plans to retire approximately 15 MMT in allowances to account for potential leakage due to the EIM, and these may end up being taken from unsold allowances that would otherwise be destined for the APCR.

TREATMENT OF ALLOWANCE PRICE CONTAINMENT RESERVE

The APCR holds a 141 MMT supply of California and Quebec allowances taken from initial cap levels through 2020 before implementation began. As well, Ontario's regulation calls for five percent of each year's cap to their reserve equivalent to the APCR. These allowances are not factored into the estimation of oversupply through 2020 due to price expectations. The historical trend and research about future prices, discussed next, suggest that emissions and prices will not be high enough to trigger the release of allowances from the APCR. Essentially, while carbon prices are no longer at the floor price, they are still relatively low. And even though they are rising (reaching $15.06 at the fourth quarterly auction of 2017) there are no signs of pressure on carbon prices that point to prices rising to the level at which the allowances in the APCR would be accessed.

This price increase would have to be very large, due to substantial distance between the price floor and the prices needed to release APCR allowances. The APCR is structured with three tiers, each holding one-third of the total, and each with its own trigger price at which the allowances contained are to be released. In 2017, the price triggering the first tier of allowances was $50.69 per allowance, $57.04 per allowance for the second tier, and $63.37 in the third tier. These compare to a current price floor of auction reserve price of $13.57 per ton. The price floor and APCR tiers all increase at an annual rate of five percent plus inflation.

It is true that if emissions are high enough, covered emitters could be pushed far enough up the marginal abatement cost curve that prices would reach APCR trigger prices. However, almost by definition, this would only occur in the absence of significant oversupply, at least if due to emissions fundamentals.

While it is unlikely APCR allowances will be released before 2020, their introduction is more likely after 2020, once cap levels decline far enough. Therefore, discussions of the implications of oversupply through 2020 for post-2020 emission reduction efforts consider APCR allowances separately but in parallel with oversupply.

FUTURE PRICE EXPECTATIONS

The analysis does not generate original estimates of future prices, but draws on existing work in the literature. Future price expectations affect the propensity to bank allowances. The potential for APCR allowances to be released in the future is also linked to future prices.

Prices through 2020

Work by Borenstein et al. (2016) forecasts price expectations through 2020 using top-down, sector level data and macro drivers like state economic output and vehicle miles travelled. Their work finds a 1.4 percent chance that any APCR allowances will be released before 2021 and only a 0.1 percent chance that all APCR allowances are released. [22]

Prior work, dating to 2009 and the collaborative modeling exercise organized by CARB, had forecasted prices of approximately $20 per ton. CARB's own modeling had estimated a 2020 price of $21 per ton and UC Berkeley's David Roland-Holst had pegged the 2020 price at $18 per ton.[23] Industry-funded work by Charles Rivers Associates was an outliner, predicting 2020 prices in the $50-80 per ton range.[24]

While prices have increased with passage of AB 398, they remain relatively moderate. The recent peak high secondary market price ($15.54 per current vintage allowance on the spot market on September 6, 2017) represents a premium of about 15 percent above the floor price, and the price has fallen by about 20-30 cents from that recent maximum.

Prices were relatively higher in the early years of the California program. In July of 2012, secondary market prices surpassed $20 per ton (e.g. $20.10 on July 24, 2012) when the price floor was $10 per allowance.[25] More recently, auction prices have been lower relative to the floor. The August auction price of $14.75 for current vintage allowances was nine percent above the $13.54 floor price, and the November price was 11 percent above the floor. May 2013 auction settlement price of $14.00 per allowance was 31 percent higher than the 2013 floor price of $10.71.[26]

Figure 2 shows price trends over time at auction and in the secondary market as well as the price floor and lowest APCR price, which both increase annually at five percent plus the consumer price index.[27]

[22] See table 7, page 37 in: Severin Borenstein, James Bushnell, Frank A. Wolak, and Matthew Zaragoza-Watkins. 2016. Expecting the Unexpected: Emissions Uncertainty and Environmental Market Design, Energy Institute at Haas Working Paper 274 (August). https://ei.haas.berkeley.edu/research/papers/WP274.pdf

[23] ARB presentation of results: https://www.arb.ca.gov/cc/scopingplan/economics-sp/meetings/042110/arb.pdf Roland-Holst results: https://www.arb.ca.gov/cc/scopingplan/economics-sp/meetings/042110/rolandholst.pdf

[24] Charles River Associates results:

https://www.arb.ca.gov/cc/scopingplan/economics-sp/meetings/042110/bernstein.pdf

[25] Historical secondary market price data from California Carbon Dashboard (http://calcarbondash.org/). The website is no longer updated, but historical InterContinental Exchange data through 2016 are available for download: http://calcarbondash.org/csv/output.csv.

[26] CARB. Auction Results Summary. https://www.arb.ca.gov/cc/capandtrade/auction/results_summary.pdf

[27] The APCR is currently separate in three tranches, each with a different price.

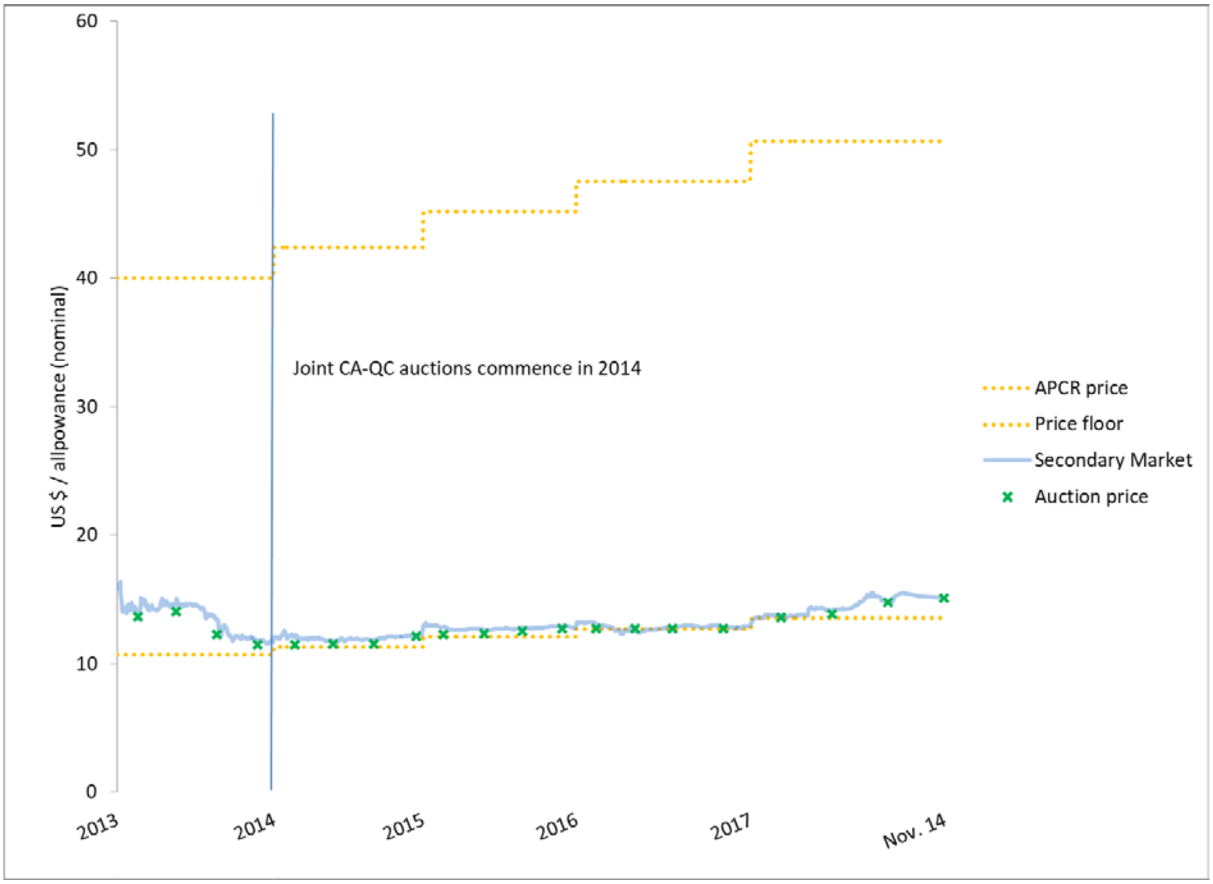

Figure 2. Auction and secondary market prices for current vintage allowances.
(Sources: California Carbon Dashboard, Intercontinental Exchange)[28]

Figure 2 shows that despite the increase after adoption of AB 398, prices are still close to the price floor.

Post-2020 price expectations

In sum, evidence suggests that long term carbon prices will be manageable but also high enough to encourage early purchasing as long as prices remain close to the floor.

Borenstein et al. estimate a 2030 price of $53.31 per ton in current dollars.[29] That is the central estimate (the probability weighted expected price) from their study, which produces a probability distribution for prices using econometric forecasting techniques. Their study

[28] These data are the prompt month or over the counter price for current vintage allowances. Each year's vintage has a slightly different price. Data are all directly or indirectly from the Intercontinental Exchange (ICE). Most of the historical secondary market price data from California Carbon Dashboard (http://calcarbondash.org/).

[29] Their central estimate is $51.62 in 2015 dollars, which we update to current dollars.

Severin Borenstein, James Bushnell, and Frank Wolak. 2017. "California's Cap-and-Trade Market Through 2030: A Preliminary Supply/Demand Analysis." (July) Energy Institute Working Paper 281 implicitly assumes that oversupply remains accessible as part of regular supply. Lowering future caps to account for oversupply would increase their price estimates. One factor biasing their costs upward is the lack of a production side response. No supply side adjustments are allowed, meaning producers neither switch to more energy efficient equipment, nor invest in lower carbon energy.

Work by David Roland-Holst also provides insights. In a 2015 paper, he conducted a policy 2030 policy. His work estimates a 2030 California carbon allowance price of $28 in current dollars for the scenario most resembling the 2017 Scoping Plan and finds positive over macroeconomic effects.[30] Professor Roland-Holst also conducted evaluations of the original Scoping Plan, and his forecasting proved more accurate than industry funded work by Charles River Associates.[31]

Proprietary analysis by National Economic and Research Associates, with the same model that Charles River Associates had used previously, has also circulated, showing much higher costs than the other studies discussed in the section.[32]

CARB's recent analysis has not involved forecasting allowance prices. Their economic modeling for the 2030 Scoping Plan explores the impacts of prices at the price floor and APCR price in 2030, taking these as given.

UPDATED OVERSUPPLY RESULTS

With methodology explained, we present results. Table 1 gives results for the mid scenario, as well as key sensitivities around future demand.

Estimated oversupply through 2020	Mid scenario (trend emissions)	Range due to high emissions and low emissions scenarios

[30] See figure ES-6 in the Roland-Holst paper for projected allowance prices. Relevant pathway is the "progressive scenario." Exact numerical values not provided, and so an approximation by visual inspection is discussed. $25 per to in $2010 amounts to $28 in current dollars. Roland-Holst's table ES-3 shows carbon pricing plus a strong vehicle electrification push to hit the 2030 target increases both Gross State Product and employment by two percent above the business-as-usual scenario.

David Roland-Holst. 2015. California Climate Policy to 2050: Pathways for Sustained Prosperity. Next 10 report (April 28) http://next10.org/sites/next10.org/files/FINAL%20Climate%20Pathways%202015.pdf

[31] As evident in presentations delivered to CARB on economic modeling of the Scoping Plan https://www.arb.ca.gov/cc/scopingplan/economics-sp/meetings/042110/outline.pdf
Roland-Holst presentation: https://www.arb.ca.gov/cc/scopingplan/economics-sp/meetings/042110/rolandholst.pdf
Charles River Associates presentation https://www.arb.ca.gov/cc/scopingplan/economics-sp/meetings/042110/bernstein.pdf

[32] The author has reviewed these results. Without explicit permission, I am not at liberty to discuss results in any details.

California and Quebec	290 MMT	220 – 360 MMT
Adding Ontario, i.e. WCI inclusive	270 MMT	200 – 340 MMT

Table 1. Updated cumulative oversupply estimate, 2016-2020

Table 1 and results in general are rounded to two significant digits so as to avoid the impression of extreme precision. These findings indicate significant oversupply and adding Ontario does not fundamentally alter the oversupply dynamic. Figure 3, below, lays the foundation for the graphical illustration of market balance by mapping supply and emission curves.

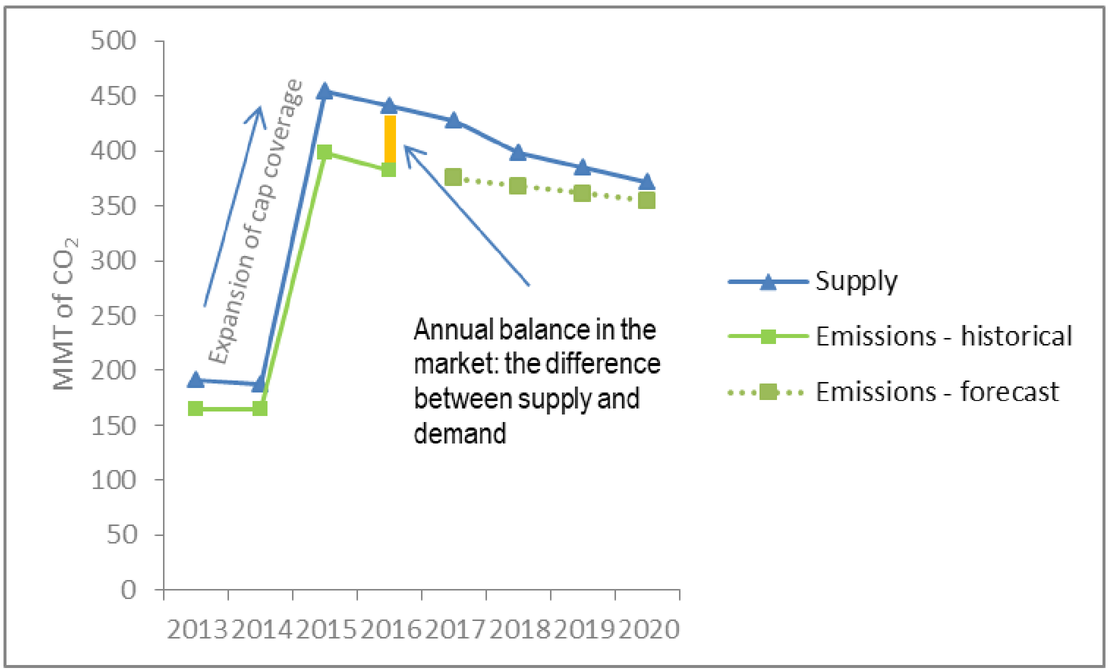

Figure 3. Market balance under trend demand forecast shows oversupply resolving in 2020.

Emission levels, representing compliance demand, are shown in green in Figure 3, with the solid line indicating historical (empirical) data and the dotted line representing the trend emission forecast, the mid-scenario for demand, which is the only one shown for simplicity. The high emission, high demand scenario would hold emissions steady at the 2016 level and in the low emissions scenario it would drop to 325 MMT in 2020. The blue line shows supply. Allowances attributed to each year reflect the actual cap levels from the total in the compliance instrument report, adjusting using the same accounting approach described above, for example removing allowances in the APCR.[33] The difference between the two, the annual balance in the market, is

[33] Allowances for the voluntary renewable energy set-aside are also removed from supply. Offsets use as explained in methodology section, actual submissions for 2013-2014 (about four percent) and five percent use for 2016-2020.

highlighted with the gold bar. With these supply and demand elements, we can track the annual and cumulative balance, shown in the next graph.

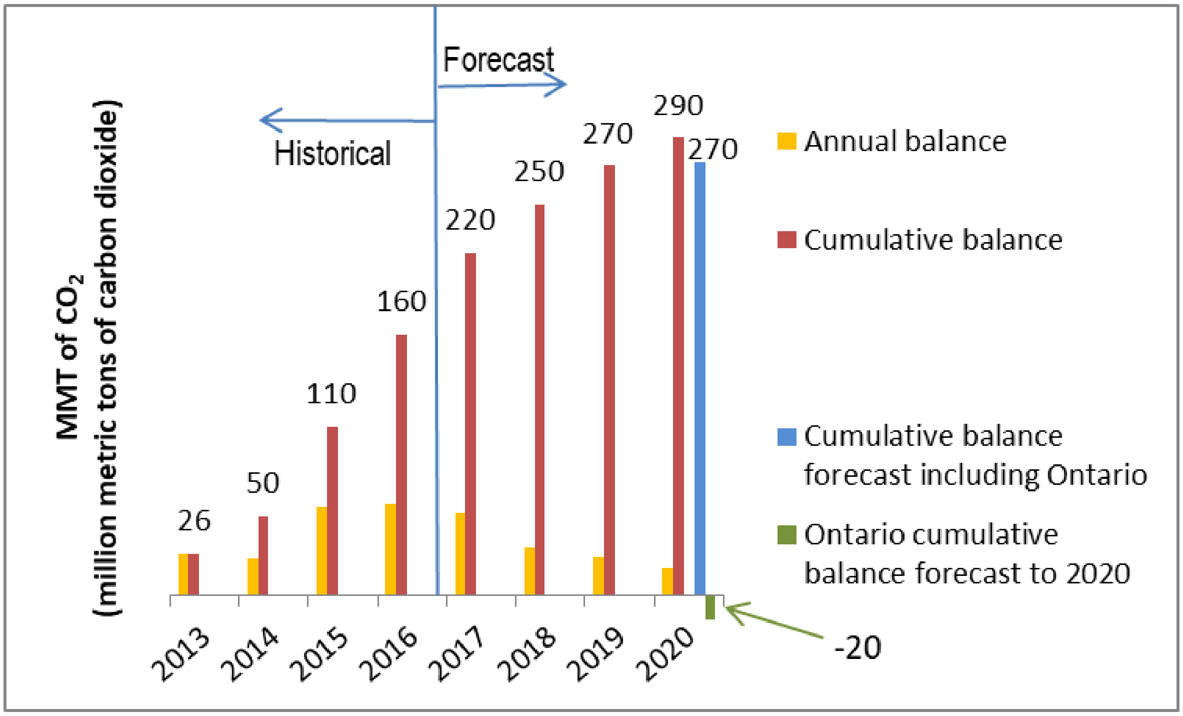

Figure 4. Annual oversupply appears to have peaked in 2016 but cumulative oversupply still climbing. Integrating Ontario does not change the basic outlines.

Figure 4 tracks the annual (gold bar, the same as in Figure 3) and cumulative market balance (red) over time. Under the mid-scenario for demand, annual oversupply peaks in 2016 at 58 MMT, falling to 52 MMT in 2017 and 17 MMT in 2020. An estimate of the cumulative balance in the Ontario market, negative 20 MMT, is shown in green.[34] The blue bar provides an integrated estimate for the WCI, pointing to 270 in oversupply cumulatively through 2020.

OFFSET SENSITIVITY ANALYSES

This section explores how different levels of offset use for the forecasted years (2016-2020) would affect cumulative oversupply through 2020.

[34] A market shortage for Ontario of 18.7 MMT was estimated by Sawyer, Dave, Jotham Peters, Seton Stiebert. "Overview of Macroeconomic and Household Impacts of Ontario's Cap and Trade Program," EnviroEconomics and NaviusResearch. May 2016.

	Cumulative oversupply through 2020 under mid-scenario emissions (MMT)	Cumulative oversupply range consider high – low emissions bounding scenarios (MMT)
Main case at 5% offsets use	270	200 – 340
Offset use sensitivities		
4%	250	180 – 320
6%	290	230 – 360
8%	340	270 – 410

Table 2. How different levels of offset use affect cumulative oversupply

Though future emissions are the most important determinant of overall market balance, Table 2 demonstrates that offsets play a nontrivial role. The range of oversupply across the range of emission scenarios considered amount to 140 MMT compared to 70 MMT across the offset sensitivities.

POTENTIAL USE OF ALLOWANCES IN APCR AFTER 2020

Rules around the use of allowances from the APCR are in flux as part of the re-consideration of cost containment required under AB 398, which provides new guidance around the setting of the price ceiling and two "price containment points" at which APCR allowances would be released.[35] Excluding APCR allowances from the oversupply calculation introduces conservatism to these estimates in the sense of not overestimating the impact of oversupply. While APCR allowances are held separate, depending on their price and the future price of allowances, they may be a factor in future market balance. Thus, a graph exploring future implications does portray APCR allowances.

The post-2020 supply of APCR allowances is estimated at 313 MMT based on the following:

- The APCR currently holds 141.8 MMT in California and Quebec allowances, taken from cap levels through 2020 as part of original design.
- Additionally, CARB will add 52.4 MMT in allowances to the APCR taken from cap levels over 2021-2030. In CARB's October 2017 workshop, staff asked for guidance on whether these should be made available at the price ceiling or the lower price containment points.

[35] AB 398 directs CARB to: "Establish two price containment points at levels below the price ceiling. The state board shall offer to covered entities nontradable allowances for sale at these price containment points. The price containment points shall be established using two-thirds, divided equally, of the allowances in the allowance price containment reserve as of December 31, 2017."

- Ontario has chosen to dedicate five percent of allowances from each cap for its cost containment mechanism which operates like the APCR. These add to 79 MMT over 2017-2030.[36]
- We understand the Canadian provinces are revising regulations to align with California's design, and so Quebec might well choose to add allowances to the APCR from caps over 2021-2030. Since we are not aware of any specific, confirmed plans in this regard, we do not assume any particular diversion of Quebec allowances to the APCR after 2020.
- A last element is the expected diversion of approximately 40 MMT in currently unsold California allowances to the APCR due to new rules discussed above.

THE RELATIONSHIP BETWEEN OVERSUPPLY AND BANKING

Before considering implications, it is necessary to touch on the foundational topic of how oversupply and banking interrelate. Banking is defined as the carrying forward of allowances from one year to the next by private entities. It is impossible to automatically draw a direct line between the amount of oversupply and the amount of expected banked allowances. However, in the case of the California-Ontario-Quebec market, it does seem reasonable all oversupply will be transformed into banked allowances for two main reasons. First, allowances do not expire, and hence can be purchased at lower prices for use later when prices are higher. Second, the aggressiveness of the post-2030 target and the emission reductions it will require are likely to cause future prices to rise. Therefore, our expectation is that all available allowances, even those above near-term compliance demand, will be purchased for future use.

Holding limits bound the amount of banking that any particular entity may undertake.[37] However, holding limits serve as a guard against the concentration of market power, which might allow market manipulation. Holding limits will not preclude the full banking of oversupply.

The 2017 holding limit was 12.6 MMT and the limit decreases to 11.6 MMT in 2020.[38] The holding limit is applied at the level of corporate association. Unlike the facility level data in mandatory reporting, these data are not public. Even if only 100 corporate associations are covered under the program, this would imply the potential for holding of up to 1,160 MMT in allowances – much larger than the maximum potential oversupply level. Furthermore, no limit on the number of third party actors (i.e. risk capital, hedging services) exists in the market. Therefore, holding limits would not preclude the full banking of oversupply available through 2020. CARB staff acknowledge this implicitly in explaining the purpose of holding limits in a

[36] O. Reg. 450/17, s. 28 at https://www.ontario.ca/laws/regulation/160144#BK76

[37] Emily Wimberger. 2016. "The Holding Limit for the California-Quebec Cap-and-Trade Programs," California Air Resources Board. (https://www.arb.ca.gov/cc/capandtrade/holding_limit.pdf)

[38] Ibid.

recent presentation: "Holding limits help ensure entities cannot create artificial allowance scarcity and price spikes via banking."[39]

The experience of the European Union Emission Trading System (EU ETS) shows that prices can remain robustly above the price floor (implicitly zero in their program) when strong confidence exists in long-term system demands even despite significant oversupply. By 2013, more than 2 billion tons of allowances had been banked in the EU system, but prices remained significantly above zero, in the range of €3-5 per ton and have recently climbed to about €7 per ton.[40]

LIKELIHOOD OF BANKED ALLOWANCE USE BY 2030

It is possible that some of the banked allowances available after 2020 could be carried over beyond 2030. One clear factor would push compliance entities to use banked allowances before 2030: the pathway that California has laid out is steepest during 2021-2030, twice as steep as during 2031-2050. This is true for both the aggregate statewide target and the reductions demanded under cap and-trade. Under cap-and-trade, the number of allowances falls by 13.3 MMT over 2021-2030, and thereafter caps are scheduled to fall by 6.7 MMT annually.[41] This reflects California's aggressive push to get halfway to its 2050 goal in one-third the time. In other words, half of the reductions planned for 2020-2050 are targeted for the first 10 years of the 30-year period, as Figure 4 illustrates.[42]

[39] CARB staff presentation. Cap-and-Trade Regulation Workshop. October 12, 2017. https://www.arb.ca.gov/cc/capandtrade/meetings/20171012/ct_presentation_11oct2017.pdf

[40] For a visual representation of the accumulation of banked allowances in the EU, see: Environmental Europe. 2014. *EU Stakeholders Divided Over Reforming EU ETS.* (June 26)

[41] These data are drawn from the newly adopted regulation, section § 95841. Annual Allowance Budgets for Calendar Years 2013-2050. See page 108 of the California regulation: https://www.arb.ca.gov/cc/capandtrade/capandtrade/unofficial_ct_100217.pdf

[42] Data for Figure 4 draw from source in footnote 41. 52.4 MMT that will be sent to the APCR are include in the cap levels shown in Figure 4.

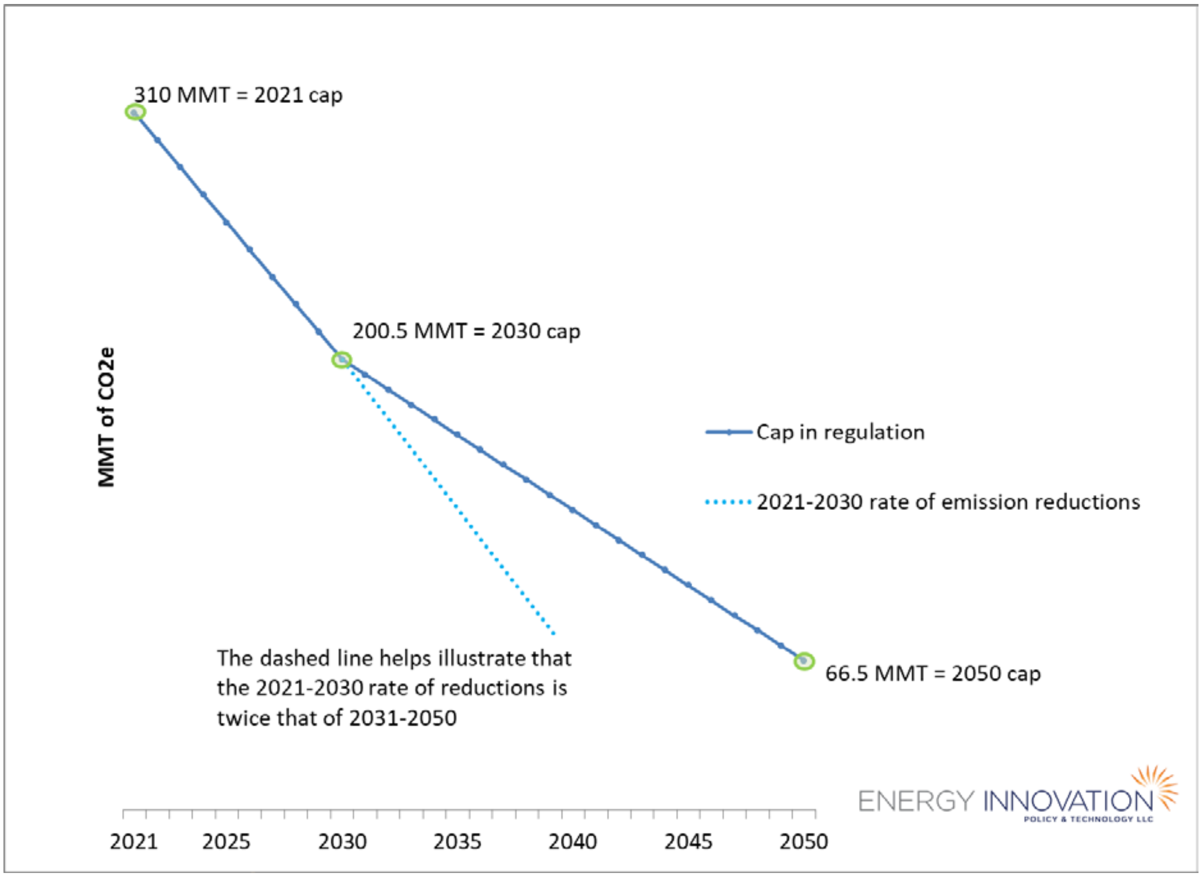

Figure 5. Faster reductions 2021-2030 compared to post-2030 trajectory

Figure 5 illustrates the steepness of the emission reductions called for in the 2020s compared to the next two decades. The line in the graph shows the cap levels under the cap-and-trade program, as distinguished from the statewide emission targets, such as SB 32's 40% below 1990 levels. CARB set the 2030 cap level of 200.5 MMT with the intention of hitting the 2030 target, identified as 260 MMT, which is pictured in Figure 5.

WHY OVERSUPPLY IS A PROBLEM IF LEFT UNADDRESSED

Current oversupply is a problem because, if left unaddressed, it will significantly depress the level of emissions reductions achieved by the WCI's cap-and-trade program after 2020. For California, which is relying upon cap-and-trade as the linchpin of efforts to achieve the emission reductions required under SB 32, oversupply risks the success of its 2030 strategy.

CALIFORNIA POLICY IMPLICATIONS

California is on track to achieve its 2020 target. The rate of emission improvement in the most recent mandatory emission data was greater than the level that will be needed in 2020s, when caps decline by 13.3 MMT annually. California emissions under the cap fell by more than 16 MMT in 2016 compared to 2015. These annual reductions exceed the pace that will be required to accomplish the aggressive 2030 target.

While a balanced assessment must recognize these positive trends, the threat posed by oversupply remains and deserves attention sooner than later. Indeed, faster than expected emission reductions, mostly due to factors other than cap-and-trade as discussed further in the section entitled, "Fortuitous over-compliance," increases the likelihood that oversupply will be large enough to dampen cap-and-trade's long term effectiveness.

The section "Fortuitous over-compliance" explores causal drivers of emission reductions under the cap-and-trade program. For the purposes of evaluating the policy strategy, the important point is that there are limits to how much longer these reductions will continue to accrue. Emissions associated with imported electricity fell to 20 MMT in 2016 compared to 30 MMT in 2017. It would only be possible for these reductions to continue at this level for two years. Put differently, reductions at this pace are unlikely to be sustainable by the current policy framework over the long term.

Looking forward, California is counting on cap-and-trade as the lynchpin of its 2030 strategy. The 2017 Climate Change Scoping Plan lays out the plan for achieving the SB 32-mandated 2030 target of 40 percent below 1990 emission levels[43] and presents analysis identifying cap-and-trade as the single largest driver of emissions. In the Initial Scoping Plan, cap-and-trade was expected to drive 20 percent of all emission reductions in 2020.[44] Cap-and-trade is expected to drive 236 MMT in reductions over 2021-2030, an estimated 38 percent of overall cumulative reductions below the latest business-as-usual scenario, taking the 2020 package of policies as given, as shown in Figure 6.[45]

[43] This document uses the abbreviated term, 2017 Scoping Plan, for the document with the full title: 2017 Climate Change Scoping Plan: The Strategy for Achieving California's 2030 Greenhouse Gas Target. https://www.arb.ca.gov/cc/scopingplan/revised2017spu.pdf
We work from the most current version available at the time of release, dated October 27, 2017.

[44] See Table 3, page 22: https://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf

[45] We work from the most recent version available at the time of publication of this report, which was released October 27, 2017. https://www.arb.ca.gov/cc/scopingplan/revised2017spu.pdf

Figure II-2. Scoping Plan Scenario – Estimated Cumulative GHG Reductions by Measure (2021–2030)[64]

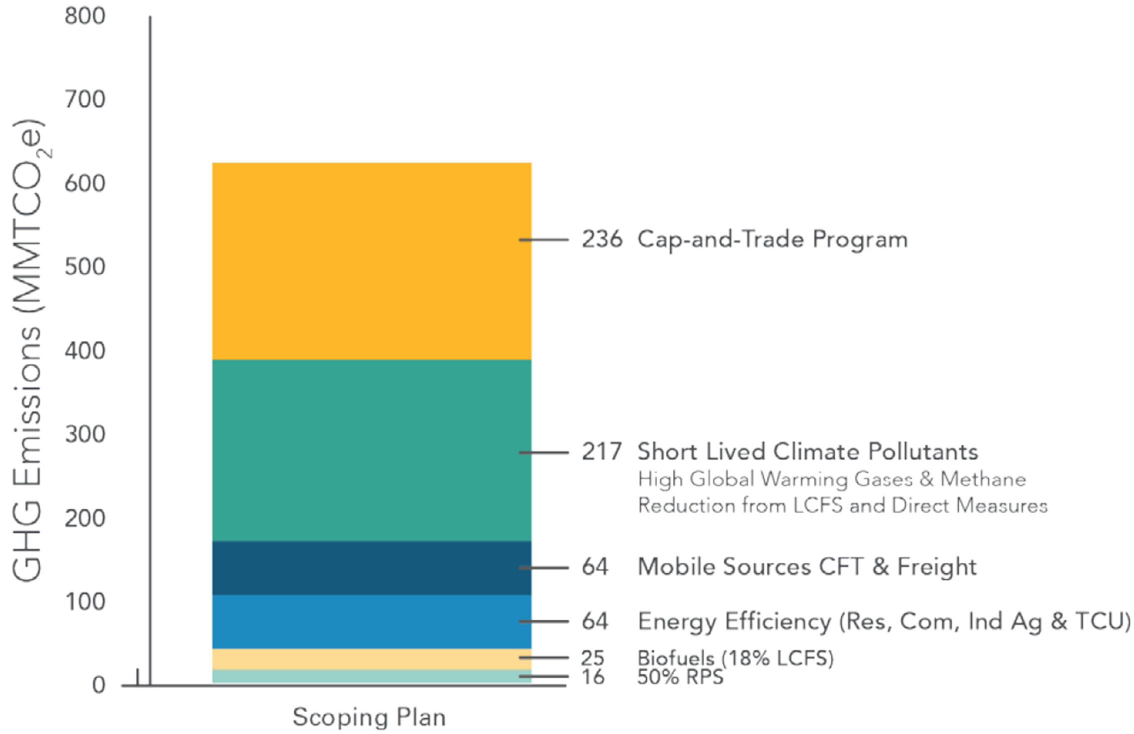

Figure 6. CARB's analysis of expected emission reductions by policy (or strategy) 2021-2030
(Source: CARB 2017 Scoping Plan, Figure II-2)

Figure 6 shows that cap-and-trade is the largest expected contributor to cumulative emissions reductions. Of course, many uncertainties exist in such a long run modeling exercise, and the Scoping Plan development process has given increasing attention to this. Previously, only uncertainty due to "sector policies" was discussed.[46] In CARB's estimation after factoring in uncertainty, the estimated reductions over 2021-2030 from sector policies (all those other than cap-and-trade) amount to 335 MMT (+/- 50 MMT), while cap-and-trade and trade drives 305 MMT in reductions (+/- 120 MMT). The details of CARB's uncertainty analysis were released after this report was largely completed and so it was not possible to include an in-depth consideration. However, it is clear that the Scoping Plan did not consider uncertainty due to the likelihood that banked allowances to spill forward after 2020.[47]

[46] The Initial Scoping Plan referred to policies other than cap-and-trade as "complementary" policies. The current draft 2017 Scoping Plan refers to these as prescriptive policies or known commitments.

[47] See list of factors contributing to uncertainty in the 2017 Scoping Plan, page 42.

CARB has generally promoted cap-and-trade over carbon taxes because cap-and-trade is meant to ensure quantitative certainty about emissions levels. This is still evident in some of the Scoping Plan language. For example, in the Proposed Scoping Plan under the policy assessment criteria evaluated in Table II-4, the "Ability to Reduce GHGs to Meet the 2030 Target" is put forth as an advantage of the cap-and-trade provides, stating: "The Cap-and-Trade Program scales to ensure reductions are achieved, even if other policies do not achieve them. This is particularly critical given the uncertainty inherent in both CARB's emission forecast and its estimate of future regulations."[48]

A new phrase added to the October draft of the Scoping Plan states: "As noted in the November 7, 2016, 2030 Target Scoping Plan Workshop, 'All policies have a degree of uncertainty associated with them,'" citing a presentation by Professor Jim Bushnell. Yet, the staff presentation from that day stated that the cap-and-trade program "is needed to achieve 2030 GHG target," because it is "uncertain if Alternative 2 [the carbon tax option] will meet 2030 GHG target."[49]

The new reference regarding uncertainty around cap-and-trade reductions seems to refer to the uncertainty around price elasticity effects.[50] While the price elasticity response expected from carbon pricing is indeed uncertainty, this seems to miss the point that it is possible to achieve emission certainty in a pure cap-and-trade system without any price controls. With proper enforcement, it is possible to achieve quantity targets with certainty under a tradeable permit system such as cap-and-trade.

While it is possible to achieve quantitative targets with certainty, it is not reasonable to expect policymakers to commit to emission reductions at any cost. A hybrid policy with some carbon price controls makes more sense. In particular, given the aggressiveness of the 2030 target, it makes sense to impose a hard price ceiling, as AB 398 does.

A final observation supporting the need to tune up the cap-and-trade program by adjusting for oversupply concerns the increasing constraints CARB faces with respect to other policies. The AB 398 deal adds some limits to CARB's authority, for example eliminating their authority to implement a rule that had been proposed targeting refineries and limiting CARB to Scoping Plan policies and strategies. Other legislation passed this year also adds new constraints. Senate Bill 1 limits authority over heavy duty vehicles, prohibiting the state from requiring them to retire or retrofit trucks before they reach 13 years old or 800,000 miles. Senate Bill 1383 prevents CARB from regulating methane from dairies and cattle farms prior to 2024. Moreover, the federal government is unlikely to be helpful, and to increase the stringency of the state's vehicles standards, a waiver would be required from the United States' Environmental Protection Agency.

[48] From the proposed final scoping plan, Table II-4.

[49] Quotes from slide 8 at https://www.arb.ca.gov/cc/scopingplan/meetings/110716/economicspresentation.pdf

[50] The appendices supporting the 2017 Scoping Plan, including the key economic analysis Appendix E, were released on Friday, December 1st, after the final version of this report had been circulated for review. There was not enough time to include a thorough, thoughtful evaluation of the appendices in this report.

IMPLICATIONS FOR WCI'S CAP-AND-TRADE PROGRAM

Next the WCI implications are considered. A different perspective is taken from the California discussion, which benefits from the policy analysis associated with the 2017 Scoping Plan, providing estimates of reductions below the reference (or business-as-usual case) for cap-and-trade and other policies. Instead of comparing the effect that the use of banked allowances could have on emission reductions below the reference case, the effect that the banking of allowances could have in effectively increasing cap levels is explored.

Partly this is out of necessity as Ontario and Quebec do not have modeling that estimates forward-looking emission impacts below the reference case by policy type. However, an advantage of the approach is that it does not involve underlying reliance on a hypothetical counterfactual (the forecasted reference case) to establish emissions reduction. The result is a less theoretical evaluation that ties more closely to policy design in the sense that cap levels are a chosen parameter, and this perspective shows how banked allowances could affect these.

WCI cap levels have not been finalized, but the outlines are largely established. California has set cap levels to 2050 in regulation with rules approved in July 2017,[51] Ontario has adopted caps to 2030[52] and Quebec has published proposed caps.[53] WCI caps are simply the sum of all three.

With 2021-2030 WCI caps established, it is possible to calculate the difference between the intended levels in any particular year as compared to the 2020 cap and to add these up to find cumulative reductions in cap levels, summing to 760 MMT.

Estimated bank of 2020 vintage and earlier allowances available in 2021 due to oversupply[54]	APCR allowances	Cumulative emission reductions in cap levels below 2020 cap level 2021-2030
270 MMT in mid-scenario (uncertainty range 200-340)	313 MMT	760 MMT

Table 3. Comparing oversupply, APCR allowances, and reductions 2021-2030 under WCI cap

Table 3, shows that estimated bank due to oversupply is large compared to cumulative reductions below the 2020 cap. APCR allowances, which may or may not be released, depending

[51] https://www.arb.ca.gov/regact/2016/capandtrade16/ctfinro.pdf

[52] Ontario Regulation 144/16: The Cap and Trade Program under Climate Change Mitigation and Low-carbon Economy Act, 2016, https://www.ontario.ca/laws/regulation/160144

[53] Quebec caps from "Gazette Officielle due Quebec, August 31, 2017, Vol. 149, No 35A"

[54] As previously noted there is the possibility that some banked allowances could be held past 2030, though the aggressiveness of the 2030 target would provide an incentive for banked allowances to be used sooner.

on the price levels for new price triggers, are tracked separately from estimated oversupply. The next table converts estimated oversupply into a percentage of cumulative cap reductions.

Mid-scenario	Lower oversupply estimate	Higher oversupply estimate
35%	26%	45%

Table 4. Percentage of emission reductions under WCI caps below 2020 level foregone due to carrying forward of banked allowances after 2020

Table 4 shows that the expected bank of allowances accumulated through 2020 is 26 – 45 percent of cumulative WCI cap declines 2021-2030. Another way to think about the impact is that the banking of allowances through 2020 could effectively negate WCI cap reductions until 2025 or 2026.

To provide some further intuition about the potential impact, Figure 7 uses a very simple hypothetical scenario with steadily increasing use to show how banked allowances might be deployed.

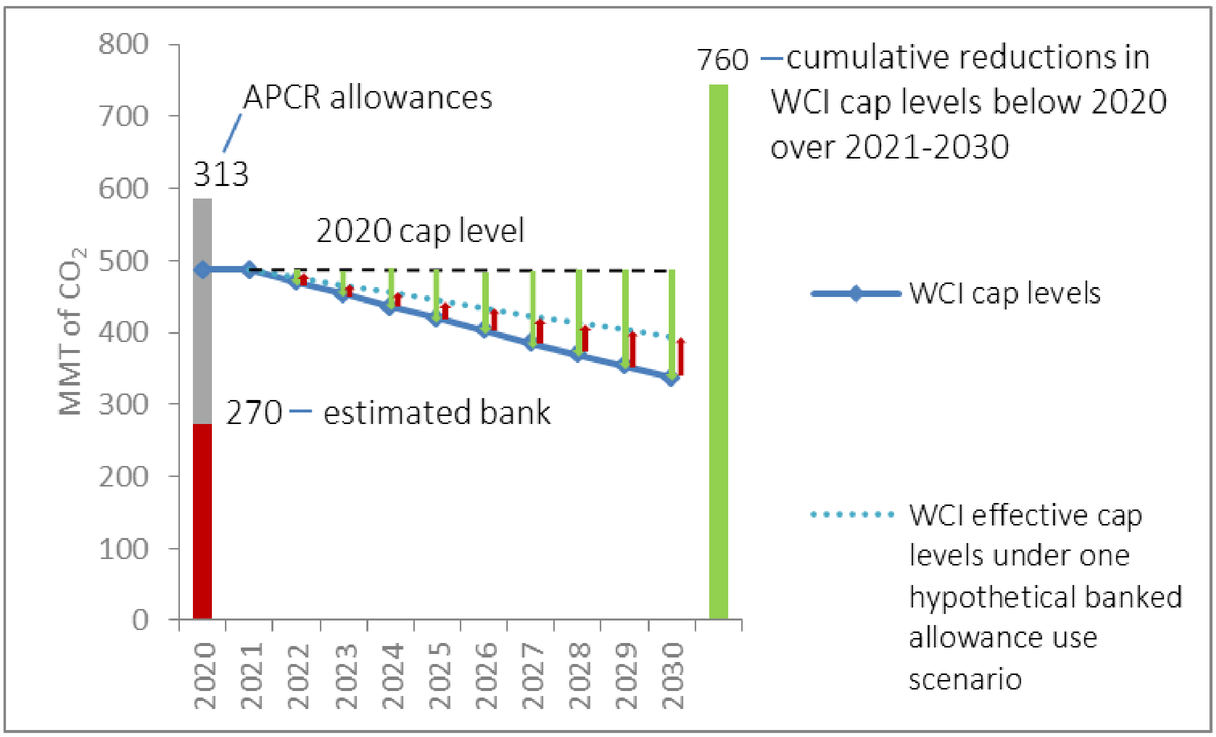

Figure 7. A hypothetical illustration of how banked allowance use could affect emissions

The dashed line shows how much this scenario would increase allowable emissions above intended cap levels, the blue line. The graph also depicts the estimated banked allowances accumulated by the end of 2020 (red bar, mid-scenario oversupply), APRC allowances (grey bar), and the cumulative reductions in cap levels 2021-2030 (green bar at right). In fact, the use of banked allowances is likely to be irregular and nonlinear. Overly simplistic though it is, the hypothetical is included to impart some intuition with respect to the potential impact of banked allowances.

THE CAUSES UNDERLYING EARLY OVERSUPPLY

Economists are inclined to look favorably on banking as a rational market outcome. For example, MIT Professor Denny Ellerman and his colleagues argue that the bank accumulated under the EU ETS is not necessarily a problem:

> "For too long, the facile explanation of some structural or behavioral defect has been offered as an explanation in the public debate when the reality is more complicated and involves economic choices by optimizing agents. One key lesson of this analysis is that it is rational to decrease emissions below the cap at the start of the banking period and to accumulate a "surplus" in order to minimize abatement costs over time. The observed EUA bank at the end of Phase II falls within the range of values indicated by the illustrative simulations presented in this paper suggesting behavior by agents consistent with intertemporal cost minimization in a perfect-foresight model."[55]

Elsewhere, the paper makes clear they are not claiming they have proved that purposeful early action drove the accumulation of the EU ETS bank, only that it is possible.

It seems clear that EU ETS policymakers disagree and found the large bank to be problem. Their creation of a "Market Stability Reserve" added high side cost controls, while also helping to resolve their oversupply problem. Essentially, the Market Stability Reserve reduces future supply, unless the market tightens beyond certain performance metrics (price or liquidity).

Just as in the EU ETS, factors other than emission reductions in anticipation of future emissions reductions under cap-and-trade are the main causes of emissions having fallen so far below cap levels. Clearly, the economic recession played a role in easing the 2020 compliance pathway. Statewide emissions dropped a record 29 MMT in 2009, as the economic downturn was hitting full force, more than three times larger than reductions in any other year.[56]

As the economy bounced back, emissions continued to decline, helped along by faster than expected progress in other policies, supported by rapid innovation in renewable electricity technologies.[57] The electricity sector's strong decarbonization performance, spurred on by

[55] Denny Ellerman, Aleksandar Zaklan, and Valero Vanessa. 2015. "An Analysis of Allowance Banking in the EU ETS." http://cadmus.eui.eu/bitstream/handle/1814/35517/RSCAS_2015_29.pdf?sequence=1&isAllowed=y

[56] CARB. 2017. Greenhouse Gas Inventory https://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-15.pdf

[57] For example, as of 2017, California has already reached its utility performance standard for 2020 requiring at least 33 percent renewables in the delivered electricity. This renewable electricity supply does not even account for the large amount of rooftop solar PV installed in California. Danny Cullenward also points out the likelihood that some

sector policies and renewable energy innovations that have made these the lowest cost options in some contexts, has also played an important role.

While the broad emission reduction figures are encouraging, digging in more deeply to the trends reveals some trouble spots.[58] Recent emission reductions have been almost entirely in the electricity sector. Transportation emissions under the cap rose in 2016 for the second year in a row.

The fact is that no researcher has yet to rank, much less identify quantitatively the causal effects, of each of the individual policies in the original Scoping Plan. CARB's ex-ante estimate that cap-and-trade would produce 20 percent of reductions is more than a decade old. Despite the clear existence of oversupply, the robust price floor ensures a minimum carbon price. Hence, it would be incorrect to conclude that the program is not having any effect.

The method that Severin Borenstein and colleagues have used to forecast future prices impacts is adapted to develop a backward looking estimate of reductions due to the cap-and-trade program.[59] Borenstein et al. apply price elasticities of demand for transportation fuels, natural gas use, and electricity to approximate future responsiveness to carbon pricing. The same approach is applied retrospectively to actual data on energy use and prices to estimate an effect from the cap-and-trade program in 2015 and 2016.

	Reductions based on low end of price elasticity range	Reductions based on high end of price elasticity range
2015 estimated reductions	1.7 MMT	3.3 MMT
2016 estimated reductions	1.7 MMT	3.4 MMT

Table 5. California emission reductions in carbon dioxide emission due to cap-and-trade [60]

emissions inherent in imported electricity have not been counted due to some accounting difficulties and past program design choices, a phenomenon known as resource shuffling. For more on reshuffling, see:

Danny Cullenward and Andy Coghlan. 2016. "Structural oversupply and credibility in California's carbon market," The Electricity Journal29(5): 7–14

[58] For more discussion of recent trends, see: Danny Cullenward, Mike Mastrandrea, and Mason Inman. 2017. *California's climate emissions are falling but cap-and-trade is not the cause.* http://www.nearzero.org/wp/2017/11/10/californias-climate-emissions-are-falling-but-cap-and-trade-is-not-the-cause/

[59] Severin Borenstein, James Bushnell, Frank A. Wolak, and Matthew Zaragoza-Watkins. 2016. *Expecting the Unexpected: Emissions Uncertainty and Environmental Market Design*, Energy Institute at Haas Working Paper 274 (August). https://ei.haas.berkeley.edu/research/papers/WP274.pdf

[60] The method used to estimate reductions from cap and trade in 2015 and 2016 as presented in this table starts with the definition of elasticity:

It is important to recognize that the method carried out to calculate the results in Table 5 is limited by its consumption focus. It does not fully capture production side adjustments that would be expected due to availability of renewable and energy efficiency options. While incomplete, some information is better than no information. And no other ex-poste analysis of reductions due to the WCI cap-and-trade program exists. These results generally correlate with the conclusion that factors external to cap and trade have been the main driver of oversupply.

HOW OTHER PROGRAMS HAVE ADJUSTED TO OVERSUPPLY

Both the EU ETS and RGGI have taken steps to adjust cap levels to account for oversupply.

In 2014, RGGI states lowered caps by 140 MMT to account for excess allowances sold and banked from 2009-2013. The adjustment is illustrated in Figure 8 with green arrows indicating the cap lowering that occurred to account for prior banking.

$$\varepsilon = \frac{\%\Delta Q}{\%\Delta P} = \frac{\frac{Q_0 - Q_1}{Q_0}}{\frac{P_0 - P_1}{P_0}}$$

$\mathcal{E}$ = elasticity. Estimated, with values taken from Borenstein et al. (2016).
P_1 is known, price of energy observed (average for the years 2015 and 2016)
ΔP is known, assumed to equal carbon price (per full cost through assumption in the paper). These results account for free allocation to natural gas deliverers, a difference from Borenstein et al.
Therefore, P_0 is calculable, using $\Delta P = P_1 - P_2$
Q_1 is known (actual energy consumed).
Therefore equation 2 has only one unknown, Q_0, and through algebraic manipulation we can show

$$Q_o = \frac{Q_1}{\varepsilon * \frac{P_0 - P_1}{P_0} + 1}$$

With this, the change in fuel combusted (transportation fuels and natural gas) or consumed (electricity) can be calculated.
Next, carbon intensity of fuels is applied to estimate emission reductions.

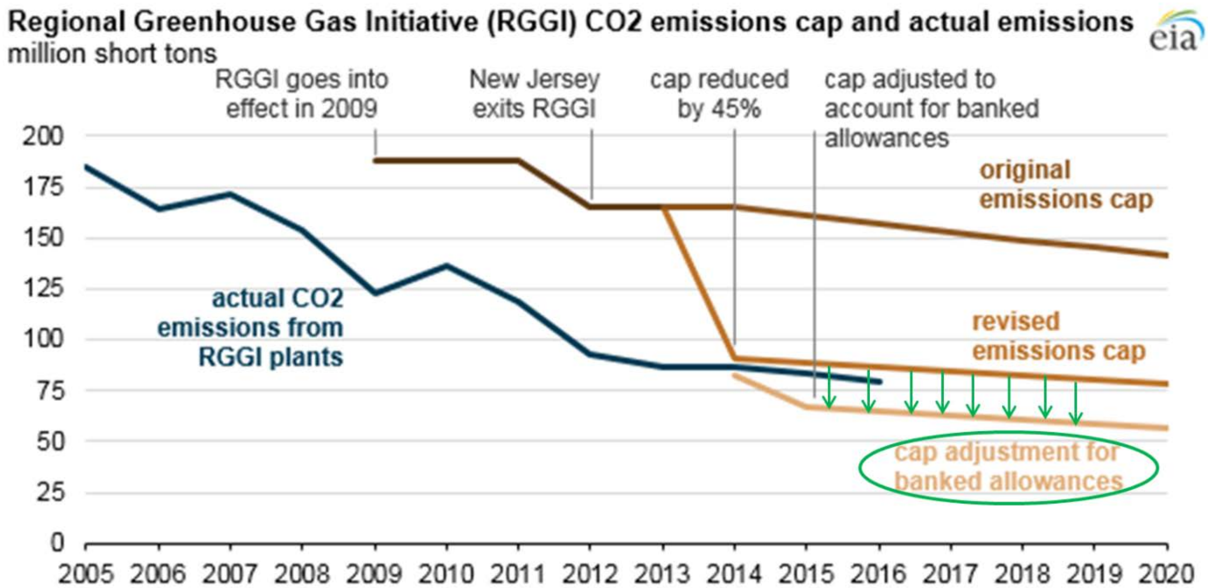

Figure 8. Lowering of cap to account for banked allowances in RGGI
(Source: U.S. Department of Energy, Energy Information Administration[61])

Recently, as part of a comprehensive review of the program and cap levels, RGGI has announced plans to undertake another cap adjustment to account for additional banking of allowances through 2020. "Proposed improvements include making… [a]dditional adjustments to the RGGI cap, to account for the full bank of excess allowances at the end of 2020. The amount of this adjustment will be calculated in 2021 according to a formula to be established in the revised Model Rule, and it will be implemented over the period from 2021-2025."[62] As proposed, this adjustment would work in the same way as the RGGI states' earlier adjustment, resulting in lowered 2021-2025 cap levels (i.e., fewer allowances made available for sale in future periods) to account for the size of the bank.

The EU ETS has also grappled with oversupply, and more than 2 billion tons of carbon allowances had been banked under the system by 2013.[63] The EU's long term response essentially involves lowering future cap levels, done in a way that helps simultaneously solve the lack of explicit cost containment in the program. Some allowances were diverted into a "market stability reserve"

[61] https://www.eia.gov/todayinenergy/detail.php?id=31432&src=email

[62] RGGI Inc. 2017. "RGGI States Announce Proposed Program Changes: Additional 30% Emissions Cap Decline by 2030," press release. August 23.

https://www.rggi.org/docs/ProgramReview/2017/08-23-17/Announcement_Proposed_Program_Changes.pdf

[63] "The surplus amounted to around 2 billion allowances at the start of phase 3 [in 2012] and increased further to more than 2.1 billion in 2013." European Commission website accessed 11 September 2017. https://ec.europa.eu/clima/policies/ets/reform_en

which will operate somewhat like the APCR in the WCI. If prices rise above or market liquidity drops below pre-determined levels, then allowances are to be released.

The EU ETS's approach going forward is different than how the program addressed oversupply in the first phase of the program (2005-2007). In that instance, no banking was allowed from the first phase to the second phase. This caused the price of allowances eligible for first phase compliance to crash to zero. This induced price volatility, and the recognition that disallowing banking creates a "use it or lose it incentive" (if the allowance is not used, it eventually becomes worthless), had led to the different, forward-looking cap adjustment approach now in favor.

RECOMMENDATIONS

To account for oversupply, California and the WCI should adjust caps for 2021-2030 downward in an amount equal to the sum of 2020 and earlier vintage allowances that remain privately held after emitters have finished submitting allowances for compliance through the end of 2020.

This straightforward adjustment to program design, tested and proven effective by RGGI, can resolve the issue. Because it involves adjusting future caps downward to account for the amount of allowances banked, this approach does not negatively affect private holdings of allowances and it does not involve a change in banking rules. It does not encourage greater volatility and it only increases the incentive for early action.

Energy Innovation first urged this approach in an April 2017 comment letter on the CARB Scoping Plan in April, when we recommended:

> "*After the third compliance period ends, adjust future caps downward in an amount equal to the size of the [private] bank of 2020 and earlier vintage allowances.*"[64]

CARB and the WCI should also adopt a specific schedule for program review. These regular reviews – we suggest at the end of each compliance period – should evaluate cap-and-trade program performance. The October draft of the 2017 Scoping Plan increases the emphasis on periodic reviews but is short on specifics, beyond noting the five-year Scoping Plan cycle.

Some might protest that reducing the supply of allowances would increase carbon prices. While a higher carbon price indicates higher compliance costs for emitters, it does not necessarily equate to higher social costs. Higher carbon prices offer two important benefits almost invariably left out of economic analyses: (1) greater public health benefits, including reduced health care costs, better student performance, and higher worker productivity, and (2) greater competitiveness for domestic clean technology companies, which are then more likely to capture a larger share of the fast growing international market for clean tech.

[64] Full comment letter available at:

https://www.arb.ca.gov/lists/com-attach/204-scopingplan2030-AmcHb1QwUHEKawR9.pdf

In addition, California's initial experience points to the positive coexistence of declining carbon emissions and robust economic growth. And despite the cost bias inherent in economic modeling, some studies indicate meeting the 2030 target will have overall economic benefits. Nonetheless, since the 2030 target is much more aggressive than the 2020 target, it is appropriate for policy design to acknowledge uncertainty. AB 398 is helpful in this regard, requiring the establishment of a hard price ceiling, guaranteeing carbon prices will rise no higher than that ceiling. This should provide policymakers the confidence to correct for early oversupply.

CONCLUSION

The WCI cap-and-trade program is the best designed in the world, not least because its price floor is the highest. While oversupply itself does not represent a mistake, it would be a mistake to not adjust to oversupply. There is no guarantee that the price floor will deliver the necessary emissions reductions. Rather, if left unaddressed banked allowances due to oversupply would be expected to effectively raise the WCI cap levels for 2021 and later substantially above the caps proposed in regulation.

APPENDIX: FURTHER DETAILS ON METHODS

This appendix provides a guide to the spreadsheet developed to carry out the methodology described above. The spreadsheet documents the mathematical calculations entailed. The notes below provide a narrative description and discuss data sources. Worksheet names are in bolded, italic text. As noted under the supporting documentation section, the spreadsheet is downloadable at the following link:

http://energyinnovation.org/wp-content/uploads/2017/12/WCI_market_balance_evaluation.xlsx

"1. demand-emission data"

This spreadsheet brings together mandatory reporting data on emissions for covered sources for 2013-2016 from. Source data:

> The Quebec Ministry of Sustainable Development, Environment, Wildlife and Parks: http://www.mddelcc.gouv.qc.ca/changements/carbone/ventes-encheres/listeetablissements-visesRSPEDE.pdf
>
> The California Air Resource Board: https://www.arb.ca.gov/cc/reporting/ghgrep/reported-data/ghg-reports.htm

These empirical data are the basis for the future emissions forecast. The data show annual declines of 0.8 percent, 1.0 percent, and 4.0 percent. The "trend emissions" approximates this as a reduction of 1.9 percent annually. As explained in the original recalibrating report, this historical trend is bounded at +/- one percent, providing high and low demand scenarios.

The user can specify different bounds, by changing the rate of emissions decline (or even contemplating increasing emissions) by changing the values in the cells B17, C17, D17.

"2. supply data – privately held"

Next, the joint California-Quebec compliance instrument report provides raw data on what allowances are in private hands and what have yet to be distributed. The most recent version of that report is always posted at:

https://www.arb.ca.gov/cc/capandtrade/complianceinstrumentreport.xlsx

It is also necessary to adapt data in the compliance instrument report (with data from April) to reflect the results of the May auction. Purchased allowances from the May auction are added to the supply of privately held allowances.

"3. supply data - retirement"

Another aspect of establishing the destruction of supply involves establishing how many allowances have already been retired for the second compliance period. This involves summing up the retired allowances in the compliance instrument report, and then subtracting what was submitted for 2013-2014 compliance, as indicated in the compliance instrument report from the first compliance period.

The 2013-2014 compliance instrument report can be found at:
https://www.arb.ca.gov/cc/capandtrade/2013-2014compliancereport.xlsx

"4. supply data – future"

The future supply data are found in the relevant parts of the compliance instrument report: Column F provides data on allowances still slated for distribution through 2020: Auction + Issuance + Allocation

It is necessary include in future supply allowances from the "limited use holding account," which are allowances that will be made available through future consignment auctions. Allowances from the ACPR are not included in this or any component of market balance through 2020.

"5. unsold allowances to reserve"

This worksheet calculates the number of unsold allowances expected to be sent to the ACPR. New rules require CARB to deposit unsold ARB allowances if they have remained unsold for two years. The first part of the worksheet identifies unsold ARB allowances by date when they first went unsold. Auctions results are accessible here:
https://www.arb.ca.gov/cc/capandtrade/auction/auction.htm

The next piece of the analytical puzzle is future auction levels. These must be estimated to apply the 25 percent rule by which previously unsold allowances will be rolled back in at future auctions. Thanks to Dan McGraw of ICIS for providing estimates of future auction levels for California allowances.

With these components, it is possible to mechanically crank through how quickly previously unsold allowances could return to auction, and what number would not return to auction fast enough to avoid diversion to the ACPR.

"6. supply aggregation"

This worksheet adds up the components of allowance supply: those retired; those in private hands; those in government hands, and; factoring in the diversion of unsold allowances to the ACPR.

"7. offsets"

This worksheet calculates the use of offsets under the different demand scenarios.

We evaluate a five percent offsets scenario and report a range of sensitivity results for offset use. Changing the value in cell B2 tests the implications of different offset levels.

"8. synthesis"

The market balance is estimated as the difference between the supply of compliance instruments and compliance demand (emissions).

DISCLAIMER

The report endeavors to use the most credible sources and to employ transparent, reasonable assumptions. Two rounds of peer review were undertaken to test findings. Perfect accuracy or absolute completeness cannot be guaranteed. Any opinions expressed reflect the current judgment of the author and are subject to change without notice. The purpose of this work is to influence the policy dialogue and not to offer investment advice. Energy Innovation: Policy and Technology, LLC accepts no responsibility for any liability arising from use of this document or its analytical underpinnings.

Cap-and-Trade Extension: Issues for Legislative Oversight

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DECEMBER 2017

LAO

Executive Summary

Cap-and-Trade Program Recently Extended From 2020 to 2030. In adopting Chapter 135 of 2017 (AB 398, E. Garcia), the Legislature extended the state's cap-and-trade program from 2020 to 2030. Cap-and-trade is a key policy to help ensure the state achieves its goal of reducing greenhouse gas (GHG) emissions to 40 percent below 1990 levels by 2030. The program establishes a "cap" on emissions by issuing a limited number of permits to emit, also known as allowances. Allowing businesses to buy and sell ("trade") allowances results in a market price, which creates a financial incentive for businesses and household to undertake emission reduction activities that are less costly than the allowance price.

Key Implementation Decisions Could Have Significant Effects on Program Outcomes. Although AB 398 provides direction to the California Air Resources Board (CARB) regarding certain design features of the cap-and-trade program, the bill gives CARB significant discretion regarding how to implement many of these features. These implementation decisions are often complex and can have significant effects on key program outcomes, such as GHG reductions and program costs. To help the Legislature ensure CARB is implementing AB 398 in a way that is consistent with legislative goals and priorities, we identify the following key issues for future oversight:

- ***Setting Post-2020 Caps and Banking Rules to Ensure State Meets Its GHG Targets.*** The Legislature will want to evaluate CARB's assessment of the potential for a large number of banked allowances issued in the early years of the program to be carried forward and used in the later years of the program, and how this could affect the likelihood of the state meeting its 2030 GHG target. If it is determined that a large number of banked allowances creates a significant risk of not meeting the 2030 target, the Legislature will want to evaluate different options to address the issue, such as reducing the number of allowances offered at future auctions.
- ***Setting Hard Price Ceiling at Level That Balances Emissions and Costs.*** The Legislature will want to evaluate how the level of CARB's proposed price ceiling balances trade-offs, such as interests in containing costs versus certainty that targeted emissions levels will be achieved.
- ***Setting Price Containment Points to Limit Price Spikes.*** The Legislature will want to evaluate whether the number of allowances in each containment point and the level of each price containment point are consistent with legislative interest in slowing price increases, while also limiting emissions.
- ***Implementing New Offset Limits Consistent With Legislative Intent.*** The Legislature will want to ensure CARB identifies projects with direct environmental benefits and limits the use of projects without direct environmental benefits in ways that are consistent with legislative intent.
- ***Determining Industry Assistance Factors (IAFs) Through 2020.*** The Legislature will want to evaluate whether CARB direction to maintain 100 percent IAFs through 2020 balances leakage risk and incentives for GHG-reductions in a way that is consistent with legislative priorities.

Clarifying the Role of Market Advisory Committee Could Enhance Information in Future Reports. Assembly Bill 398 includes a variety of new reporting requirements meant to enhance oversight and accountability. This includes establishing an Independent Emissions Market Advisory Committee and requiring the committee to report annually on the environmental and economic performance of cap-and-trade and other relevant climate policies. In our view, the committee has the potential to provide valuable information that enhances legislative oversight and improves future policy decisions. However, there are areas where the Legislature might want to consider clarifying or refining the direction given to the committee. For example, the Legislature could clarify (1) which climate policies are within the committee's jurisdiction, (2) whether the committee should advise on future program design issues and/or evaluate past program performance, and (3) specific outcomes it would like the committee to evaluate. More specific direction could increase the likelihood that committee reports will include the type of information that the Legislature finds most valuable.

Cap-and-Trade Revenue Could Vary By Billions of Dollars Annually. Assembly Bill 398 also extended the period in which the state will receive revenue from cap-and-trade auctions. The amount that will be generated in future years is highly uncertain, largely because a wide variety of factors could affect prices, including (1) future "business-as-usual" emissions, which depend on economic conditions and technological changes; (2) the stringency and effectiveness of other GHG reduction policies; and (3) cap-and-trade program design decisions, such as the ones discussed in this report. We examine state revenue under two different assumptions about future allowance prices—a "low price" scenario and a "high price" scenario. Under these two scenarios, revenues would range from $2 billion to $4 billion in 2018 and from $2 billion to about $7 billion in 2030. Although these two scenarios provide a plausible range of future revenues, there are alternative scenarios where revenue could be higher or lower.

INTRODUCTION

The cap-and-trade program is one of the state's key policies intended to reduce statewide greenhouse gas (GHG) emissions. Recently, the Legislature extended the state's cap-and-trade program from 2020 to 2030 with the passage of Chapter 135 of 2017 (AB 398, E. Garcia). In this report, we (1) provide background information on cap-and-trade and the recent extension of the program to 2030, (2) identify key administrative implementation decisions that could affect program outcomes and the need for legislative oversight, (3) identify potential opportunities to increase the effectiveness of a new advisory committee created by AB 398, and (4) describe potential state cap-and-trade revenue scenarios through 2030.

BACKGROUND

AB 32 Authorized Cap-and-Trade Through 2020

State Law Establishes 2020 and 2030 GHG Limits. The Global Warming Solutions Act of 2006 (Chapter 488 [AB 32, Núñez/Pavley]) established the goal of limiting GHG emissions statewide to 1990 levels by 2020. Subsequently, Chapter 249 of 2016 (SB 32, Pavley) established an additional GHG target of reducing emissions by at least 40 percent below 1990 levels by 2030. The California Air Resources Board (CARB) is required to develop a Scoping Plan, which identifies the mix of policies that will be used to achieve the emission targets, and update the plan periodically. Prior Scoping Plans included a wide variety of programs, including a low carbon fuel standard (LCFS) intended to reduce the carbon intensity of transportation fuels, energy efficiency programs, and the 33 percent renewable portfolio standard (RPS) for retail electricity sales. One policy that is used to help ensure the state meets its emissions goals is cap-and-trade. Assembly Bill 32 authorizes CARB to implement a market-based mechanism, such as cap-and-trade, through 2020. However, prior to the passage of AB 398, CARB did not have the authority to implement cap-and-trade beyond 2020.

Cap-and-Trade Designed to Limit Emissions at Lowest Cost. The cap-and-trade regulation places a "cap" on aggregate GHG emissions from large GHG emitters, such as large industrial facilities, electricity generators and importers, and transportation fuel suppliers. Capped sources of emissions are responsible for roughly 80 percent of the state's GHGs. To implement the program, CARB issues a limited number of allowances, and each allowance is essentially a permit to emit one ton of carbon dioxide equivalent. (Please see the Appendix for a more detailed definition of an allowance and other key cap-and-trade terms used in this report.) The annual caps—or number of allowances issued each year—decline over time, from 395 million allowances in 2015 to 334 million allowances in 2020. Entities can also "trade" (buy and sell on the open market) the allowances in order to obtain enough to cover their total emissions. Businesses that are covered by the regulation can comply in three ways: (1) reduce emissions, (2) obtain allowances to cover emissions, and/or (3) obtain "offsets" to cover emissions. Offsets are alternative compliance instruments—similar to allowances—that are generated by undertaking certified GHG emission reduction projects from sources that are not subject to the state's cap-and-trade program (uncapped sources), such as forestry projects that reduce GHGs.

From a GHG emissions perspective, the primary advantage of a cap-and-trade regulation is that total GHG emissions from the capped sector do not exceed the number of allowances issued. Some entities must reduce their emissions if the total number of allowances (and offsets) available is less than the number of emissions that would otherwise occur. From an economic perspective, the primary advantage of a cap-and-trade program is that the market sets a price for GHG emissions, which creates a financial incentive for businesses and households to implement the least costly emission reduction activities. In theory, the market price will adjust to reflect the cost of reducing the last ton needed to ensure emissions remain under the cap. This is the price that provides an incentive to businesses and households that is high enough to encourage enough emission reductions to stay under the cap, but no higher than what is needed. (For more details on how cap-and-trade works, see our February 2017 report *The 2017-18 Budget: Cap-and-Trade*.)

Some Allowances Auctioned, Some Given Away for Free. About half of allowances are allocated for free to certain industries, and most of the remaining allowances are auctioned by the state. Of the allowances given away for free, most are given to utilities and natural gas suppliers. CARB also allocates free allowances to certain energy-intensive trade-exposed industries based on how much of their goods (not GHG emissions) they produce in California. This strategy, known as "industry assistance," is intended to minimize the extent to which emissions are shifted out of state because companies move their production of goods out of California in response to higher costs associated with the cap-and-trade regulation. This type of emissions shifting is referred to as "leakage."

The allowances offered at auctions are sold for a minimum price—set at about $14 in 2017—which increases annually at 5 percent plus inflation. A small percentage of allowances are also placed in a special account—called the Allowance Price Containment Reserve (APCR)—and made available at higher predetermined prices. These predetermined prices are sometimes called a "soft" price ceiling. The APCR is intended to help moderate potential spikes in allowance prices by increasing the supply of allowances available if prices increase to a certain amount.

State Revenue Used to Facilitate GHG Reductions. The state has collected a total of about $6.5 billion in cap-and-trade auction revenue from 2012 through 2017. Money generated from the sale of allowances is deposited in the Greenhouse Gas Reduction Fund (GGRF). To date, the revenues have generally been used to fund projects intended to reduce GHGs.

AB 398 Extends Cap-and-Trade Through 2030

Assembly Bill 398 extends CARB's authority to operate cap-and-trade from 2020 to 2030 and provides additional direction regarding certain design features of the post-2020 program. It also includes new reporting and oversight requirements. We summarize these changes below. (As discussed in the box on page 7, AB 398 and related legislation make other significant changes to climate change and air quality polices.)

Provides Direction for Certain Post-2020 Cap-and-Trade Design Features. Assembly Bill 32 gave CARB almost complete discretion over how to design the cap-and-trade program. In contrast, AB 398 provides more specific legislative direction about certain design features of the post-2020 program, such as the price ceiling and offsets.

CARB adopted amendments to the cap-and-trade regulation a few weeks after the Legislature passed AB 398. However, restrictions imposed by the state regulatory process prevented CARB from adjusting the regulation to incorporate most of the AB 398 changes. As a result, CARB will have to undertake a new rulemaking process to amend the regulation to comply with AB 398. **Figure 1** summarizes the major areas of direction in AB 398 and how they compare to the current cap-and-trade regulation, as amended this past summer by CARB.

Adds New Reporting and Oversight Requirements. Assembly Bill 398 adds several new reporting and oversight requirements, as summarized in **Figure 2** (see page 6). In most cases, existing entities—such as CARB and our office—are required to report on certain topics. Assembly Bill 398 also creates a new Independent Emissions Market Advisory Committee (Market Advisory Committee), located within the California Environmental Protection Agency. The committee is composed of at least five experts on emissions trading market design—including three appointed by the Governor, one by the Senate Committee on Rules, and one by the Speaker of the Assembly. It will also include a representative from our office.

Figure 1

Major Differences Between Current CARB Cap-and-Trade Regulation and AB 398[a]

Design Feature	Current Regulation	AB 398 Extension (2021 Through 2030)
Setting Post-2020 Emissions Caps	Establishes the number of allowances issued each year through 2030.	When setting post-2020 caps, directs CARB to evaluate and address concerns related to a large number of banked allowances.
Banking	No expiration date for allowances; limits on the number of allowances an entity can hold at a time.	Directs CARB to adopt banking rules that "discourage speculation, avoid financial windfalls, and consider impact on complying entities and market volatility."
Price Ceiling	"Soft" price ceiling of about $60 per allowance in 2017, increasing gradually in future years.	Directs CARB to establish "hard" price ceiling and consider various factors when setting the level of ceiling.
Price Containment Points	None.	Directs CARB to establish two price containment points (also known as speed bumps) between the price floor and the price ceiling.
Offset Limits	Maximum of 8 percent of a covered entity's emissions.	Maximum of 4 percent in 2021-2025 and 6 percent in 2026-2030, with no more than half from projects that do not provide direct environmental benefits in California.
Industry Assistance	Different IAFs for high- (100 percent), medium- (75 percent) and low- (50 percent) risk industries from 2018 through 2020; not specified from 2021 through 2030.	100 percent IAFs from 2021 through 2030.

[a] Chapter 135 of 2017 (AB 398, E. Garcia).
CARB = California Air Resources Board and IAF = industry assistance factor.

KEY IMPLEMENTATION DECISIONS COULD AFFECT PROGRAM OUTCOMES

A variety of factors will affect future cap-and-trade outcomes, including the key outcomes of GHG emission reductions and the costs of reducing emissions. Reducing GHG emissions is the primary goal of the program, and the costs of GHG reductions will ultimately be borne by California households and businesses. Many of the major factors that could affect these outcomes—such as future technological changes, broader economic conditions, and the presence of other GHG regulations—will largely occur for reasons that are unrelated to the design of the state's cap-and-trade program. However, some key cap-and-trade implementation decisions—such as the overall supply of allowances and how they are distributed—could have significant effects on program outcomes. For these decisions, the Legislature will want to ensure CARB is implementing the program in a way that is consistent with legislative goals and priorities.

At the time this report was prepared, CARB staff had already begun public workshops to discuss some of the changes to the post-2020 cap-and-trade regulation required by AB 398, as well as other potential changes identified by the board. Based on an initial timeline presented at a public workshop in October 2017,

Figure 2

Key AB 398[a] Reporting Requirements

Subject of Report	Responsible Entity	Date and Frequency
Environmental and economic performance of cap-and-trade regulation and other relevant climate policies.	Market Advisory Committee.	At least annually until 2031.
Economic impacts and benefits of state greenhouse gas (GHG) limits.	Legislative Analyst's Office.	Annually until 2031.
Need for increased workforce development activities and funding to help transition to economic and labor-market changes related to state GHG targets.	California Workforce Development Board, in consultation with California Air Resources Board (CARB).	By beginning of 2019.
Progress toward meeting GHG limits, leakage risk posed by cap-and-trade regulation, and recommended changes needed to reduce leakage, including potential for border carbon adjustment.	CARB.	By end of 2025.
Potential for allowance prices to reach price ceiling for multiple auctions.	CARB, in consultation with Market Advisory Committee.	If prices at two consecutive auctions exceed the lower speed bump.

a Chapter 135 of 2017 (AB 398, E. Garcia).

CARB expects to begin the formal process to amend the regulation in 2018 and finalize the amendments in the middle of 2019.

In this section, we discuss some of the key regulatory decisions CARB will have to consider when implementing AB 398. These decisions relate to (1) setting post-2020 caps and banking rules, (2) implementing a hard price ceiling, (3) establishing two price speed bumps, (4) implementing new offset limits, and (5) providing industry assistance through 2020. We also identify some key issues related to these decisions to guide legislative oversight and identify areas where the Legislature might want to consider clarifying state law if it determines CARB's actions are inconsistent with legislative goals and priorities. CARB also has considerable discretion over many other critical design features of the program not specifically addressed in AB 398—such as minimum auction price, allowance allocations to electric utilities, and linking the program with other jurisdictions. These particular design features are outside the scope of this report.

Setting Post-2020 Caps and Banking Rules to Ensure State Meets Its GHG Targets

Current Program Allows Banking. Under the current program, there is no expiration date for allowances. An allowance issued today can be purchased today and used to cover emissions in a future year—a design feature commonly known as banking. Since the annual cap on emissions becomes more stringent in later years, banking gives firms an incentive to obtain extra allowances in early years as a way to protect against the risk of higher prices in later years when allowances are more scarce. As a result, banking can change when emissions (and emission reductions) occur. Relative to a program without it, banking has the effect of increasing allowance prices (and incentives for reductions) in early years, while reducing prices (and incentives for reductions) in later years. This is because it shifts some of the supply of allowances from earlier years to later years.

Banking Has Significant Advantages, but Also Has Trade-offs. Some of the key advantages of banking include (1) less price volatility and (2) incentivizing some emission reduction activities in early years that are less costly than an equivalent number of reductions in later years. One potential downside to banking, however, is that there is a greater risk that the state does not meet its specific GHG target set in 2030. With banking, *cumulative* emissions are capped over the life of the program and covered entities have some flexibility to adjust their level of emissions between different years. Since entities can

Other Major Climate and Air Quality Changes Recently Adopted

In addition to extending the cap-and-trade program, the Legislature also recently adopted various other related changes.

Limitations on Adopting Additional Greenhouse Gas (GHG) Regulations. Chapter 135 of 2017 (AB 398, E. Garcia) requires the California Air Resources Board (CARB) to update the Scoping Plan by January 1, 2018 and to designate cap-and-trade as the GHG reduction regulation for refineries and oil and gas production facilities. This restricts CARB from implementing a new GHG regulation focused on refineries, which was a measure included in the proposed Scoping Plan update issued in early 2017. Assembly Bill 398 also restricts local air quality management districts from implementing their own regulations intended to reduce carbon dioxide—the most common GHG—from stationary sources that are also subject to the state cap-and-trade program.

State Fire Prevention Fee Suspension. Assembly Bill 398 suspends the state fire prevention fee from July 1, 2017 until January 1, 2031. The fee was imposed on landowners in State Responsibility Areas (SRAs), and the money was used to fund state fire prevention activities in these areas. The bill also expresses the Legislature's intent to use cap-and-trade revenue to backfill the lost fee revenue and continue fire prevention activities. Subsequently, the 2017-18 budget provided $80 million from the Greenhouse Gas Reduction Fund to backfill lost SRA fee revenue.

Extension and Expansion of Sales and Use Tax (SUT) Exemption for Certain Equipment. Assembly Bill 398 extends the sunset date from 2022 to 2030 for a partial SUT exemption for certain types manufacturing and research and development equipment. It also expands the exemption to include equipment for other types of activities, such as certain electric power generation and agriculture, through 2030. The bill, as amended by legislation adopted as part of the 2017-18 budget, also transfers cap-and-trade revenue to the General Fund to backfill revenue losses associated with these changes.

Changes Intended to Reduce Local Air Pollution. Chapter 136 of 2017 (AB 617, C. Garcia) makes a variety of changes that are intended to reduce criteria and toxic air pollutants that have adverse effects on local communities. The key changes include (1) directing CARB to establish a uniform statewide annual reporting system; (2) requiring local air districts to adopt an expedited schedule for requiring certain facilities to install updated pollution control technologies; (3) increasing the maximum allowable penalties for violations of air quality rules; (4) requiring CARB to develop, and air districts to implement, additional air monitoring in heavily polluted communities; and (5) requiring CARB to develop a strategy to reduce air pollution in these communities.

Constitutional Amendment Establishing Temporary Two-Thirds Vote Requirement for Cap-and-Trade Spending. Chapter 105 of 2017 (ACA 1, Mayes) places a proposed Constitutional Amendment on the June 2018 ballot. If the amendment passes, a two-thirds vote of the Legislature would be needed to allocate cap-and-trade revenue collected after January 1, 2024. After one such vote, any future revenue could again be allocated with a simple majority vote. Also, beginning in 2024, the manufacturing SUT exemption would be suspended until the Legislature allocated cap-and-trade funds with a two-thirds vote.

use banked allowances from earlier years to comply in later years, it is possible that *annual* emissions from these entities exceed the 2030 annual target. Although there are legitimate debates about whether state climate policies should focus primarily on cumulative or annual emissions targets, the Legislature has established an *annual* 2030 GHG target, and banking creates a risk of not meeting that goal.

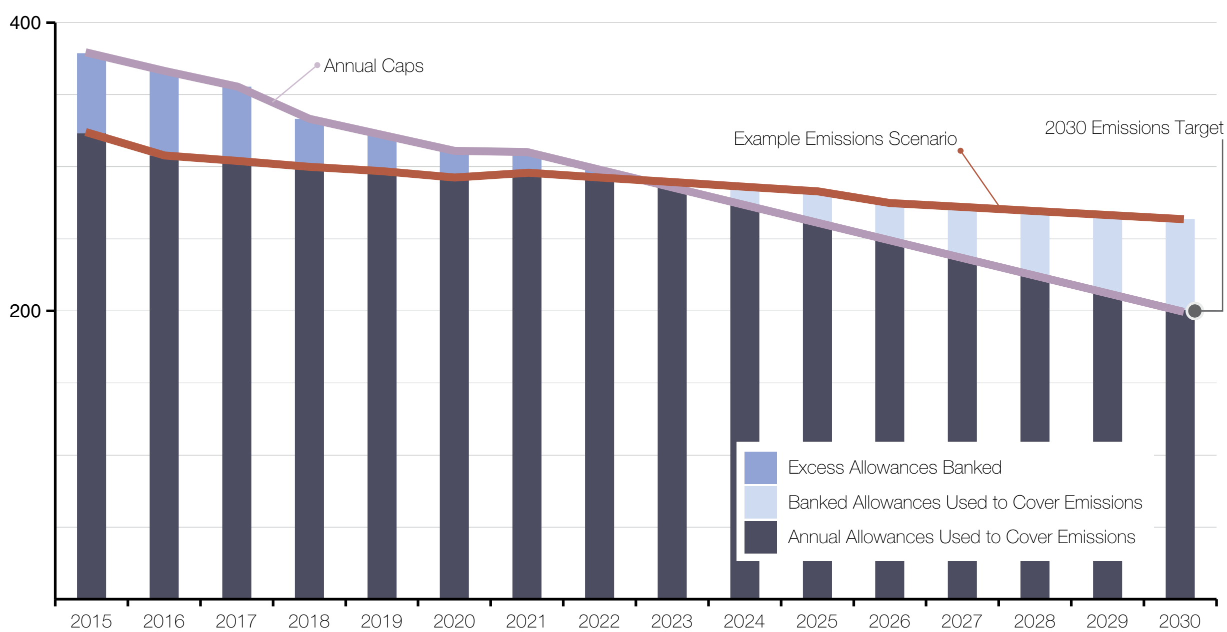
Over 200 Million Banked Allowances Could Be Used for Post-2020 Compliance. Emissions from covered entities have been below the annual caps for the first few years of the program, and CARB projects emissions will remain below the annual caps through 2020. This is likely primarily the result of factors unrelated to cap-and-trade, such as economic conditions and the effects of other GHG reduction policies. As a result, there could be a substantial number of allowances banked into the post-2020 program. Earlier this year, we estimated that by 2020 there could be a substantial number of banked California allowances—ranging from 100 million to 300 million allowances, with it most likely being roughly in the middle of that range. This estimate did not account for other factors that could increase or decrease the oversupply, including the effect of linking California's cap-and-trade program with other jurisdictions, recently adopted regulatory changes affecting previously unsold allowances, and updated 2016 emissions data.

Effect of Oversupply on 2030 Target Could Be Substantial. Figure 3 illustrates a potential scenario where over 200 million banked allowances are carried forward into the post-2020 program without any adjustments to the current caps. This example assumes California emissions from covered entities (minus offsets) decline steadily through 2030 as a result of incentives provided by allowance prices, as well as other factors. It also assumes no allowances are sold from the price containment points or price ceiling (discussed in more detail below). Notably, under this scenario, the cap would effectively limit *cumulative* emissions, and covered entities would be complying with the regulation. However, due to the large number of banked allowances, 2030 annual emissions from

Figure 3

Large Number of Banked Allowances Increases Risk of Exceeding GHG Target

Million Metric Tons



GHG = green house gas.

covered entities would be over 30 percent higher than the levels likely needed to meet the state's target.

We found this general result—2030 emissions significantly higher than the annual target—under a couple different scenarios we analyzed. There are alternative scenarios where the difference is either larger or smaller than the one illustrated in Figure 3. Some factors that could change this outcome are (1) if emissions trends are substantially different than the steady decline in emissions reflected in Figure 3 and (2) if linking with other jurisdictions has significant effects on emissions from California entities.

AB 398 Directs CARB to Address Overallocation and Consider Changes to Banking Rules. Assembly Bill 398 directs CARB to evaluate and address concerns related to overallocation when determining post-2020 caps. (Although overallocation is not defined in the legislation, we interpret it to mean the number of allowances that are banked into the post-2020 period.) It also directs CARB to establish banking rules that "discourage speculation, avoid financial windfalls, and consider the impact on complying entities and volatility in the market."

Key Issues for Legislative Oversight. Setting the post-2020 caps are a critical design feature of the cap-and-trade program because the caps are the key mechanisms used to limit emissions. As discussed above, there are important questions about whether the caps and banking rules are likely to ensure the state meets its annual 2030 GHG target, especially given the large number of banked allowances that are likely to be carried forward from the pre-2020 program.

As a result, the Legislature will want to monitor CARB's assessment of overallocation and how it could affect the likelihood of meeting the state's GHG goals. For example, the Legislature could direct CARB to explain how it will evaluate overallocation and outline what criteria it will use to determine whether the program is likely to ensure the state meets its 2030 GHG goals. The Legislature could also direct CARB to explain what type of adjustments it would likely make in the future if it determines that the program is likely not going to ensure the state meets its 2030 GHG targets. Clearly outlining this process in advance could give the Legislature greater confidence that the program will limit GHGs in a way that is consistent with its goals. It could also provide greater long-term certainty to the market, which helps ensure allowance prices provide the incentives for GHG reduction strategies that are needed to meet the state's goals.

Options to Address Potential Overallocation Concern Exist. If the Legislature decides that having a large supply of banked allowances in the future is an issue that needs to be addressed, it has several options. In general, these approaches would be aimed at reducing the number of allowances available in later years of the program (including 2030). One such option would be to directly reduce the supply of allowances issued in post-2020 years to account for some or all of the allowances available to be banked from the pre-2020 period. Specifically, the state could offer fewer allowances in regular auctions than what is currently scheduled. This could reduce cumulative emissions (assuming prices do not reach the ceiling), as well as reduce the risk that emissions from covered entities substantially exceed the state's 2030 goal. Alternatively, the Legislature could direct CARB to establish an expiration date for allowances sold in the future. This would reduce the number of allowances issued in the next several years that could be banked and used to comply in later years.

The above options would have trade-offs. For example, establishing an expiration date for allowances could increase price volatility by reducing the ability to bank allowances. In addition, both of these options could increase long-term allowance prices by reducing the overall supply of allowances available in the later years. However, in our view, decisions about the number of allowances that could be available to be used in the later years of the program should be driven primarily by an evaluation of what is likely needed to ensure the state meet its 2030 GHG goals. Other design features that are designed specifically to limit price increases, such as the price ceiling and price containment points, are likely to be effective tools for addressing concerns about high allowance prices. In fact, if the state reduced the number of allowances available at future auctions, it could move those allowances to the price containment points (discussed below) to help mitigate potential price increases.

Setting Hard Price Ceiling at Level That Balances Emissions and Costs

Current Program Has Soft Price Ceiling. To implement the soft price ceiling, CARB sets aside a limited number of allowances in the APCR and offers them for sale to covered entities at predetermined price tiers—ranging from about $51 to $63 per allowance in 2017. This design feature is intended to moderate potential price spikes by increasing the supply of allowances if prices reach a certain level. It is sometimes called a soft price ceiling because market prices could still exceed the ceiling after all of the APCR allowances are purchased. Since the overall number of allowances available is still limited, there is still a fixed limit on overall emissions in the capped sector.

AB 398 Directs CARB to Establish a Hard Price Ceiling. Assembly Bill 398 directs CARB to establish a "hard" price ceiling. In contrast to a soft ceiling, a hard ceiling makes an *unlimited* number of additional compliance instruments available for sale at a predetermined maximum price. (Assembly Bill 398 does not specify a name for these compliance instruments, but in this report we refer to them as allowances because, like allowances, they could be used as a permit for covered entities to emit GHGs.) This approach is intended to ensure that market prices do not exceed the amount established by the ceiling. It accomplishes this goal by ensuring covered entities always have the option of purchasing compliance instruments from CARB at the ceiling price. Assembly Bill 398 specifies that some of the allowances left in the APCR at the end of 2020 will be sold at the price ceiling in the post-2020 program. After those allowances are sold, CARB must offer "additional metric tons" for sale to covered entities at the ceiling price if needed for compliance. Assembly Bill 398 also identifies the following factors that ARB must consider when setting the level of the ceiling:

- Need to avoid adverse impacts on households, businesses, and the state's economy.
- Social cost of emitting a ton of GHGs.
- 2020 APCR tier prices.
- Minimum auction price.
- Potential for leakage.
- Cost per metric ton of GHG reductions to achieve the state's emissions targets.

The primary trade-off associated with creating a hard price ceiling is that the program would no longer cap overall emissions if prices reach the ceiling. This is because entities could purchase an unlimited number of additional compliance instruments at that predetermined price. Assembly Bill 398 seeks to address this issue by specifying that the revenue from selling the additional compliance instruments sold at the ceiling must be expended by CARB to achieve an equivalent number of emissions reductions.

Issue for Legislative Oversight. Assembly Bill 398 provides CARB with significant discretion in setting the level of the price ceiling. The decision requires a balancing of the state's interests in containing costs for businesses and households with the certainty that targeted emission levels will be achieved. A relatively low ceiling price would do more to limit the costs of the program on businesses and households. On the other hand, it would increase the likelihood that prices reach the ceiling, thereby increasing the likelihood that emissions exceed the cap (by selling additional allowances). In contrast, a higher ceiling price does less to limit program costs but provides greater certainty that emissions will not exceed the cap.

Other factors are also worth considering when setting the price ceiling, such as how different price levels might affect the likelihood of linkages with other jurisdictions and the extent to which higher prices encourage businesses to develop different types of technologies that can be used to reduce GHGs in other jurisdictions. For example, in a recent workshop, CARB indicated that it might consider what price level might be needed to encourage the development of carbon capture and sequestration technology.

In our view, setting the level of the price ceiling is a policy decision that will depend on how one weighs many different factors. The Legislature will want to monitor whether CARB is weighing these various factors in ways that are consistent with legislative priorities. If the level of the price ceiling proposed by CARB is inconsistent with legislative priorities, the Legislature could set the price ceiling in statute or provide additional direction about how to weigh the different factors.

Setting Price Containment Points to Limit Price Spikes

CARB to Establish Price Containment Points. Assembly Bill 398 directs CARB to create two new price containment points—sometimes called speed bumps—at levels below the price ceiling. Assembly Bill 398 specifies that one-third of the allowances available in the APCR at the end of 2017 be deposited in each speed bump (roughly 40 million each). In concept, the speed bumps are intended to moderate potential price spikes. This is accomplished in a manner that is similar to the current APCR, where a limited number of allowances are offered at predetermined prices. However, in contrast to the APCR, the speed bumps will be set at intermediate price levels somewhere between the price floor and the ceiling.

Issues for Legislative Oversight. CARB has discretion to set the price level of the speed bumps. Similar to setting the level of the price ceiling, this decision involves a potential trade-off between having lower prices or lower emissions. Making more allowances available at a certain price helps limit price increases, but also permits more emissions. When determining the level of the speed bumps, CARB must determine the price at which it is willing to release more allowances in order to moderate price increases. The Legislature will want to evaluate CARB's regulatory proposal when it is available to ensure that the price levels at which it sets the speed bumps are consistent with legislative intent. If the Legislature determines that the speed bumps are set too high or too low, it could set the levels in statute or provide more specific direction to CARB about factors to consider when setting them.

In addition, in an initial workshop, CARB staff requested stakeholder feedback on whether it should place additional allowances that would otherwise go to the post-2020 price ceiling into the speed bumps. More allowances in the speed bumps could increase the degree to which they slow price increases but also make the program less stringent once prices reach certain intermediate levels. Since placing additional allowances in the speed bumps goes beyond the direction in AB 398, the Legislature will want to evaluate CARB's assessment of why this change might be needed to prevent rapid price spikes and determine whether any such change would reflect the Legislature's desired balancing of the potential effects on overall emissions and costs. If not consistent with its priorities, the Legislature could provide additional direction to CARB that explicitly limits the number of allowances allocated to each speed bump.

Implementing New Offset Limit Consistent With Legislative Intent

Current Program Has 8 Percent Limit on Offsets. Currently, a covered entity can use offsets to cover up to 8 percent of its emissions. To date, covered entities have used offsets to cover about 5 percent of their compliance obligations. As the Legislature considered extending cap-and-trade, there was some concern that continuing to allow up to 8 percent offsets for compliance would result in a large share of GHG reductions coming from offset projects, relative to reductions directly from covered entities. This was a concern largely because offset projects, many of which are in other states, might be less likely to provide other environmental benefits to Californians—such as reductions in local air pollutants.

AB 398 Establishes Stricter Offset Limits and Prioritizes Projects With Direct Environmental Benefits in California. In response to these concerns, AB 398 directs CARB to reduce the offset limit to 4 percent from 2021 through 2025 and to 6 percent from 2026 through 2030. The bill also requires that no more than half of these offsets can come from projects that do not provide direct environmental benefits in California (non-direct offsets). The bill defines direct environmental benefits as the reduction or avoidance of any air pollutant in the state or pollutant that could adversely affect state waters. These restrictions on offsets will likely decrease the overall number of offsets used for compliance. To make up the difference, covered entities would need to either buy more allowances or reduce more emissions directly. As a result, there could be higher allowance prices. Assembly Bill 398 also establishes the Compliance Offsets Protocol Task Force, made up of different stakeholder representatives appointed by CARB, to provide guidance on ways to increase offset projects with direct environmental benefits in the state.

Issues for Legislative Oversight. CARB has a variety of implementation decisions that could affect the types of offset projects undertaken and the overall level of offsets used for compliance. For example, it must determine which projects meet the requirements for direct environmental benefits. It is currently unclear whether certain types of projects would qualify, such as forestry projects in neighboring states that could affect water in California. Rules that tend to limit the number projects determined to have direct environmental benefits would decrease the overall number of offsets available and used. The Legislature will want to monitor how CARB identifies projects that provide direct environmental benefits to ensure those decisions are consistent with legislative intent and consider approving legislation if additional clarification is necessary.

In addition, there is some uncertainty about how the limit on non-direct offsets is applied. For example, if a company uses offsets to cover 2 percent of its compliance obligation in 2021, can all 2 percent be from non-direct offsets (half of the 4 percent limit) or only 1 percent (half of the offsets used for compliance)? The second interpretation would likely limit the number of offsets used for compliance more than the first. It would also be more complex for covered entities to plan for the use of offsets because the number of non-direct offsets to purchase would depend, in part, on the number of direct offsets it is able to purchase, which could be subject to considerable uncertainty. In an initial workshop, CARB staff indicated that it would apply the first interpretation. The Legislature will want to ensure this provision is being implemented in a way that is consistent with legislative intent and consider clarifying legislation if CARB adopts an inconsistent approach.

Determining Industry Assistance Factors Through 2020

Current Regulation Reduces Industry Assistance Factors (IAFs) in 2018. In 2017, about 15 percent of allowances were given for free to certain businesses for industry assistance. Only those covered entities operating in industries CARB has assessed as being at risk for leakage receive free allowances for industry assistance. The number of allowances given to each company is calculated based on four factors:

- ***Output.*** The amount of product (not GHG emissions) the company produces in California. The more a business produces in California, the more allowances it receives.
- ***Emissions Intensity Benchmark.*** A benchmark level of GHG emissions per unit of output. This benchmark is developed by CARB and reflects about 90 percent of each affected industry's average emissions intensity.
- ***Industry Assistance Factor.*** A percentage assigned by CARB to each industry based on that industry's risk of leakage. Industries with higher leakage risk can be assigned higher IAFs than those in industries with lower leakage risk. A higher IAF means a business within that industry receives more free allowances than if it were in a lower risk industry. CARB currently divides industries into one of three categories of leakage risk: high, medium, or low.
- ***Cap Adjustment Factor.*** A percentage that declines each year for all affected industries, consistent with the decline in the annual caps.

Through 2017, CARB applied a 100 percent IAF to businesses in all three categories of leakage risk. Setting the IAFs at 100 percent for all three categories was largely intended to serve as transition assistance to give affected companies time to adjust to the effects of the cap-and-trade program. Under the current regulation, IAFs are scheduled to decrease for medium (75 percent) and low (50 percent) risk industries from 2018 through 2020. This change was originally intended to more closely align the number of free allowances with the level of leakage risk.

AB 398 Requires 100 Percent IAFs for Post-2020 Program. Assembly Bill 398 directs CARB to apply 100 percent IAFs for all three categories of leakage risk beginning in 2021 (but to continue to apply the declining cap adjustment factor). However, the legislation does not provide direction for what IAF to apply in 2018 through 2020. Soon after AB 398 was enacted, the board directed staff to propose future amendments to the regulation that would maintain all IAFs at 100 percent from 2018 through 2020.

Issues for Legislative Oversight. Maintaining the higher IAFs would align with the post-2020 direction provided by the Legislature and could reduce leakage risk for medium- and low-risk industries. On the other hand, it also increases the risk that the state is providing more allowances to medium- and low-risk industries than are needed to prevent leakage. This could encourage more production and consumption of some GHG-intensive goods, which means more in-state emissions from these industries. Higher emissions from these industries could mean more emission reductions are needed from other sources—which could lead to higher overall costs to the extent that these other sources have higher costs for reducing emissions.

Figure 4 provides an estimate of industry assistance under the current regulation and AB 398 direction, as well as how the board's direction could increase the number of free allowances for industry assistance by about 8 million in each of the next few years. At fall 2017 allowance prices, the value of the additional allowances that would be allocated is over $100 million in each of the three years. These estimates assume output remains constant through the life of the program and is unaffected by a change in IAFs. Since higher IAFs would tend to lead to higher in-state output and the number of allowances given as industry assistance, the figure might underestimate the difference in allowances.

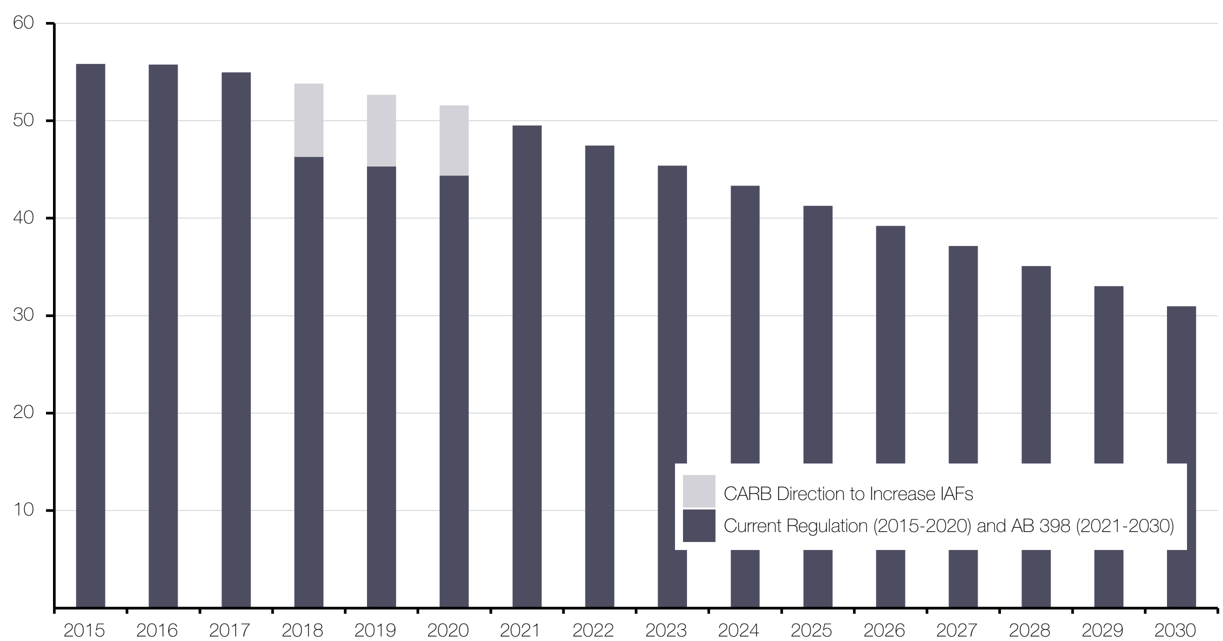
Although AB 398 does not provide specific direction regarding industry assistance from 2018 through 2020, the Legislature may want to consider whether the board's direction is consistent with legislative priorities. If not, the Legislature could specify in statute the IAFs for this period.

Summary of Key Issues for Legislative Oversight. Figure 5 (see next page) summarizes the key issues discussed above for legislative oversight of AB 398 discussed in this report.

Figure 4

Industry Assistance Under Current Regulation, AB 398, and CARB Direction

Allowances[a] (In Millions)



[a] Actuals for 2015 through 2016. Estimated for subsequent years.
CARB = California Air Resources Board and IAF = industry assistance factor.

Figure 5

Key Issues for Legislative Oversight

✓ **Setting Post-2020 Caps and Banking Rules to Ensure State Meets Its GHG Targets**

- Evaluating CARB's assessment of potential for large number of banked allowances carried forward into post-2020 period and how it could affect the state meeting its 2030 GHG target.
- Evaluating different options for adjustments to address a large number of banked allowances, if it is determined that it would create a significant risk of not meeting state's 2030 target.
- Ensuring there is a clear process in place to make future adjustments, if needed.

✓ **Setting Hard Price Ceiling at Level That Balances Emissions and Costs**

- Evaluating whether CARB's proposed price ceiling weighs different trade-offs, such as interests in containing costs versus certainty that targeted emissions levels will be achieved, in accordance with legislative priorities.

✓ **Setting Level and Size of Two Price Containment Points to Limit Price Spikes**

- Evaluating whether the number of allowances in each containment point is consistent with legislative interest in slowing price increases at intermediate levels, while also limiting emissions.
- Evaluating whether price containment points are set at levels where the Legislature is willing to allow greater emissions in exchange for limiting price increases.

✓ **Implementing New Offset Limits Consistent With Legislative Intent**

- Ensuring CARB's identification of projects with direct environmental benefits is consistent with legislative intent.
- Ensuring the limits on non-direct offset projects is implemented in a way that is consistent with legislative intent.

✓ **Determining Industry Assistance Factors Through 2020**

- Evaluating whether CARB direction to maintain 100 percent IAFs through 2020 balances leakage risk and incentives for GHG-reductions in a way that is consistent with legislative priorities.

GHG = greenhouse gas; CARB = California Air Resources Board; and IAF = industry assistance factor.

IMPLEMENTING THE MARKET ADVISORY COMMITTEE

Given the potentially significant environmental and economic effects of state GHG policies, including cap-and-trade, AB 398 includes a variety of reporting requirements meant to enhance oversight and accountability. Key among these is the establishment of the Market Advisory Committee. In our view, the committee has the potential to provide valuable information to support legislative oversight and future policy and regulatory decisions. Below, we identify potential areas where the Legislature might want to consider clarifying or refining direction for the Market Advisory Committee to increase the likelihood that it will provide useful information for these future decisions.

Scope of Policies Under Committee Jurisdiction. Assembly Bill 398 directs the committee to annually report on the environmental and economic performance of cap-and-trade and other relevant climate policies. Given the wide range of state policies focused on climate change—such as cap-and-trade, energy efficiency, RPS, and LCFS—the scope of this requirement appears rather broad. The Legislature could provide more specific direction about which policies it would like the committee to focus on. This could help ensure the committee's workload is manageable and make it easier to appoint members that have in-depth expertise in the policies within the committee's jurisdiction.

Role of Committee. It is not clear whether the Legislature established the committee to (1) advise on future program design issues (such as how to manage an oversupply of allowances) and/or (2) evaluate past program performance. Advisory activities are generally aimed at providing information to guide future program decisions. In contrast, program evaluations tend to focus more on measuring past program outcomes. Although the name of the committee suggests it will serve an advisory function, the statutory requirements suggest that it is responsible for program evaluation. In a workshop on October 2017, CARB indicated that the advisory committee will be responsible only for program evaluation. The Legislature will want to consider whether this approach is consistent with its intent. If not, it should clarify whether it would like the committee to advise on program design issues, evaluate program outcomes, or both.

CARB has indicated that to ensure that the committee's evaluation is independent, committee members will not be involved in advising on program design issues. It is reasonable to have some concern about this conflict. However, this type of conflict frequently occurs when agencies are asked to evaluate their own programs. In this case, unlike agencies that evaluate their own programs, the committee would not be the one responsible for designing the program (just advising). As a result, in our view, this is a relatively minor concern. Nonetheless, if this is a significant concern for the Legislature, one option would be to establish two separate committees—one for program evaluation and one to advise on program design. This would help maintain independence for each committee. In addition, the members of each committee could be selected based on the type of expertise that is most relevant for the activities within the committee's jurisdiction.

Alternatively, under a scenario where there continues to be only one committee, the Legislature could direct the committee to primarily serve in an advisory role for program design while also requiring it to (1) identify high-priority areas for additional research funding and/or (2) help evaluate proposed research projects, particularly to ensure sound methodologies. Since the committee members would not be conducting the research, this could reduce concerns about conflicts. We find that this approach would also more clearly focus the committee's role as advisory, while using its expertise in guiding effective evaluation practices.

Different Roles Could Require Different Levels of Resources. In our view, there is value in having independent experts both advising on program design issues and evaluating program outcomes. When determining which activities the committee should conduct, the potential value of these activities will have to be balanced against the level of resources that might be needed. For example, a committee with a narrower scope of advising just on cap-and-trade program design might require fewer resources—likely less than a million dollars annually—because committee members would largely rely on their existing expertise in these areas and other information that is already available.

Alternatively, program evaluation activities could require substantially more resources for new data collection, modeling, and analysis. The structure of the committee could also limit the amount of analysis that could be conducted in a timely manner. For example, a similar committee established by the California Energy Commission to help evaluate petroleum markets (called the Petroleum Market Advisory Committee) recently found a significant unexplained difference in California gasoline prices compared to the rest of the country. However, it could not reach clear conclusions about the cause of elevated gasoline prices and the best remedies for a variety of reasons, including:

- Limited staff with the necessary expertise were available to carry out the analysis needed by the committee. Less than one full-time equivalent staff person from the California Energy Commission was available to support committee activities.
- Difficulty conducting regular in-person meetings because the committee members had full-time jobs in disparate locations and did not receive reimbursement for travel or other expenses. Committee members had full-time jobs in Irvine, Berkeley, San Francisco, Stanford, and Davis. In addition, under California's Bagley-Keene open meeting rules, members are limited in how much they can discuss issues within the jurisdiction of the committee with each other outside of public meetings.

If the Emissions Market Advisory Committee faced similar challenges, they could adversely affect its ability to conduct timely and effective program evaluations. As discussed above, the Legislature might want to direct the committee to have a more limited role in helping identify areas for future research funding and/or evaluate research proposals to ensure they are methodologically sound, rather than conducting its own research. This approach would also be less costly to support than if the committee were directly responsible for program evaluation. However, there could still be additional costs to fund the program evaluations performed by other entities that the committee identifies as high priorities.

Consider Identifying More Specific Outcomes to Evaluate. Assembly Bill 398 does not specify which outcomes or program characteristics the committee should focus on. The Legislature could provide more specific direction about what it would like the committee to evaluate. For example, if the committee should be focused on evaluating program performance, the Legislature could direct it to evaluate such things as GHG emission reductions, costs of reductions, and how those costs are distributed across the different sectors of the state economy. If the committee primarily acts in a cap-and-trade advisory role, the Legislature could direct it to make recommendations on program design features that would help ensure the program limits price volatility, prevents market manipulation, encourages the most cost-effective reductions, and is structured in a way that likely helps the state meet its GHG targets. Providing more specific direction could help ensure the committee is focusing on the outcomes that are of greatest interest to the Legislature.

IMPLICATIONS FOR AUCTION REVENUE

The extension of the cap-and-trade regulation through 2030 also extended the period in which the state will receive revenue from cap-and-trade auctions. While it is clear that there will be additional revenues to the state beyond 2020, the amount that will be generated annually is highly uncertain. Accordingly, we identify two potential cap-and-trade revenue scenarios below.

Various Factors Contribute to Substantial Uncertainty. Over the last few years, annual revenue has ranged from less than $1 billion to nearly $2 billion. The amount of state revenue generated from future cap-and-trade auctions depends on two basic factors: the number of allowances sold and the price of those allowances. Both of these factors, especially prices, are affected by (1) future "business-as-usual" (BAU) emissions, (2) the effect of other GHG reduction policies, and (3) cap-and-trade program design decisions. First, BAU emissions reflect what future emissions would be if no new GHG reduction policies (including extending cap-and-trade) were implemented. These future emissions would largely depend on general economic conditions and technological changes, both of which are subject to significant uncertainty. Higher BAU emissions means cap-and-trade would need to encourage greater emission reductions, resulting in higher allowance prices. Second, the effect of other GHG reduction policies—such as RPS requirements and LCFS standards—on emissions could affect revenue. For example, a more stringent RPS or LCSF means cap-and-trade would need to encourage fewer emission reductions and result in lower allowance prices. Third, as discussed above, various regulatory decisions—such as setting post-2020 caps, banking rules, the level of industry assistance, and setting the levels of the price ceiling and speed bumps—could also have significant effects on the number of allowances sold and prices.

Range of Future Revenue Could Vary by Billions of Dollars Annually. Figure 6 illustrates two revenue scenarios through 2030 under different assumptions about future allowance prices. The low price scenario assumes all allowances sell at the minimum price established by CARB from 2018 through 2030. The high price scenario assumes prices are roughly $20 in 2018 and increase to reach a price ceiling of about $85 in 2030 (in 2017 inflation-adjusted dollars). This scenario also assumes the price speed bumps are evenly distributed between the price floor and ceiling, and that they have the effect of keeping prices flat for about one year (in 2023 and 2027). Although the speed bumps slow price increases, the result is a net increase in revenue in this scenario because the state sells the additional allowances available in the speed bumps. Under these two scenarios, revenues would range from $2 billion to $4 billion in 2018 and from $2 billion to almost $7 billion in 2030. In our view, these two scenarios provide a plausible range of future revenues. However, there are alternative scenarios where revenue could be higher or lower, especially in certain years.

Figure 6

Cap-and-Trade Revenue Scenarios Vary by Billions of Dollars Annually

(In Billions, 2017 Inflation-Adjusted Dollars)

CONCLUSION

In July 2017, the Legislature passed AB 398, extending the state's cap-and-trade program through 2030. The program is one of the state's key strategies intended to ensure GHG emissions are 40 percent below 1990 levels by 2030. Cap-and-trade is a complex program that requires many different design decisions that could affect both emissions and costs to businesses and households. In this report, we identify key CARB implementation decisions and major trade-offs associated with those decisions. We also identify potential opportunities to improve Legislative oversight and future policy decisions to ensure that the administration is implementing the program in a way that is consistent with legislative intent and priorities.

APPENDIX: KEY CAP-AND-TRADE TERMS

Allowance. A permit issued by the California Air Resources Board (CARB) to emit one ton of carbon dioxide equivalents. Allowances are either given away to certain industries, auctioned, or sold at a price ceiling or price containment point.

Allowance Price Containment Reserve (APCR). A *limited* number of allowances that are set aside by CARB and used to implement the soft price ceiling. Specifically, CARB offers these allowances for sale to covered entities if allowance prices reach a predetermined level.

Banking. The act of purchasing an allowance in one year, but using it for compliance in a future year.

Business-as-Usual (BAU) Emissions. The level of emissions that would occur absent any effects from cap-and-trade or other greenhouse gas (GHG) reduction policies. The level of BAU emissions is affected by such things as general economic activity and technological changes.

Compliance Instruments. Allowances or offset credits that covered entities can use to comply with the regulation. Each instrument covers one ton of carbon dioxide equivalent.

Emissions Cap. The number of allowances issued, as determined by CARB. Cap can be considered on either annual or cumulative basis.

Greenhouse Gas Reduction Fund (GGRF). The state fund where moneys generated from state auction or sale of allowances are deposited.

Industry Assistance Factor. A factor, established by state law or regulation, that is used to determine the number of allowances given to certain industries for free to help prevent emissions leakage.

Leakage. When emissions are shifted out of state because companies move their production of goods out of California in response to higher costs associated with in-state regulations.

Offsets. Emissions credits that are generated by undertaking certified GHG emission reduction projects from sources that are not subject to the state's cap-and-trade program. Covered entities can use a limited number of offsets instead of allowances.

Price Ceiling. A predetermined allowance price level that is intended to moderate or prevent price spikes above that price level. There are two types of price ceilings:

- ***Soft Price Ceiling.*** A predetermined allowance price level intended to moderate, but not necessarily prevent, price spikes. If prices reach the soft ceiling, CARB would sell a *limited* number of allowances from the APCR.
- ***Hard Price Ceiling.*** A maximum allowance price that is designed to ensure that allowance prices do not exceed that level. If prices reach the hard ceiling, CARB would be able to sell an *unlimited* number of allowances at that price.

Price Containment Points ("Speed Bumps"). Similar to the APCR, speed bumps are intended to limit price spikes by making a limited number of allowances available at predetermined prices. However, for the speed bumps, allowances are made available at intermediate prices between the floor and the ceiling.

Price Floor. A predetermined allowance price level that is intended to moderate or prevent price drops below that level. To implement a price floor, CARB establishes a minimum price at which allowances can be auctioned.

LAO PUBLICATIONS

This report was prepared by Ross Brown and reviewed by Brian Brown. The Legislative Analyst's Office (LAO) is a nonpartisan office that provides fiscal and policy information and advice to the Legislature.

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TECHNICAL APPENDIX TO BLOG POST "ANALYZING THE LIKELY IMPACT OF OVERSUPPLY ON CALIFORNIA'S CARBON MARKET MUST CONSIDER STATE'S 2030 EMISSIONS GOAL AND POTENTIAL FOR CLEAN TECH BREAKTHROUGHS"

BY CHRIS BUSCH ● JANUARY 2018

This technical note provides more detail regarding how the Borenstein-Bushnell blog, abbreviated "BBB," calculates the likely impact of adjusting for oversupply and explains the role played by the arguably overly inelastic abatement supply used in BBB. The core analytical framework used in BBB is developed in a recent research paper Borenstein, Bushnell, and Wolak 2017 (Borenstein et al. 2017).

After developing the necessary background, the extreme example of a completely inelastic abatement response due to the carbon price is illustrated. In the case of perfectly inelastic abatement supply, adjusting for oversupply would make absolutely no difference in emissions reductions. In the perfect inelasticity case, the price would be at the floor if the market is short and at the ceiling price if the market is long. Under either outcome, emissions would be the same. To set the stage for the discussion, I start by borrowing and explaining some figures (Figures 3 and 4) from Borenstein et al. 2017).

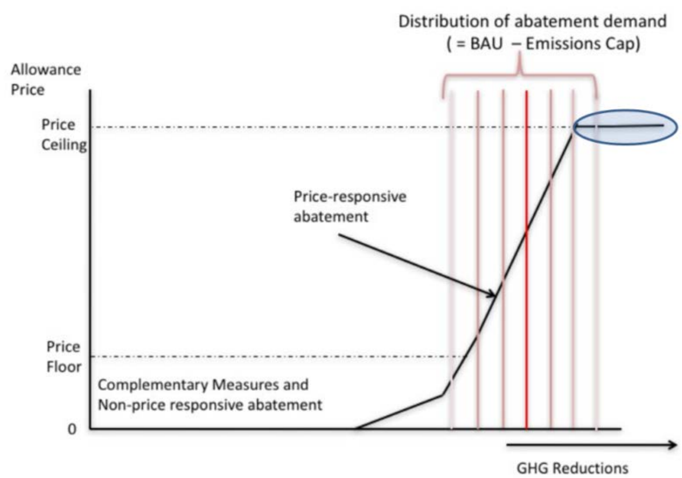


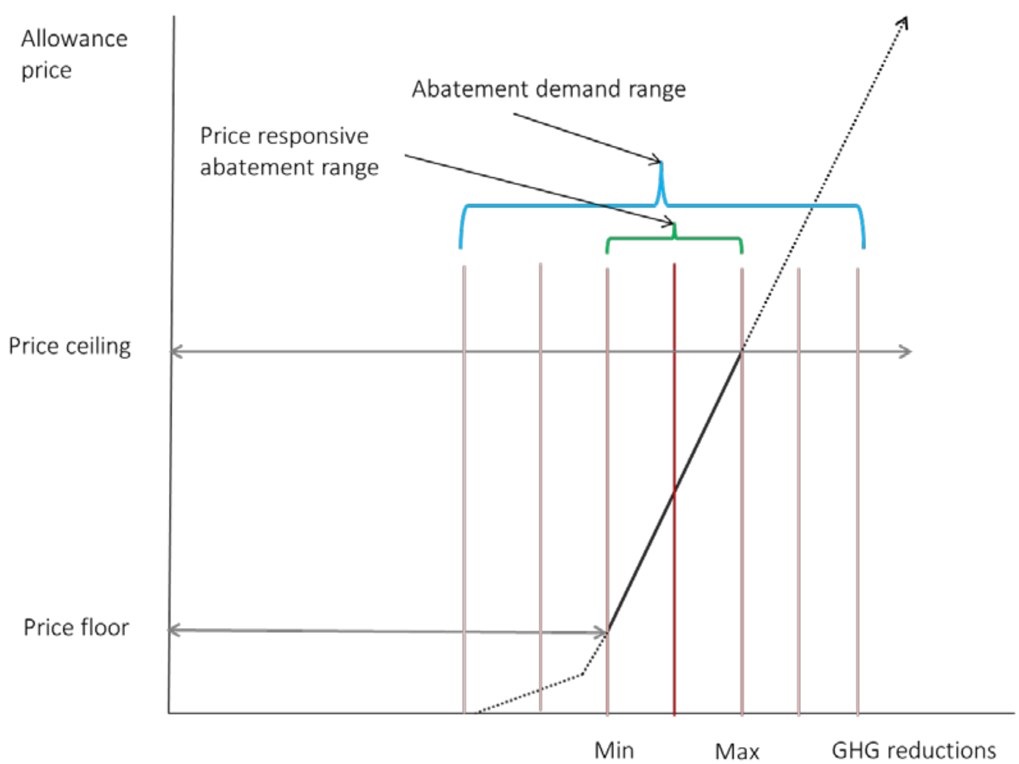
FIGURE 3. HYPOTHETICAL SUPPLY AND DEMAND FOR ABATEMENT

Source: Borenstein et al. 2017

Figure 3 shows supply and demand for abatement in the paper's main scenario, the "base case." The black line, labeled "price responsive abatement," shows emission reductions expected at different price levels if opportunities from fuel switching are omitted. As the carbon allowance price increases, moves up the horizontal-axis, the amount of reductions increase, i.e. move further to the right on the vertical-axis. The brightest red line shows the probability weighted average for abatement demand, which a label helpfully explains is a reflection how many reductions the cap requires below BAU (business-as-usual) emissions, i.e., emissions expected in the absence of a cap-and-trade program. So, abatement demand equals BAU emissions minus the cap. (Borestein et al. 2017 treats 2015-2030 as a single cumulative cap, hence the use of cap singular, representing the sum of annual caps.)

A range of possible abatement demand levels are possible, reflecting uncertainties about future economic growth and other variables, and this reality is indicated by the vertical lines of various shades of red in Figure 3. As these move farther away from the bright red probability weighted average at the center, their coloring becomes less intense, reflecting the lower probability that they will happen. Since the abatement demand curves shown barely intersect with the price floor (the minimum auction price) and price ceiling (if prices reach this level, CARB will auction more), it seems this is a stylized representation. Since the most likely outcomes are actually at the price floor or ceiling, the actual distribution of abatement would appear to be much larger than the range shown. There is nothing problematic about this, just worth noting for readers wishing to understand the geometry of the graph.

Figure 3 is shown exactly as in the original research paper, with the exception of the light blue oval, which appears to show greenhouse gas emissions continuing to accumulate at the price ceiling, but this is not consistent with the analysis. In an email exchange, Professor Borenstein agreed that the graph could be made clearer. I've attempted to do that with the graphic below, in order to set the stage for the discussion that follows.



A1. Modified graphic of base case result in Borenstein et al. (2017)

The black line shows the price-responsive abatement supply within range of the price collar (price ceiling and price floor). The dotted line extension of the black line in Figure A1 shows price-responsive abatement supply outside of the price collar. Reductions to the left of where the dotted line intersects the horizontal axis are due to complementary policies (i.e. policies other than cap-and-trade). Different abatement demand outcomes under different values for uncertain variables are shown with the red (probability weighted average) or pink vertical lines, as in the original Figure 3. Abatement demand that intersects abatement supply outside of the price collar forces reductions to the level implied at the price floor or ceiling. This implies the maximum or minimum greenhouse gas emission reduction levels labeled along the horizontal axis, which is shown above with a green bracket (labeled “price responsive abatement range”).

The intersections of supply and demand in Figure 3 (and reproduced in this document as Figure A1) produce a probability distribution of outcomes around price and quantity of greenhouse gas reductions under different economic growth, different travel demand (vehicle miles traveled), and other uncertain variables. Figure 4 depicts the resulting probability distribution of prices.

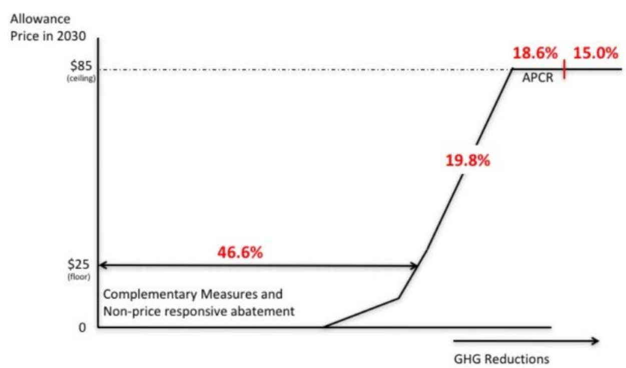
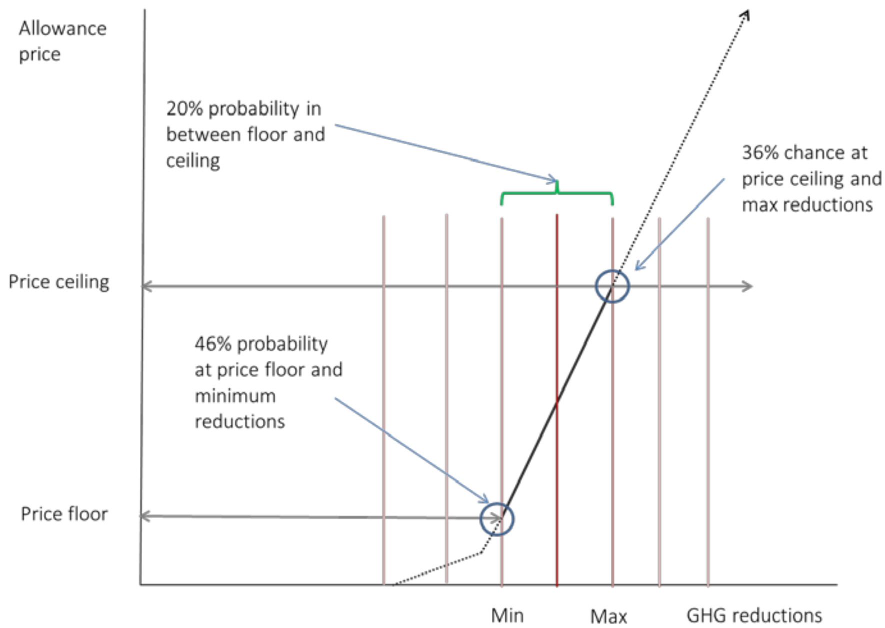


FIGURE 4. DISTRIBUTION OF OUTCOME PROBABILITIES WITH HARD PRICE CEILING, NO STEPS

Source: [Borenstein et al. 2017]

For ease of explanation to non-economists, I present the same results building on the modified graphical framework developed in figure A1. Figure A2 shows how the probability distribution for prices emerges from the intersection of abatement demand and abatement supply.

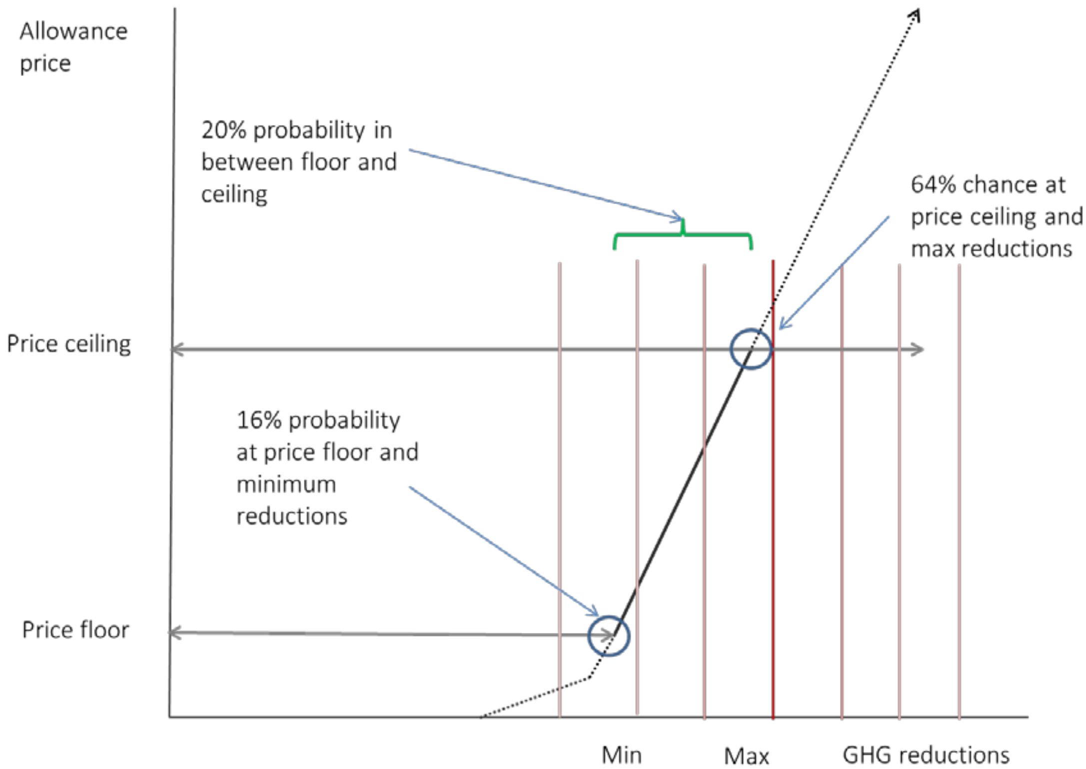


A2. Probability distribution of prices in base case for Borenstein et al. 2017. [1]

As in the original Figure 3 from Borenstein et al. 2017, where the pink abatement demand line intersects the abatement supply line to the below the level of reductions at the price floor, the price floor kicks in, driving reductions to the "min" level, the minimum amount of reductions from cap and trade. Where the abatement demand line intersects abatement cost above the price floor, the price ceiling kicks in, resulting in emission reductions at the "max" level.

In figure A3, we show how the Borenstein and Bushnell blog (BBB) arrives at their conclusion that adjusting for oversupply would have an effect of 42 million metric tons (MMT).

[1] For simplicity, this presentation rounds their probability estimate downward from 46.6 percent so that the total for percentage outcomes adds to 100 percent.



A3. Probability distribution of prices after adjusting for oversupply in base case for Borenstein et al (2017). [2]

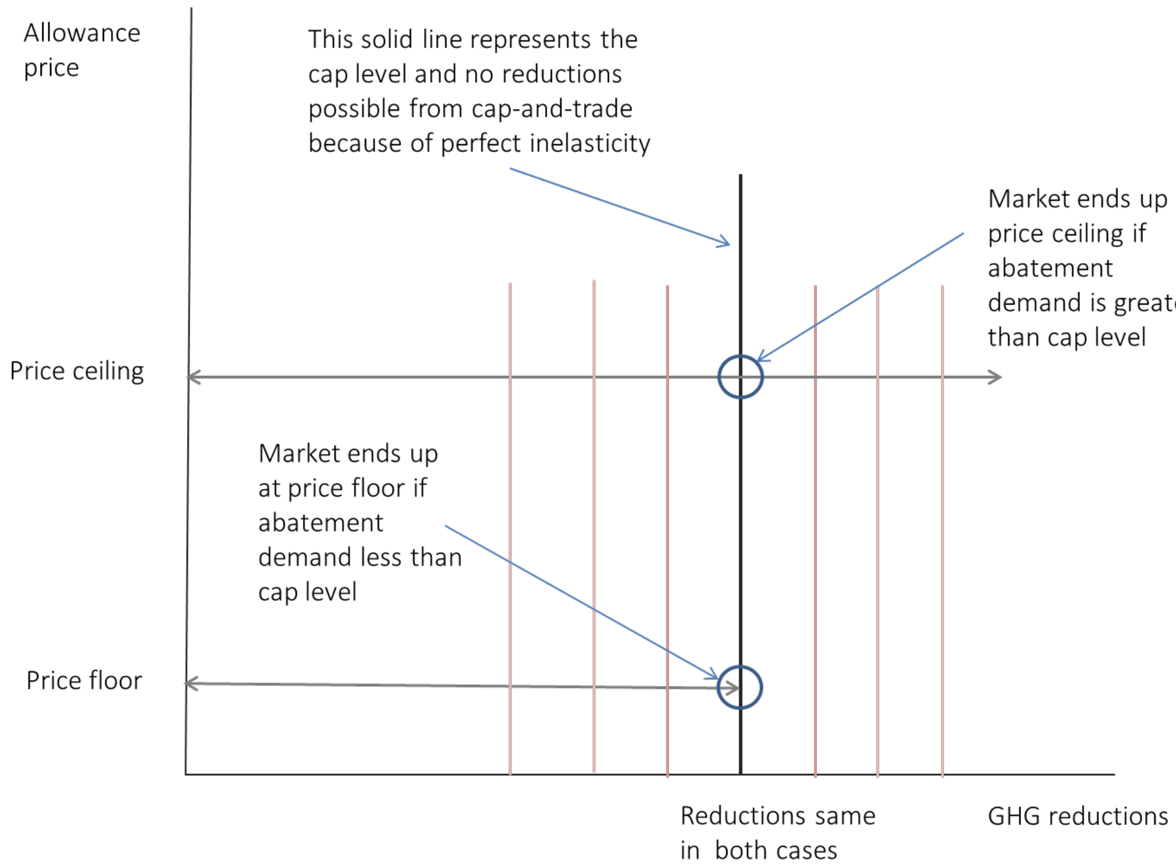
Adjusting for oversupply results in increased abatement demand (more reductions are required). This shifts the abatement demand probability distribution to the right. The result is a 30 percent shift in probability to the ceiling from the floor. Table 1 of Borestein et al. shows their estimated reductions at the price floor equal 78 MMT and estimated reductions at the ceiling as 218 MMT.

So, the impact estimate equals the effect of the increased likelihood of ending up at the ceiling plus the effect of the decreased likelihood of ending up at the price floor, which implies:

Impact of oversupply adjustment = 0.3 * 218 – 0.3 *78 = 42 MMT

Having explained how Borenstein, Bushnell and Wolak arrive at the results in their base case, next we show how the inelasticity of abatement supply helps to drive this result. Figure A4 shows how adjusting for oversupply would make zero difference if abatement supply is perfectly inelastic. If this is the case, the market ends up at the price floor if the market is long or the price ceiling if the market is long. In either case the amount of reductions is the same.

[2] For simplicity, this presentation rounds their probability estimate downward from 46.6% so that total for percentage outcomes add to 100 percent.



A4. Implications of a perfectly inelastic abatement supply curve for carbon allowance market

The vertical solid black line indicates a completely inelastic curve. No emission reductions happen because carbon pricing makes no difference. If abatement demand is to the left/below the cap level, the price is at the floor. If abatement demand is to the right/above the cap level, the price is at the ceiling. Under such circumstances, adjusting for oversupply makes no differences in the level of emissions. The impact of adjusting for oversupply would be to move the abatement demand curves to the right, affecting the expected price, but having no effect on the level of emission reductions.

This discussion has shown that the inelastic supply curve developed in Borenstein et al. (2017), which we argue is overly constrained in terms of the possible abatement response, plays an important role in the conclusion from BBB that adjusting for oversupply would not affect greenhouse gas emissions as much as a straightforward consideration of the change in allowance supply would indicate.

RESEARCH NOTE

Removing excess cap-and-trade allowances will reduce greenhouse gas emissions

A response to Severin Borenstein and Jim Bushnell

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Jan. 11, 2018

Last month, the California Air Resources Board (ARB) identified the cap-and-trade program as the single largest component of its approved Scoping Plan for meeting California's ambitious 2030 target for greenhouse gas (GHG) emission reductions. However, the program has a large oversupply of emission allowances—that is, the number of allowances issued to date have been far in excess of the emissions from sources regulated under the program.

Several prominent economists have argued that this oversupply could undermine the effectiveness of the cap-and-trade system in achieving emission reductions in support of the 2030 target. If oversupply spurs companies to "bank" extra allowances for future use, polluters could be able to comply with the program while their emissions significantly overshoot the emission cap in 2030. To address this risk, some have suggested that ARB lower the emissions cap for the period 2021-2030, reducing the supply of allowances to ensure that the program delivers its intended reductions.

A new analysis this month by two prominent economists—Professors Severin Borenstein of UC Berkeley and Jim Bushnell of UC Davis—argues that lowering program caps to address market oversupply would not actually have much effect on the state's emissions. Borenstein and Bushnell argue that the program cap is no longer binding because ARB must sell unlimited allowances at a new ceiling price. If prices reach this level, they argue, removing excess allowances to address market oversupply would not have any additional effect.

Although Borenstein and Bushnell's analysis makes important contributions to the state climate policy discussion, their assertion that addressing market oversupply would not substantially affect emissions depends on several core assumptions that differ from ARB's views as well as what the cap-and-trade extension bill, AB 398, now requires. In this note, we review their calculations and offer three responses:

1. **AB 398 requires ARB to reduce additional emissions for every allowance sold at the price ceiling.** Although ARB has not identified how it would achieve this outcome and there are reasons to be skeptical of this requirement, AB 398's environmental integrity provision is current law. If enforced, it would give full effect to strategies that address market oversupply, resulting in a much greater benefit than what Borenstein and Bushnell project—although some of those benefits may accrue outside California.

2. **The new analysis suggests that ARB may need to set a higher price ceiling to ensure the effectiveness of the cap-and-trade program.** Borenstein and Bushnell calculate that a market design which eliminates oversupply has a nearly two-thirds chance by 2030 of reaching a price ceiling close to what is set in current regulations. Many of these scenarios would not constrain the emissions covered by the cap-and-trade program. Rather than justify inaction on oversupply, the new analysis suggests it may be necessary for ARB to consider a higher price ceiling than that in current regulations in order to deliver on the reductions the Scoping Plan calls for from cap-and-trade.

3. **ARB's expectations for the program suggest that addressing market oversupply will reduce emissions more than Borenstein and Bushnell calculate.** ARB asserts that cap-and-trade will be much more effective at reducing emissions than do Borenstein and Bushnell. Although ARB hasn't publicly justified its view, the Board's assumptions would, if true, cause oversupply adjustments to be much more effective at reducing emissions.

Fundamentally, this discussion illustrates how different market design choices can interact and why it is important to analyze proposed market designs on a comprehensive basis. It also indicates the need for ARB to explain how the market reforms it will adopt under AB 398 are consistent with the role the Board has identified for cap-and-trade in the final 2017 Scoping Plan.

ARB has not yet produced any analysis of how its cap-and-trade market design choices will produce the emission reductions identified in the Scoping Plan. We hope that such an analysis is forthcoming and will be as transparent in its assumptions and model structure as the work that Borenstein and Bushnell have published.

Table of Contents

Introduction: What's a few hundred million tons between friends?

In a recent post at the UC Berkeley Energy Institute blog, noted economists Severin Borenstein (UC Berkeley) and Jim Bushnell (UC Davis) weighed in on the debate over what to do about the California cap-and-trade program's oversupply problem (Borenstein and Bushnell 2018).[1]

Borenstein and Bushnell are well known for their important work on the design of California's cap-and-trade policy, including their public service with the now-defunct Emissions Market Advisory Committee (EMAC). More recently, they released a July 2017 working paper (along with their former EMAC colleague, Stanford Professor Frank Wolak) that estimates likely market outcomes for the cap-and-trade program's extension through 2030 (Borenstein et al. 2017).

Using the quantitative model developed for their working paper, Borenstein and Bushnell argue in their new blog post that whatever ARB decides to do about the glut of allowances currently in the market will have only "a modest impact on the state's emissions through 2030."

This conclusion is striking, especially given the concern many other prominent economists have expressed about the risks oversupply creates with respect to California's ability to meet its 2030 climate target:

- Energy Innovation's Chris Busch recently calculated that cumulative market oversupply through 2020 is on the order of 270 (±70) $MMTCO_2e$. This amount could "allow for significantly more emissions than intended under the 2017 Scoping Plan, cutting into planned cumulative emissions and possibly leaving 2030 emissions above the SB 32 target" (Busch 2017).

- Resources for the Future's Dallas Burtraw reviewed multiple options to resolve the market oversupply problem, drawing on experiences from other cap-and-trade programs around the world. Although fundamentally optimistic that the Air Resources Board (ARB) will address market oversupply, he acknowledged that the "magnitude of the [oversupplied] allowances could undermine the state's intent" to achieve its climate targets, if left unaddressed (Burtraw 2017).

- Finally, the non-partisan Legislative Analyst's Office addressed market oversupply in a recent report (LAO 2017). In a section titled "Effect of Oversupply on 2030 Target Could Be Substantial," the LAO considered a scenario in which 200 $MMTCO_2e$ worth of allowances are banked into the post-2020 period. In this scenario, LAO concluded that 2030 emissions in capped sectors could end up 30% higher

[1] A note on terminology: there are multiple terms in use to describe the same phenomenon, including *oversupply*, *overallocation*, and *overhang*. All terms refer to the number of extra allowances in the cap-and-trade program as a result of program caps that were set above where GHG emissions covered under the program have been to date. This is calculated on a cumulative basis, meaning that oversupply is the sum of extra allowances from the program's first year of compliance in 2013 through a benchmark year—typically 2020, the end of the program's third compliance period.

than the nominal program caps, even under the assumption that no additional allowances are sold at the market's price ceiling.

In their new post, Borenstein and Bushnell adapted the Borenstein et al. (2017) model to simulate a scenario in which California lowers its emissions caps to eliminate the large oversupply of allowances building up in the market today. According to their calculations, the probability-weighted emission reductions from this intervention would be only 42 million tons ($MMTCO_2e$) through 2030—an amount they consider "not chump change," but also not a "fundamental change" to the cap-and-trade system's large role in the final Scoping Plan.

In particular, they point to the fact that AB 398, the bill extending the cap-and-trade program through 2030, directs ARB to determine a maximum price, or price ceiling, and to allow unlimited sales of allowances at that ceiling. Thus, after 2020, there will no longer be a hard cap on the number of allowances that can be sold if prices reach the ceiling. Borenstein and Bushnell argue that if the market is already going to reach the price ceiling, removing extra allowances to compensate for oversupply won't have any effect.

Because of the importance of the oversupply issue as a potential risk to California's ability to reach its 2030 climate target, we wanted to review Borenstein and Bushnell's analysis to better understand the conditions under which their conclusion holds true.

Two key concepts

Before we address Borenstein and Bushnell's arguments, it is important to clarify two conceptual issues:

Concept #1: Annual vs. cumulative emissions

Key California policies operate on an *annual* emissions accounting basis—most notably, AB 32's requirement that ARB return statewide GHG emissions back to their 1990 levels by 2020, and SB 32's requirement to cut a further 40% by 2030.

In contrast, California's cap-and-trade program features unlimited banking of allowances from one year to the next, and therefore effectively operates on a *cumulative* emissions accounting basis. In ARB's cap-and-trade market, emitters may shift the timing of their emissions (as well as emission reductions) by adjusting how many allowances they submit for compliance with program rules in each year, such that the program controls not the timing of annual emissions but rather the cumulative total over time. As a result, there is a mismatch between the way emissions are handled in the cap-and-trade system and the way California's climate policies are evaluated under AB 32 and SB 32.

Reflecting the cumulative nature of cap-and-trade programs, Borenstein and Bushnell's work models the cumulative supply/demand balance in the cap-and-trade market through 2030, not the annual emissions in any given year. We'll retain that approach in our discussion here for convenience. But we want to emphasize that ultimately AB 32 and SB 32 charge ARB with the responsibility of meeting annual targets in 2020 and 2030, not a cumulative target expressed over a period of time.

Concept #2: Prices vs. quantities

Further complicating matters is the distinction between price- and quantity-based instruments. For example, consider the classic price instrument, a carbon tax: the tax sets a fixed price on emissions, but the resulting emission reductions are uncertain, depending on how regulated parties respond to the fixed price signal. In contrast, the classic quantity instrument, a cap-and-trade program, sets a fixed limit on emissions but leaves the price of allowances up to the market. As these examples illustrate, a policy can produce certainty in only prices or quantities, but not both at the same time.

ARB initially adopted a hybrid model that combines the features of price- and quantity-based instruments. California's program includes an auction reserve price that sets a minimum price—called the floor price—at which ARB will sell new allowances. If California did not have a floor price, market prices for allowances would probably have been significantly lower to date, as a result of the oversupply of allowances currently in the market (Cullenward 2014; Cullenward & Coghlan 2016).

In adopting AB 398, California doubled down on its hybrid model by adopting a hard price ceiling that complements the price floor. ARB will implement the hard price ceiling by offering an unlimited number of allowances at a ceiling price (at a level yet to be determined). If market prices rise to this level, ARB will issue as many new allowances as buyers demand to cover their emissions.

California's cap-and-trade program is now a true hybrid. If allowance prices would naturally fall below the price floor, the price floor will kick in and the program will operate like a tax. If allowance prices would naturally fall between the price floor and the price ceiling, the program will function like a market. But if allowance prices would naturally rise above the price ceiling, the price ceiling will kick in and the program will again operate like a tax. In other words, at low demand the program operates like a tax (a price instrument), at moderate demand it operates like a market (a quantity instrument), and at high demand it again operates like a tax (a price instrument)—a hybrid approach.

Critically, if allowance prices reach the price ceiling, the program will no longer provide a "backstop" that limits total covered emissions. In essence, a price ceiling makes a tradeoff: although the program can no longer guarantee a certain level of environmental performance, a price ceiling ensures market prices remain at or below a politically determined level.

The Borenstein and Bushnell critique

In their Energy Institute post, Borenstein and Bushnell make two key arguments.

- First, they argue that the program's "cap" is not really a cap—that is, that because of the hard price ceiling required under AB 398, the cap-and-trade program no longer sets a hard limit on cumulative emissions. If market prices rise to the price ceiling, ARB will issue unlimited allowances and the program will no longer contain covered emissions at the nominal program cap levels—neither in annual nor in cumulative terms. (Later in this report, we examine their argument that the cap is not really a cap.)

- Second, they argue that addressing market oversupply will not have a particularly large effect on state GHG emissions because of interactions that occur when market prices reach the price ceiling. Specifically, Borenstein and Bushnell argue that if the cap is lowered in a scenario that reaches the price ceiling by 2030, then lowering the cap by a certain number of allowances won't deliver a corresponding amount of emission reductions. Removing excess allowances from the market would increase market prices and therefore incentivize emission reductions in the short term. But once the market reaches the price ceiling, they argue that no additional reductions would occur.[2]

In their July 2017 working paper, Borenstein et al. use their model to estimate the probability of the cumulative market supply/demand balance reaching the price floor, the price ceiling, or somewhere in between the minimum and maximum prices.

To assess the impact of removing excess allowances to account for market oversupply, Borenstein and Bushnell adjust their model by reducing the cumulative supply of allowances (i.e., lowering the emissions cap) in their model by between 250 and 300 MMTCO_2e.[3] We compare the original 2017 paper and the new results from the Energy Institute blog post here:

[2] Similarly, for scenarios in which market prices stay at the price floor through 2030, removing excess allowances doesn't matter because in these scenarios, the resulting market price would still be at the price floor. As we explain below, however, Borenstein and Bushnell expect that removing excess allowances would make such an outcome much less likely.

[3] Borenstein and Bushnell did not specify the precise number of allowances they removed. For context, Chris Busch estimated cumulative oversupply through 2020 of 270 (±70) MMTCO_2e. A number in the range of 250 to 300 MMTCO_2e should be roughly representative of Dr. Busch's median estimate.

Table 1: Probability that market prices reach three allowance price scenarios in 2030

Scenario	Source	2030 Allowance Price Scenarios		
		Price floor ($25/t$CO_2$e)	**In between price floor and ceiling**	**Price ceiling ($85/t$CO_2$e)**
No adjustment for oversupply	Borenstein et al (2017): Table 2, Row 1[4]	46.2%	19.9%	33.9%
Lower cap by 250-300 MMTCO_2e to address oversupply	Borenstein & Bushnell blog[5]	16%	20%	64%
Change due to lower program caps		–30%	N/A	+30%

In essence, Borenstein and Bushnell's model calculates that lowering the cap to address oversupply would shift the range of outcomes, making the market about 30% more likely to hit an $85 price ceiling by 2030, and about 30% less likely to stay at a $25 price floor through 2030. The chance of being somewhere in between the floor and ceiling remains roughly the same across both scenarios.

To estimate the emission reductions attributable to removing excess allowances to account for market oversupply, Borenstein and Bushnell address two issues:

- **Fixed emission reductions at price ceiling or price floor.** This issue reflects Borenstein and Bushnell's first core assumption—that allowances ARB sells at the price ceiling represent additional emissions above and beyond program caps. Borenstein and Bushnell make an important contribution to the

4 In their Energy Institute blog post, Borenstein and Bushnell combine two supplies of allowances available at the current price ceiling that are identified separately in Table 2 of Borenstein et al. (2017): the allowances currently held in the APCR ("In APCR at C Price") and supplemental allowances issued at the price ceiling ("Beyond APCR at C Price"). The probability of reaching each is 18.7% and 15.2%, respectively. For the purposes of discussing market prices, their assumption is sensible. However, the allowances currently in the APCR are part of the cumulative program caps, whereas those sold at the new price ceiling are in excess of the cumulative program caps.

5 Borenstein and Bushnell do not offer their full results, stating only that the probability of market prices reaching the price ceiling in 2030 increased from "about 34% to about 64%" with the probability of market prices staying at the price floor "decreasing by a similar amount." We extrapolated accordingly.

state climate policy discussion by observing that implementing a price ceiling could limit how effective it would be to lower the cap to address the oversupply problem.

The argument goes like this: despite oversupply, if the market is already going to hit the price ceiling by 2030, removing allowances only accelerates the date at which ARB starts issuing extra allowances at the price ceiling and indeed will increase the number of allowances sold at the price ceiling as a result. In turn, this dilutes the emission reductions that would be expected from reducing the supply of allowances because, once the market reaches the price ceiling, every new allowance sold enables polluters to emit a new ton of pollution without increasing market prices. Borenstein and Bushnell conclude that if market conditions are going to equilibrate at the price ceiling anyway, removing allowances to account for oversupply will only marginally accelerate higher prices but ultimately have little long-term impact.

Similarly, for scenarios where prices are projected to remain at the price floor whether or not program caps are reduced, addressing market oversupply has no long-term effect on emissions. This is because in these scenarios allowance prices (and emissions) are projected to remain low through 2030 in the absence of the cap-and-trade policy, e.g. as a result of low economic growth and high gasoline prices.

- **Estimated price-induced mitigation.** Their main calculation addresses price-induced emissions reductions under the cap-and-trade program. Borenstein and Bushnell's model uses price elasticities of demand to estimate how demand for energy changes in response the prices of three key fuels—electricity, transportation fuels, and natural gas. A higher carbon price raises fuels costs, and therefore reduces fuel consumption and associated GHG emissions.

  Their model projects that a market that remains at the price floor ($25 in 2030) will reduce a cumulative 78.2 $MMTCO_2e$ through 2030. At a market equilibrium that reaches the price ceiling ($85 in 2030), their model projects a cumulative reduction of 217.7 $MMTCO_2e$ (see Table 1 in Borenstein et al. 2017). Thus, the price-induced reduction from a scenario that shifts from the price floor to the price ceiling is therefore 139.5 $MMTCO_2e$, or about 140 $MMTOC_2e$.

Borenstein and Bushnell then compare their model results when the model is run with or without removing allowances to eliminate oversupply. To calculate the expected emission reductions attributable to lowering the cap, Borenstein and Bushnell use a probability-weighted average that takes the probability that removing excess allowances would lead to emission reductions (30%) and multiply by that by the expected reductions (140 $MMTCO_2e$).[6] The result is an expected cumulative reduction of 42 $MMTCO_2e$, which Borenstein and Bushnell describe as "not chump change" but also not a "fundamental change" in a larger program.

[6] In fact, more than 30% of all scenarios feature some emission reductions. For example, some scenarios would reach the price floor without a cap adjustment but because of a cap adjustment would equilibrate in between the price floor and price ceiling, delivering some but not all of the 140 $MMTCO_2e$ projected for a full transition from the floor to the ceiling. Similarly, some scenarios will reach an intermediate price without a cap adjustment, but because of the cap adjustment will eventually reach the price ceiling, delivering some but not all of the

Our responses to Borenstein and Bushnell

We genuinely appreciate the work that Borenstein and Bushnell have done and hope our response will contribute to a productive discussion about how to manage California's climate policy goals. However, we are not convinced by their argument that whether or not ARB reduces program caps to address oversupply won't have much impact on GHG emissions. We offer three responses below.

Response #1: If ARB maintains the environmental integrity that AB 398 requires of price ceiling sales, strategies to address market oversupply will have their full intended effect.

Borenstein and Bushnell assume that allowances sold at the market price ceiling lead to additional emissions beyond the cumulative program cap. That would be the case if California's cap-and-trade system were using a "classic" hard price ceiling, but AB 398 requires ARB to take a different approach. Although ARB must issue unlimited allowances at the price ceiling, ARB is also obligated to use revenue raised from extra allowance sales at the price ceiling to achieve at least as many GHG reductions as are enabled by the sale of extra allowances.[7] If implemented as written, this provision would ensure the environmental integrity of the cumulative program cap; for every extra allowance sold at the price ceiling, another equal reduction must take place somewhere outside the cap-and-trade program.

There are good reasons to be skeptical about the feasibility, policy wisdom, or even the political sustainability of this requirement. One issue is that ARB might need to spend revenue from extra allowance sales at the price ceiling on out-of-state GHG reductions. Another issue is that ensuring reductions outside the program cap that are truly "additional" could be very difficult (as some of us have expressed previously in the context of carbon offsets). Nevertheless, current state law requires ARB to reduce emissions to fully account for extra allowances sold at the market price ceiling.

We recognize that the stakeholder community is split between those who believe this environmental integrity provision is a critical part of AB 398 and those who see it as lacking credibility. But for those who have faith in the environmental integrity of allowance price ceiling sales or those who merely want analyses to reflect current law, Borenstein and Bushnell's argument about the limited effect of oversupply corrections is wrong.

Rather than leading to no net reductions, the removal of excess allowances for a market that reaches the price ceiling will lead to higher sales of price ceiling allowances and therefore greater accompanying investments in GHG reductions outside of the cap-and-trade program on at least a 1:1 basis. In other words, removing 250 million allowances will cause cumulative emissions to fall by at least 250 $MMTCO_2e$. Those

140 $MMTCO_2e$ projected for a full transition from the floor to the ceiling. Because Borenstein and Bushnell report approximately equally sized shifts in model outcomes at the price floor and the price ceiling, with no significant change in the share of scenarios equilibrating in between the price floor and price ceiling, their simplified calculation accurately captures the net impact of a broader set of shifts in their modeled outcomes.

7 Cal. Health & Safety Code § 38562(c)(2)(A)(ii)(II).

reductions will occur in different sectors as a result of the price ceiling: emissions within the cap-and-trade program will exceed cumulative program caps, but emissions outside the cap-and-trade program (including, potentially, out-of-state emissions) will see corresponding reductions.

Again, we are only observing that the assumption Borenstein and Bushnell make is not consistent with the current legal status of the environmental integrity of the hard price ceiling. Theirs is a defensible position. But those who think AB 398's provision will ensure the integrity of the cap should also expect that removing excess allowance to eliminate for market oversupply would lead to much larger effects than Borenstein and Bushnell estimated. Because these corresponding reductions could occur outside of California, however, ensuring environmental integrity in this way may not ensure the same level of in-state reductions and contribution to meeting California's 2030 statewide GHG emissions target.

Response #2: If the price ceiling means there is no longer a hard cap, ARB may need to consider a higher price ceiling to deliver the reductions it calls for from cap-and-trade.

Borenstein and Bushnell assume that ARB will not actually mitigate the extra emissions that occur as a result of additional allowance sales at the price ceiling—allowances which are in excess of the cumulative program caps. In this situation, addressing market oversupply will be less effective than it would at first appear. Rather than provide a justification for inaction, however, their analysis actually shows the need for ARB to consider setting the price ceiling at a higher level than the price ceiling in current regulations.

Since the original Borenstein et al. (2017) analysis was published, several economists have argued that ARB risks putting the 2030 target at risk because of the oversupply of allowances currently in the system. According to Borenstein and Bushnell's model, if these excess allowances are removed then the probability of the market reaching an $85 price ceiling rises from a one-in-three chance to a two-in-three chance. In turn, their model concludes that there is a significant chance that the cap-and-trade program will not contain cumulative emissions—hence their conclusion that there is longer any program "cap."[8] We note that even

[8] As Table 1 shows, the probability of market prices reaching the price ceiling rises from about 34% (no adjustment for oversupply) to 64% (with adjustment for oversupply). However, Borenstein and Bushnell do not provide the complete model results that would be necessary to show what share of these scenarios involve cumulative program emissions exceeding cumulative program caps. As discussed in note 4, *supra*, and Table 2 in Borenstein et al. (2017), market scenarios that reach the price ceiling include two sets of scenarios: (1) those in which the market equilibrium reaches the current APCR level but no additional price ceiling allowances are sold because existing APCR allowances (which are part of the cumulative program cap) are sufficient to cover demand, and (2) those in which the market equilibrium reaches the current APCR level and additional allowances must be sold at the price ceiling to cover emissions that exceed cumulative program caps. Borenstein et al. (2017) show that 33.9% of scenarios without oversupply adjustments reach the current APCR price, of which 18.7% are satisfied with existing APCR allowances and no new price ceiling allowances and 15.2% require additional allowances sold at the price ceiling. In other words, Borenstein et al. (2017) conclude that cumulative emissions exceed cumulative program caps in only 15.2% of scenarios. Without further information on the breakdown of the 64% of scenarios that reach the price ceiling when the Borenstein et al. (2017)

when the program delivers the stated cumulative reductions, oversupply can cause the annual emissions in 2030 to be significantly higher than program caps that year (see Burtraw 2017, Busch 2017, LAO 2017)—and this is why it is important for ARB to consider measures to resolve the market's current oversupply conditions.

We agree with Borenstein and Bushnell that the implementation of AB 398 requires ARB to make important political and policy judgments that cannot be set by technical analysis alone. Nevertheless, ARB is obligated to produce a Scoping Plan that is consistent with the SB 32 target for 2030 and has identified in the final Scoping Plan a large role for the cap-and-trade program. If ARB ultimately decides to implement a market design that is unlikely to deliver the reductions called for in the Scoping Plan, then the Scoping Plan would not be consistent with SB 32's instruction to achieve the SB 32 target.

Response #3: Price-induced emission reductions depend on assumptions and could be higher than what Borenstein and Bushnell calculate.

Borenstein and Bushnell's model uses significantly different assumptions than ARB does in the Scoping Plan. Specifically, ARB's assumed effects appear to reflect much greater optimism about the potential for carbon prices to reduce emissions subject to the cap-and-trade program. If more optimistic assumptions are warranted, adjusting the cap-and-trade program to account for oversupply will reduce emissions more than what Borenstein and Bushnell conclude.

Borenstein and Bushnell's model uses historical relationships between energy prices and energy consumption to estimate how future changes in the carbon price will affect fuel consumption, and therefore GHG emissions. Although their approach transparent and reflects standard economic methods, one shortcoming is that it would not capture new technological developments that could change the historical relationship between prices and consumption, such as a breakthrough in electric vehicle costs.

Unfortunately, the final 2030 Scoping Plan is essentially silent on what market prices ARB expects from the cap-and-trade program and exactly how ARB projects the program will deliver on California's 2030 climate target. However, ARB provides some information in the Scoping Plan's Appendix E that indicates the Board takes a much more optimistic perspective than does the Borenstein et al. paper with respect to the cap-and-trade program's ability to deliver emission reductions.

Here, we compare the cumulative emission reductions projected by Borenstein et al. (2017) and by ARB in its final Scoping Plan analyses. We note that ARB states that its assumed cap-and-trade effects "should not be used as a forecast of emission responses to allowance prices"—even though that is exactly how ARB uses them in Appendix E's economic analysis and in the summary of those results in the main Scoping Plan

model adjusts program caps to address oversupply, we cannot say for sure in what share of these scenarios cumulative emissions exceed cumulative program caps. Nevertheless, we do know that this share will rise to substantially more than the 15.2% reported in the original Borenstein et al. (2017) paper that does not account for market oversupply.

(ARB 2017b: 65). Nevertheless, since ARB has offered no other insights into how it expects the cap-and-trade program to perform, we decided it was appropriate to compare these assumptions against those in Borenstein et al. (2017).

Figure 1: Cumulative emission reductions at different market prices ($MMTCO_2e$) [9]

As the figure above shows, ARB and Borenstein et al. share roughly comparable assumptions around the price-induced response that would occur at the market floor price. However, ARB projects significantly greater emission reductions at the price ceiling—about double what Borenstein et al. calculate. The difference between the response ARB expects at the price floor and the price ceiling is 356 $MMTCO_2e$, two and

[9] The figure does not make a strictly apples-to-apples comparison. There are several minor differences between the two sets of estimates. For example, ARB assumes a slightly lower price ceiling of approximately \$82/tCO_2e, as compared to Borenstein et al.'s \$85/tCO_2e. Most important, ARB calculates cumulative emission reductions over the period 2021-2030, whereas Borenstein et al. calculate cumulative emission reductions over the period 2016-2030. We cannot tell from the Borenstein et al. paper how to adjust their estimate to harmonize the time periods with ARB's estimates, but note that the difference is likely minor because cap-and-trade has not yet produced significant emission reductions as a result of program caps consistently being higher than covered emissions. In any case, a proper adjustment to harmonize the time periods would show a reduced projection from Borenstein et al., and thus larger differences between their results and ARB's assumptions. Full details on ARB's approach can be found in ARB (2017b): page 65 for the January 2017 draft scoping plan analysis and on page 90 for the final November 2017 Scoping Plan analysis. Finally, we note that unlike ARB, Borenstein et al. do not offer an explicit estimate of the emissions response at a price point halfway in between the floor and the ceiling.

a half times greater than Borenstein and Bushnell's estimate of 140 $MMTCO_2e$, which drives their final estimate of the environmental benefit of addressing market oversupply.

We do not claim to know what the "correct" values are for how much cap-and-trade would reduce emissions at any given price. We express no views on whether or not ARB's assumptions are defensible because we have no information from ARB on how it developed these assumptions nor why they are appropriate.[10] Rather, we argue that it is crucial for ARB to provide additional information on these points and for the expert community to continue with discussion and analysis of the effects of cap-and-trade at various possible allowance prices to inform the AB 398 implementation process.

The bottom line: ARB still needs to show its work

We appreciate the many insights Borenstein and Bushnell have offered on state climate policy and provide our reactions to their most recent work with the goal of contributing to the broader discussion that is already underway. In particular, their work highlights that individual aspects of the post-2020 cap-and-trade program design should not be considered in isolation; instead, the program design should be guided by a comprehensive analysis that includes all major factors and how they interact. In addition, Borenstein and Bushnell's working paper with Frank Wolak offers one of the only public analyses of possible market outcomes (Borenstein et al. 2017)—and, crucially, one that is transparent about its assumptions and model structure.

Borenstein and Bushnell are also right to point out that the price ceiling and market oversupply solutions can interact in counterproductive ways. If they are correct in assuming that unlimited sales at the price ceiling won't control cumulative emissions, then under a significant share of plausible scenarios the cap-and-trade program will not be able to serve as a backstop guarantee that limits cumulative emissions. Instead, the program will function like a carbon tax under these conditions.

In our view, when ARB sets the level of the price ceiling pursuant to AB 398, ARB should be explicit about the likely emissions consequences. If ARB asserts the program can still function as a backstop due to AB 398's requirement to mitigate emissions outside of the cap-and-trade program for every allowance sold at the price ceiling, it should explicitly identify the strategies and sectors where such reductions could take place—including whether these reductions are expected to occur in California or in other jurisdictions.

ARB has called for cap-and-trade to play a significant role in supporting California's 2030 Scoping Plan—indeed, the largest single contribution. Despite the Scoping Plan's emphasis on emission reductions from cap-and-trade, however, ARB has not yet analyzed what market designs are consistent with the program's greater role in the next decade. Nor has ARB evaluated concerns related to how oversupply could enable

10 We are not criticizing the macroeconomic impact analysis in the Scoping Plan (ARB 2017b). Rather, we are pointing out that ARB has not substantiated its views on how different carbon prices and cap-and-trade market designs will deliver the reductions called for in the final Scoping Plan.

emissions under the program to exceed annual caps and potentially cause statewide emissions to exceed the SB 32 target.

We repeat our earlier call (see Mastrandrea and Inman 2017) for ARB to provide further insights into the Board's thinking on these matters so that a robust public discussion can continue as we work together to deliver on California's ambitious climate goals.

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About Near Zero

Near Zero is a non-profit environmental research organization based at the Carnegie Institution for Science on the Stanford University campus. Near Zero provides credible, impartial, and actionable assessment with the goal of cutting greenhouse gas emissions to near zero. This research note is for informational purposes only and does not constitute investment advice.

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Appendix G

Technical Aspects of Oversupply in the WCI Market

Contents

This Appendix presents a simple forecast for the WCI carbon market and comments on the impacts of oversupply. These are technical details that were not covered in Chapter 3 of the ECO's 2017 Annual Greenhouse Gas Progress Report.

G1 Outlook for the WCI Carbon Market

Based on current evidence, WCI's cap and trade system is expected to have surplus allowances until well after 2020.[1] California and Quebec both started out oversupplied and still issue excess allowances each year. California reduced its emissions earlier than the cap required. The reasons may include low-carbon policies, innovation in renewable energy, and decarbonisation of the electricity sector.

G1.1 California Has Surplus Allowances

Every year since the program began in 2013, California has issued more allowances than needed by compliance entities. California reduced its emissions earlier than the cap required. The reasons may include low-carbon policies, innovation in renewable energy, and decarbonisation of the electricity sector.

Why is oversupply so common in cap and trade programs?

Oversupply in cap and trade programs is common. Often it reflects "fortuitous overcompliance" in the initial phases of the program.[2] Overlapping policies, such as closing of coal power plants and low-carbon fuel standards, as well as technological advances, can help to reduce emissions under the cap. Economic recessions and other structural changes can also play a role.

In some ways, it is good when emissions are lower than anticipated. But it also means that caps should then be adjusted downward or oversupplied allowances retired in order to meet future reduction targets.

WCI'S CAP AND TRADE SYSTEM IS EXPECTED TO HAVE SURPLUS ALLOWANCES UNTIL WELL AFTER 2020

Furthermore, compliance entities only need allowances to cover 92% of their emission obligations. Until 2020, they can meet the other 8% of their legal obligations with offset credits, then 4% until 2025, and then 6% until 2030 (see Appendix A, available online only at eco.on.ca).

Based on the rate of emissions reductions reported until 2016 (the most recent public data available in November 2017), California will continue to issue more allowances than compliance entities need for several more years. In total, by 2020 California will likely have issued hundreds of millions of allowances that no California compliance entity needs for legal compliance from 2013 – 2020.[3] The forecast in Figure G.1 suggests that compliance entities in California may need only 70 to 80% of the allowances that California will offer for sale by 2020.

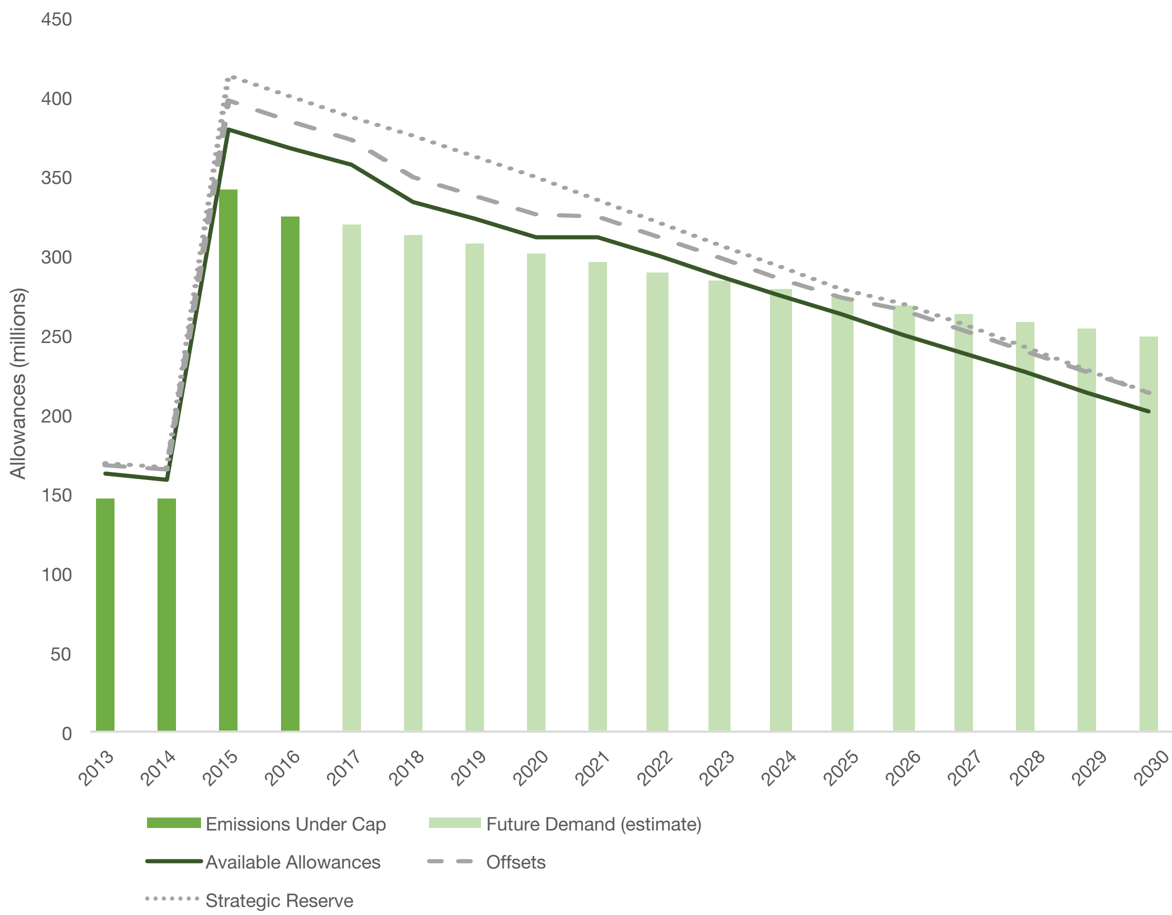

Figure G1. Forecast of California's demand (emissions under the cap). Figure assumes demand will decrease at approx. 1% per year and 4.4% offsets as per current trend until 2020, and then maximum offsets as per AB 398 (4% until 2025 and 6% until 2030). In 2013 and 2014, only large final emitters and utilities were included in the cap and trade program. In 2015, the program was expanded to include transportation fuels.

Under the new law AB 398, California has started to address oversupply by moving some of its surplus 2013-2020 allowances into its strategic reserve (the Allowance Price Containment Reserve, or APCR) to provide a price cushion for the more rapid reductions in its overall cap in 2021-2030. Allowances that have gone unsold for more than two years will be moved into the higher-priced APCR.[4] Moving unsold allowances into the reserve and not offering them at the next auction should reduce the oversupply and increase the proportion of allowances that sell at auctions between now and 2020. The contents of the APCR, which is similar to Ontario's strategic reserve will be offered to California compliance entities at three higher price thresholds to be set by the California Air Resources Board (CARB).

Additionally, carbon traders may buy some or all of the remainder, in order to profit by reselling them in the next decade when allowances will become more expensive. However, California is still likely to have far more allowances than it needs for compliance purposes between now and 2020.

G1.2 Quebec Also Has Surplus Allowances

Quebec linked its market with California in 2014. Its demand for allowances between 2014-2020 is expected to be around 338 million,[5] compared with a supply of allowances to be issued of 360 million.[6] Together with its 8% offset allowance, Quebec is likely to increase the WCI allowance surplus until at least 2020.

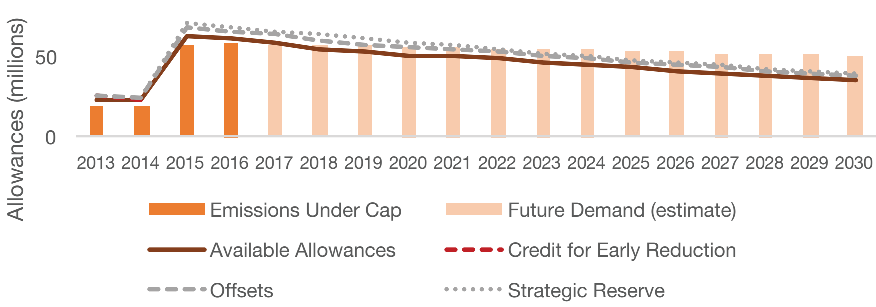

Figure G2. Forecast of Quebec's demand (assumes emissions under the cap will decrease at approx. 1% per year). Assumes 8% offsets as per current trend from 2015 until 2030.

G1.3 WCI Oversupplied Until Well After 2020

As shown in Figure G3 below, the WCI market is forecast to be oversupplied until well after 2020, possibly until 2030. This supports the projection that carbon prices may trade near the floor price most of the time until well after 2020, and not all auctions are likely to sell out. Of course, this could change at any time. The carbon market is affected by many unpredictable factors that are capable of rapid change (global economic factors, local temperatures, technology changes, rate of adoption, etc.)

CARBON PRICES MAY TRADE NEAR THE FLOOR PRICE MOST OF THE TIME UNTIL WELL AFTER 2020, AND NOT ALL AUCTIONS ARE LIKELY TO SELL OUT

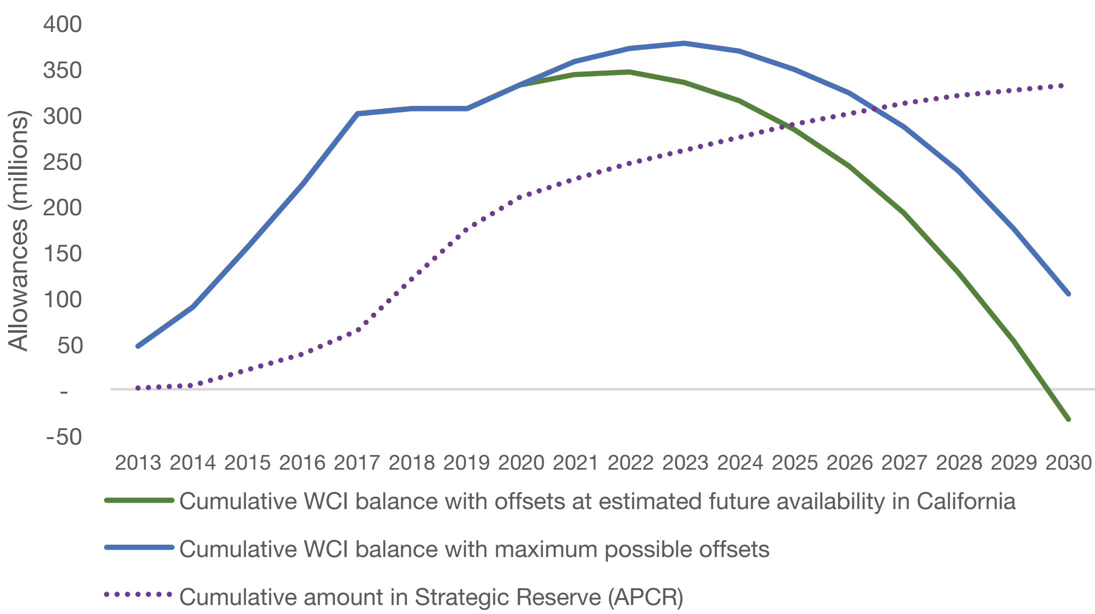

Figure G3. Projected WCI supply and demand to 2030. Analysis includes assumptions for each jurisdiction as explained above, and includes shifting some of the unsold allowances to the strategic reserve (Allowance Price Containment Reserve) in 2018 and 2019, as per AB 398. Analysis does not include moving unsold allowances into the strategic reserve after 2019.

Source: ECO analysis, adapted from ClearBlue Markets, “Ontario and WCI Cap & Trade Supply and Demand Report”, (Sept 2017) with input from Chris Busch.

To address this technical detail, the ECO has suggested in this report that the government should work with California and Quebec to reduce the oversupply of allowances, and to adjust future caps and allowance supply as needed to meet GHG reduction targets. Ways to reduce oversupply include lowering future caps, moving surplus allowances to the reserve and/or fully retiring some surplus allowances. California will likely need to take further action in order to meet its 2030 targets.[7] Reducing California's oversupply will also reduce the amount of WCI revenues that could flow from Ontario to California.

G.1.4 Impact of Oversupply on Achieving Targets and Future Carbon Prices

California's commitment to reduce its GHGs to 40% below 1990 levels by 2030 will require the state to dramatically reduce the number of allowances it issues each year. These targets, in addition to the new law's requirement that CARB develop a new policy on excess allowances, should mean that the number of allowances available will drop below demand sometime in the next decade. When this happens, the price of carbon should rise.

G.1.5 Impact of Oversupply on Revenues for Ontario

Now that Ontario is linked to the WCI market, all allowances are interchangeable. Compliance entities buy WCI allowances, i.e., Ontario entities can no longer buy "Ontario" allowances. Revenues will be distributed across all jurisdictions proportionally, i.e. if 92% of all WCI allowances are sold, Ontario, Quebec and California will each receive the settlement price for 92% of their auctioned allowances, regardless of where the buyers come from. The other 8% will be considered unsold (see Figure G.4 below). In the first example, Ontario emitters buy the equivalent of 97% of Ontario's auctioned allowances, but only get revenue for 92%. In the second example, if California's oversupply is reduced, all jurisdictions receive an approximately proportional amount of revenues. This is a technical detail, but resolving it will improve the program and help maintain the integrity of the cap.

Note that even if Ontario only sells 92% of its WCI allowances as in example 1, actual revenues depend on the Canadian/U.S. exchange rate. If the Canadian dollar is strong, Ontario might still receive as much revenue as if the auctions were not linked and 97% of Ontario's allowances were sold.

The key point is it is hard to predict how funds will flow between Ontario and its WCI partners, and flows may be different for different auctions.

Furthermore, these examples show that there is little financial incentive for one jurisdiction to reduce their own oversupply. When a jurisdiction has surplus allowances, they receive a greater proportion of pooled revenues. It will take collective effort and time to reduce oversupply across all jurisdictions. The Regional Greenhouse Gas Initiative has done this effectively (see Section 3.5.1.1).

IT IS HARD TO PREDICT HOW FUNDS WILL FLOW BETWEEN ONTARIO AND ITS WCI PARTNERS

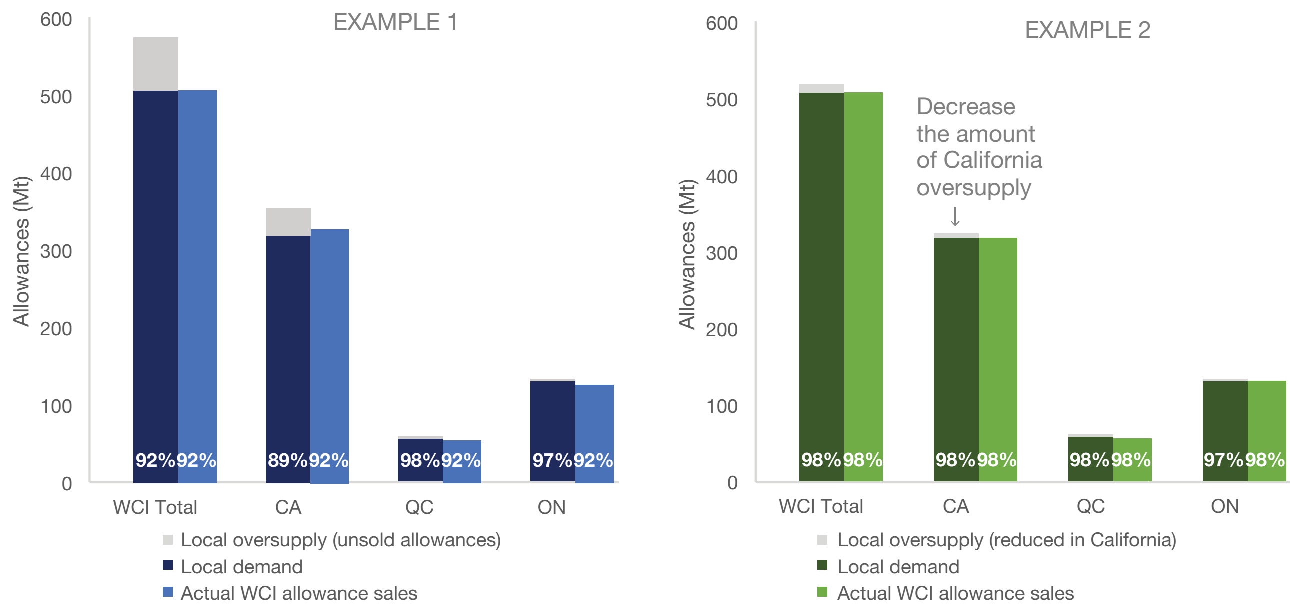

Figure G4. Example annual distributions of WCI revenues compared to local demand. In example 1, local Ontario demand is 97% of Ontario's auctioned allowances, but Ontario only gets revenue for 92% based on total WCI demand. In example 2, California oversupply is decreased, and Ontario gets revenue for 98% based on WCI demand despite only have 97% demand locally, i.e., money would flow into Ontario.

Over time the market may change. The market is currently forecasted to develop a shortage of allowances sometime after 2020, which is when carbon prices are expected to go up. In the future, if California is in a more acute shortage than Ontario, funds could flow from California to Ontario, likely at a higher carbon price per tonne than today.

G.2 What Happens When There is a Shortage of Allowances?

G.2.1 Post-2020, California Will Have a Price Ceiling

An acute shortage of allowances could lead to uncontrolled price increases. California's new law therefore requires the CARB to establish a price ceiling for allowances, in addition to the existing price control mechanism provided by the Allowance Price Containment Reserve (APCR). If auction prices rise substantially above the floor price, the allowances in the APCR will be offered for sale to California compliance entities to help avoid uncontrollable price surges. One-third of the APCR will be sold at each of three price thresholds: two intermediate price steps or "speed bumps" and the price ceiling (see Appendix A for more details on California's cap and trade mechanisms, available only online at eco.on.ca).

What about the reserves?

California, Quebec and Ontario all have large supplies of allowances set aside for sale to compliance entities at high prices. To date, no one has purchased any of the reserve allowances. In 2017, reserve allowances in Ontario were offered for sale at about $51, $58 and $64 and are projected to range from $62 to $78 in 2020.[8]

California's reserve, the APCR, is already quite substantial and will continue to grow. As shown in Figure G.3, the cumulative amount of allowances in the APCR is forecast to grow until it is almost as large as the entire WCI market in 2030. California is also required to move some unsold allowances into the APCR, which will further increase its size. All of this enormous reserve would have to be exhausted before the CARB would issue "extra" allowances because of the price ceiling.

If, after all of the APCR allowances are sold, California compliance entities want to buy even more allowances, the state is required to sell them additional allowances beyond the cap at the ceiling price. This means that "an unlimited number of permits will be made available at a ceiling price to guarantee prices can rise no higher"[9]. This means that California will no longer have an absolute limit on the number of allowances to be issued each year starting in 2021. However, California is required to purchase an equivalent amount of offsets for every "extra" allowance that they sell.

STABILITY ALLOWS MORE AMBITION WITHIN THE CAP AND TRADE SYSTEM, AND MORE BUSINESS CONFIDENCE TO INVEST IN REDUCING EMISSIONS

The final design of the price ceiling mechanism is not yet determined. Section 4 of California's new law[10] requires CARB to consider the following factors, using the best available science, when setting the price ceiling:

a) The need to avoid adverse impacts on resident households, businesses, and the state's economy;

b) The 2020 tier prices of the allowance price containment reserve;

c) The full social cost associated with emitting a metric ton of greenhouse gases;

d) The auction reserve price (or *price floor*);[11]

e) The potential for environmental and economic leakage; and

f) The cost per metric tonne of greenhouse gas emissions reductions to achieve the statewide emissions targets.

CARB has an elaborate rule-making process that is likely to take at least 12 to 18 months to complete. Thus, it will likely take a year or more before Ontario knows what California's price ceiling will be. Even after the price ceiling is set, allowance prices may or may not approach that ceiling for years, if ever.

This "price collar" (a price floor and a price ceiling) was an essential element of the compromise that allowed California to resolve its political uncertainty and adopt its ambitious cap and trade program for 2021-2030. There are good theoretical arguments for having a price ceiling, i.e. a hybrid system between cap and trade and a carbon tax[12], in terms of program stability and predictability. This stability allows more ambition within the cap and trade system, and more business confidence to invest in reducing emissions.

G2.2 How will the Price Ceiling Impact Ontario?

The impact of the California price ceiling on California emissions will depend both the balance between allowance supply and demand, and on how high CARB sets the price ceiling.

If the price ceiling were set high, say, $100/tonne in 2018 and increasing annually, California emitters are not expected to rely on it and it should not have any practical effect. If the price ceiling were set too low, say, $40/tonne, California would no longer have any meaningful cap on its emissions, and its system will function more like a carbon tax if prices hit the ceiling, with an added requirement to purchase equivalent offsets.[13] If set too low, this could reduce a key benefit of cap and trade, the hard cap on emissions. The state would have to rely on purchasing offsets in non-capped sectors and states to counter the "extra" allowances provided beyond the cap (see Chapter 4 for the ECO's recommendations regarding requirements for offsets and concerns about Californian offsets).

If WCI prices hit the California price ceiling, since WCI allowances are interchangeable across jurisdictions, Ontario and Quebec would, in effect, also have a price ceiling, but with the price ceiling money flowing to California and then spent on offsets. To avoid this result, the government should consider matching California's price ceiling mechanisms, with a requirement for the province to purchase quality Ontario-based offsets for any allowances sold above the cap.

G3 If Ontario Emitters Purchase WCI Allowances From Outside Ontario, do GHGs Go Down?

Before AB 398 and the oversupply in the WCI market, there was a clear, if delayed, link between purchases of allowances by Ontario emitters, and GHG reductions in California, as long as demand for WCI allowances by compliance entities eventually exceeds supply. The reduced availability of WCI allowances would then induce California emitters to reduce their emissions. In this way, WCI allowance purchases by Ontario emitters could be reliably linked, tonne to tonne, to (eventual) GHG reductions in California.[14]

After AB 398 and the oversupply, (depending on the price ceiling and how many unsold allowances are moved into the APCR) it may no longer be possible to prove such a tonne-to-tonne link. Instead, allowance purchases by Ontario emitters will influence California emissions indirectly, through the price of allowances. Carbon market dynamics are uncertain, and are affected by unpredictable factors that are capable of rapid change.[15] Scenario analysis and computer models can estimate what may happen, but certainty about precise cause-and-effect relationships may be unachievable. This is partly why the ECO has recommended Ontario work with its WCI partners to reduce oversupply.

Thus, while allowance purchases by Ontario emitters should eventually put upward pressure on WCI allowance prices, it may be impossible to know by how much and when (reductions may actually be caused by other complementary low-carbon policies). In turn, a rise in WCI allowance prices should encourage all WCI emitters to reduce their GHG emissions, but we may not know when or how much. Instead, Ontario will have to rely on the cap on emissions and models which predict that the linked market will gradually develop a shortage of allowance, and therefore rising prices, which in turn will stimulate reductions.

This uncertainty can be unnerving for policy makers, but it is not unanticipated. A linked carbon market between three different economies in two different countries, with differing climates and differing laws, is a complex system. By definition, complex systems cannot be completely understood the way simple systems can.[16] However, that doesn't mean the simple system is better. Systems can benefit from some complexity to deliver better or more equitable results. It takes time to sort out and properly manage a carbon market with multiple players. The Regional Greenhouse Gas Initiative provides a good example of different jurisdictions working together to take surplus allowances out of their cap and trade system (see section 3.5.1.1). Although prices are still low and it required time to get it right, emissions are going down, air quality is improving, and overall the program is working quite well.

If the government and its WCI partners follow the ECO's recommendation to reduce oversupply, the cap will become binding at an earlier date, which will help reduce this uncertainty around this technical detail.

G.4 Conclusion

There are a few technical details that should be "tuned up" moving forward to improve the WCI carbon market, including oversupply, the validity of offsets and the integrity of the price ceiling. Overall, the ECO expects that these issues will be addressed by policy makers. Part of the pressure to make these changes for each jurisdiction include meeting future targets and meeting each jurisdiction's part of their Nationally Defined Contribution towards Paris agreements.

Endnotes

1. Reasons typically given for the existence of this large surplus include the regulatory measures that California has used to drive down emissions from electricity generation and transportation, two of its largest sources of GHGs. This predicted surplus combined with the legal uncertainty described on page 72 in *Facing Climate Change* may help explain the low demand for California allowances at auction in 2016 and early 2017.

2. Chris Busch, “Oversupply Grows in the Western Climate Initiative Carbon Market: An Adjustment for Current Oversupply is Needed to Ensure the Program will Achieve its 2030 Target” (December 2017), online: <energyinnovation.org/wp-content/uploads/2017/12/Oversupply-Grows-In-The-WCI-Carbon-Market.pdf>

3. Some California allowances have been, and may continue to be, purchased by non-compliance entities, presumably in the hope of selling them later and/or on the secondary market at higher prices. Allowance purchases by non-compliance entities, and trades on the secondary market, are important factors in carbon market functioning, but they have no direct relevance to GHG emissions reductions and are therefore discussed no further in this chapter.

4. The contents of the Allowance Price Containment Reserve will be sold to California compliance entities at three price thresholds to be set by CARB; two intermediate price steps or “speed bumps” and the price ceiling discussed below. One third of the APCR will be allocated to each threshold, establishing a mechanism to slow down price increases with an additional supply of allowances. See Appendix A for more details, available only online at eco.on.ca.

5. This is a projection based on reductions occurring the trend rate. Under a high demand/high emissions scenario, aggregate demand is projected at 346 million versus a low demand scenario that would result in 329 million aggregate demand. As per ECO communications with Chris Busch, Energy Innovation: Policy and Technology LLC.

6. Environment Quality Act, c Q-2, r 15.2, Determination of annual caps on greenhouse gas emission units relating to the cap-and-trade system for greenhouse gas emission allowances for the 2013-2020 period, online: http://legisQuébec.gouv.qc.ca/en/ShowDoc/cr/Q-2,%20r.%2015.2.

7. ibid

8. The price of allowances that are offered for sale at three thresholds are defined in Ontario’s *The Cap and Trade Program*, O.Reg 144/16, s 80. The price thresholds increase annually by 5% plus inflation, as measured by the Consumer Price Index, data used from “Table 326-0020 Consumer Price Index (CPI), monthly (2002=100)”, online: Statistics Canada <www5.statcan.gc.ca/cansim/a01?lang=eng>

9. Chris Busch, “Implications of Assembly Bill 398 for Oversupply in the California-Québec Carbon Market: An Easy Fix Exists to Resolve Oversupply Concerns” (September 2017) at 4.

10. This section of AB 398 amended Section 38562 of the Health and Safety Code.

11. USD $15.06 per allowance in November 2017. Similar to Ontario’s, California’s auction reserve price increases annually by 5% plus inflation, as measured by the Consumer Price Index.

12. Richard Schmalensee and Robert N Stavins, “lessons Learned from Three Decades of Experience with Cap-and-0Trade” (2017) 11:1 Review of Environmental Economics and Policy at 59. <doi.org/10.1093/reep/rew017>

13. ibid

14. The reductions would occur years later than if there had been no link, which is highly undesirable from a climate point of view, but least they would eventually be sure to occur.

15. Including weather, GDP, technological developments, economic and tax policy, and other impacts, such as the damage done by Hurricane Harvey to gasoline refining capacity in the U.S., which in turn drove up gasoline prices.

16. Paraphrased from Thomas Homer-Dixon’s speech, “Complexity Science and Public Policy”, Manion Lecture for the Canada School of Public Service, in Ottawa, Canada, May 5, 2010, https://homerdixon.com/complexity-science-and-public-policy-speech/

RESEARCH NOTE

Interpreting AB 398's carbon offsets limits

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AB 398 requires the California Air Resources Board (ARB) to incorporate new limits on the use of carbon offsets in its post-2020 cap-and-trade market design. ARB has released its initial thinking on how to implement these new statutory provisions. We review two key issues here.

First, AB 398 requires ARB to limit the use of offsets to 4% and 6% of an entity's emissions in the periods 2021-25 and 2026-30, respectively. ARB has proposed a novel interpretation of how to calculate the timing of applicable restrictions such that the higher limit would apply to most emissions that take place in calendar years 2024 and 2025, in addition to those that occur in 2026 through 2030. The proposed interpretation would increase the maximum quantity of offset credits that can be used by a total of approximately 8.5 million instruments, relative to a scenario in which AB 398's limits are applied to calendar-year emissions.

Second, AB 398 further limits the total number of offset credits that covered entities can use from projects that do not generate a "direct environmental benefit" (or "DEB") to air or water quality in California. We explore under what conditions an offset project produces a DEB. ARB has proposed a project-by-project evaluation but has not yet offered any bright-line rules to limit acceptable arguments for establishing a DEB. While a project-by-project approach could make sense, we argue that ARB's DEB assessment should exclude greenhouse gas (GHG) emissions from consideration because carbon offsets create no net reduction in GHGs and therefore no net climate benefits that could be said to constitute a DEB to California air or water quality.

Background: AB 398 sets new offset limits

Under California's original climate law, AB 32, the legislature gave ARB broad discretion to determine whether and to what extent covered entities may use carbon offsets to satisfy their compliance obligation under the state's cap-and-trade program. For the period 2013 through the end of 2020, ARB eventually selected a limit that enables covered entities to submit ARB-approved carbon offset credits for up to 8% of their covered emissions.[1]

Although 8% might seem small, the original offsets limit is actually quite large compared to the emission reductions expected from the current phase of the cap-and-trade program. Dr. Barbara Haya at UC Berkeley calculated that this limit—which enables covered entities to use more than 200 million offset credits through 2020—could, if fully exploited, generate 100% of net reductions expected under the cap-and-trade program through 2020 (Haya 2013). In the market's first compliance period (2013-14), however, covered entities submitted allowances equal to 4.4% of their covered emissions in the market's first compliance period—just over half of the limit.[2] That share rose to 7.9% and 8.3% of compliance obligations submitted in 2015 and 2016, respectively, although it is not possible to say whether offsets usage is changing relative to the first compliance period because only 30% of the total compliance obligations for 2015 and 2016 have come due.[2] Data on the share for the full second compliance period (2015-17) is not yet available, as the compliance obligation will come due later this year.[3]

In contrast to the broad discretion ARB enjoys with respect to carbon offsets under AB 32, AB 398 imposes new offset limits that apply to the state's post-2020 market design:

> (I) From January 1, 2021, to December 31, 2025, inclusive, a total of 4 percent of a covered entity's compliance obligation may be met by surrendering offset credits of which no more than one-half may be sourced from projects that do not provide direct environmental benefits in state.
>
> (II) From January 1, 2026, to December 31, 2030, inclusive, a total of 6 percent of a covered entity's compliance obligation may be met by surrendering offset credits of which no more than one-half may be sourced from projects that do not provide direct environmental benefits in the state.[4]

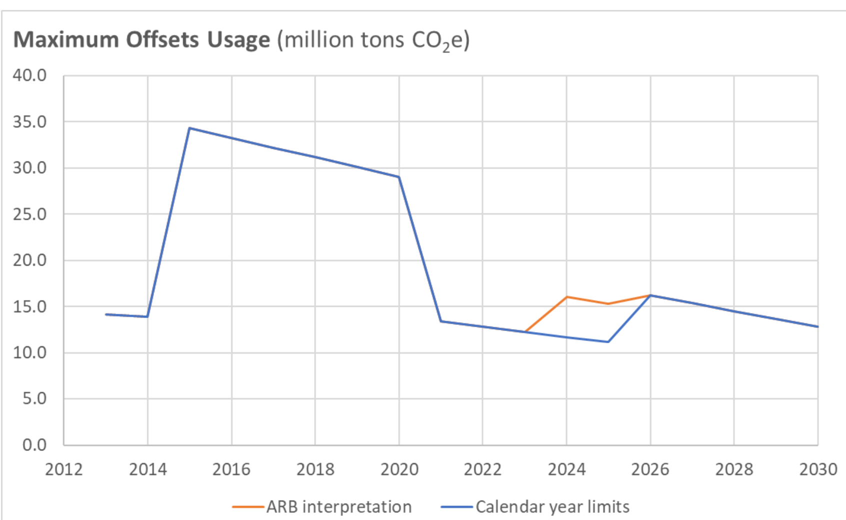
The Board's attention has turned to developing regulations that implement AB 398's requirements, including the new offset limits.

A permissive interpretation of AB 398's total offset limits

ARB has proposed an initial interpretation of AB 398's new offset limits that increases the total number of carbon offsets that can be surrendered by covered entities to account for their emissions in 2024 and 2025, compared to an interpretation in which the AB 398 offset limits are directly applied to calendar-year emissions (ARB 2018a: slide 25).

The proposal is based on the way ARB requires covered entities to submit compliance instruments within three-year compliance periods. For each of the first two years of a compliance period, ARB requires covered entities to submit compliance instruments to account for at least 30% of their annual emissions obligation.[3] In the third and final year, however, covered entities must submit compliance instruments to cover any remaining emissions from those previous years (up to 70% of each year's total) as well as all of the emissions in the final year of the compliance period.[3] Thus, the compliance obligation that comes due for the third year of a compliance period can represent a substantial majority of a covered entity's emissions over the entire three-year compliance period.

This distinction matters because the market's fifth compliance period spans 2024-26, during which time the carbon offsets limits under AB 398 increase from 4% to 6%. Under ARB's proposal the higher limit would apply to all emissions in 2026, as well as up to 70% of emissions in both 2024 and 2025 that covered entities could elect to submit to cover their 2026 compliance obligations.



SOURCE: NEAR ZERO CALCULATIONS, BASED ON ARB (2018a)

In the figure above, the dark blue line ("Calendar year limits") represents the annual offsets limits that would apply if ARB interpreted the AB 398 limits literally, based on the calendar year of emissions. The orange line ("ARB interpretation") shows the limits that ARB staff proposed in its March 2018 preliminary discussion draft regulations. For simplicity, both scenarios assume that covered emissions will be equal to annual program budgets for each year plus the maximum number of permissible offsets. Other outcomes would be possible if covered entities bank allowances from year to year. If covered entities' GHG emissions are higher than program budgets in 2024 and 2025 due to banking of previously unused allowances, then maximum offsets usage would be higher; if covered entities' GHG emissions are lower than program budgets for 2024 and 2025, then maximum offsets usage would be lower.

	2023	2024	2025	2026	2027
Calendar Year Limits	4%	4%	4%	6%	6%
ARB Interpretation	4%	5.4%	5.4%	6%	6%

SOURCE: NEAR ZERO CALCULATIONS, BASED ON ARB (2018a)

Expressed numerically, the effect of ARB's proposed interpretation is to increase the effective carbon offsets limit for emissions that occur in 2024 and 2025 from 4% to 5.4%. In total, ARB's interpretation would allow covered entities to submit approximately 8.5 million more offset credits relative to an interpretation that applies the limits in AB 398 to the emissions by calendar year.

What constitutes a "direct environmental benefit"?

AB 398 not only sets a limit on the total number of carbon offset credits that can be surrendered by covered entities in the post-2020 market period, but also on the types of offsets that qualify. Beginning in 2021, additional restrictions apply to projects that do not provide "direct environmental benefits" (or "DEB") in California. No more than half the total number of allowable offsets may come from such projects. AB 398 defines a DEB as:

> [T]he 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.[4]

In its preliminary discussion draft regulations, ARB has proposed a bifurcated approach to interpreting this statutory requirement.

First, ARB has proposed a set of bright-line rules that, if met, would automatically deem an offset project as producing a DEB. For example, a project located in California that reduces air pollution would qualify; so too would any project that reduces water pollution and is located either in California or adjacent to a body of water that flows into California (ARB 2018: 17-19). If any of these bright-line rules are met, ARB would automatically deem the project to provide a DEB.

Second, if ARB does not deem a project to provide a DEB based on these bright-line rules, ARB staff have proposed a process whereby projects may make individualized applications to ARB to demonstrate their case. ARB has invited comment on what factors, data, and analysis should be considered in this process.

ARB's bifurcated approach offers important advantages, in that it both outlines bright-line rules for inclusion and contemplates a bottom-up process to provide opportunities for projects to justify direct environmental benefits to California air or water quality. However, ARB has not provided any bright-line rules that would foreclose unacceptable arguments for establishing a DEB—that is, ARB has not proposed any limits on arguments that would qualify a project as providing a DEB. As a result, there are several important open questions that will need careful consideration to implement the legislative intent of AB 398 while also ensuring that ARB's regulatory implementation respects constitutional standards that apply to state regulation of interstate commerce.

The most challenging issue concerns the role of GHG emissions. ARB's preliminary discussion draft regulations suggest that ARB believes "a GHG reduction anywhere is a benefit everywhere" (ARB 2018b: 17)—a position the state and its allies successfully took in a landmark dormant commerce challenge to California's Low Carbon Fuel Standard.[4] Furthermore, in response to questions at its March 2018 workshop, ARB staff indicated that they believe GHGs are included in the operative phrase "any air pollutant" used in AB 398's DEB definition, suggesting that the Board may be open to offset projects demonstrating a DEB by demonstrating a reduction in GHG emissions.

However, recognizing reduced or avoided project-level GHG emissions as the basis for a DEB would raise significant concerns because offset projects by definition produce zero *net* GHG reductions. In return for gross reductions or avoided emissions of GHGs as measured at the offset project, ARB awards an equal number of offset credits to the project developer. Project developers sell these credits to covered entities, which use them to emit additional GHGs equal in quantity to the offset project's reduced or avoided GHG emissions. Thus, there is no net reduction in GHGs attributable to any offset project.

Even though there is a marginal but incontrovertible climate benefit everywhere when GHGs are reduced anywhere, that benefit accrues only when there is a *net* reduction in GHGs. By definition, an offset project produces no net GHG reductions because the gross reduction measured at the project level is counteracted by an increase in GHG emissions by covered entities that acquire the project's offset credits.

A more complicated example: ozone depleting substances

Although no offset project can claim net GHG reductions when its credits are used by covered entities to emit more GHGs, the Ozone-Depleting Substances (ODS) Protocol raises several additional complications.

The ODS Protocol credits the destruction of ODS that would have eventually leaked out of devices such as older air conditioning and refrigeration units. ODS projects take ODS-containing equipment—including some equipment collected in California—and ship this equipment to an out-of-state facility for controlled gas destruction. Does the out-of-state destruction of ODS-containing equipment that was previously located in California constitute a "direct environmental benefit" to California?

To evaluate this question, we consider an ODS offset project that avoids 1 metric ton of carbon dioxide equivalent (tCO_2e) from ODS-containing equipment that was originally located in California but was subsequently shipped to an out-of-state facility for destruction. As a result of the offset project, in-state ODS emissions are reduced by 1 tCO_2e. At the same time, however, an in-state entity will be able to use the resulting offset credit to increase its CO_2 emissions by 1 tCO_2e. Thus, as with other offset projects, there is a gross GHG reduction at the project level, but no net change in GHGs on a global level.

The ODS example illustrates additional challenges in interpreting what constitutes a direct environmental benefit under AB 398 because ODS gases are both GHGs and gases that contribute to the destruction of the ozone layer. Although there is no net climate benefit to ODS destruction projects that earn offset credits, the avoidance of ODS emissions that would have occurred in California could be interpreted as an "avoidance of emissions of any air pollutant in the state." Furthermore, ODS destruction arguably provides a net global benefit to reduced ozone layer destruction that partially accrues to California—although the benefit would more accurately be described as an indirect environmental benefit, rather than a direct environmental benefit to state air or water quality.

	Before offset (*)	**After offset**	**Net change**
In-state ODS (tCO_2e)	10	9	−1
In-state GHGs (tCO_2e)	100	101	+1
Total GHGs (tCO_2e)	110	110	0
In-state co-pollutants	Lower	Higher	Higher
Indirect ozone layer impacts	Higher	Lower	Lower

* VALUE IS ARBITRARY; NET CHANGE IS NOT

As this example illustrates:

- Like all offset projects, an ODS offset project produces a gross GHG reduction but zero net GHG benefits. As a result, there is no net climate benefit to California air or water quality.

- Like all offset projects, ODS projects can also lead to higher net in-state co-pollutants if covered entities that emit GHGs and co-pollutants increase emissions of both local and global air pollutants relative to a scenario in which no ODS offset credit is available.

- Nevertheless, ODS credits awarded for destruction of ODS-containing equipment in California—which would have eventually emitted ODS in California—could plausibly be said to involve the "reduction or avoidance of any air pollutant in the state."[4]

- ODS projects also provide a net reduction in impacts to the ozone layer, although the corresponding environmental benefit to California air or water quality would better be described as indirect—not a direct environmental benefit to California air or water quality.

Conclusions

In this note we evaluated two key issues related to implementing AB 398's new offset requirements.

First, ARB must implement AB 398's overall limits on offset usage. We show that ARB's proposed interpretation of AB 398's limits increases the quantity of offset credits that can be used in 2024 and 2025 by a total of approximately 8.5 million, relative to a scenario in which the statutory limits apply to calendar year emissions and assuming that emissions in those years are equal to the annual program budget plus the maximum allowable offsets usage. Under ARB's proposed interpretation, covered entities could submit offset credits equal to 5.4% of their 2024 and 2025 emissions, rather than 4%.

Second, ARB must determine what constitutes a "direct environmental benefit" to California air or water quality. We show that if ARB interprets the "reduction or avoidance of any emissions of any air pollutant" by looking only at the gross reduction of greenhouse gas emissions from offset projects, local air pollution could actually increase without producing any climate benefits. We recommend that ARB be explicit and consistent in its analysis of the gross vs. net impacts on local environmental pollution, greenhouse gas emissions, and any other environmental issues (such as reduced ozone layer depletion). Once emissions from offset credit use are taken into account, no offset projects reduce net greenhouse gas emissions and therefore no offset projects provide net climate benefits to California air or water quality—whether direct or indirect.

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Barbara Haya (2013), California's Carbon Offsets Program – The Offsets Limit Explained, http://beci.berkeley.edu/barbara-haya/.

Notes

1. Cal. Code Regs., tit. 19, § 95854(b).
2. Compliance obligations for 2015 and 2016 represent 30% of emissions by covered entities in the respective year. Compliance reports are available at https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm.
3. Cal. Code Regs., tit. 19, §§ 95855–95856.
4. Cal. Health & Safety Code § 38562(c)(2)(E) (as added by AB 398).
5. Rocky Mountain Farmers Union v. Corey, 730 F.3d 1070 (9th Cir. 2013). Full disclosure: Dr. Cullenward represented environmental scientists who made this argument in support of ARB's position in the case.

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RESEARCH NOTE

Implementing AB 398: ARB's initial post-2020 market design and "allowance pool" concepts

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AB 398 requires the California Air Resources Board (ARB) to make several important reforms to the cap-and-trade program's post-2020 market design. For example, the statute requires ARB to implement a hard price ceiling at which unlimited compliance instruments will be offered for sale at a fixed price; establish two new price containment points at which limited quantities of allowances will be made available at a fixed price; and impose new limits on carbon offsets, to name only a few changes.

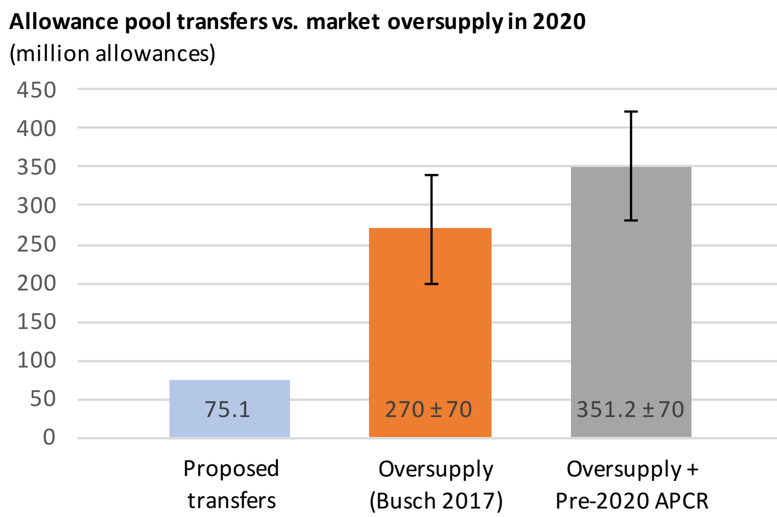
Earlier this month, ARB released its initial thinking on how to implement the post-2020 market design reforms required by AB 398 (ARB 2018a, 2018b, 2018c). As a threshold matter, it is important to observe that ARB has not yet addressed two key issues on which AB 398 requires further evaluation—potential changes to banking rules and adjustments for over-allocation (also known as oversupply). Both of these statutory provisions require ARB to consider the extent to which the current cap-and-trade program has too many allowances relative to near-term demand. So far, ARB has characterized lax market conditions as a success, not a liability.

On the whole, ARB's proposal (summarized in Appendix 1) features high long-term price ambitions, but no serious efforts to balance long-term mitigation needs against near-term oversupply conditions.

Key features of ARB's proposal include:

- **High long-term price ambitions.** ARB has proposed setting two new price containment points no lower than $70 per allowance in 2021 (2015 USD), and has suggested the new market price ceiling will, in 2030, be no lower than $81.90 and no higher than $147 per allowance (2015 USD). Pursuant to AB 398, ARB must offer unlimited additional compliance instruments for sale at the price ceiling. The ambition of the price containment point and price ceiling would allow allowance prices to rise substantially from recent levels, which remain near the price floor (just under $15 per allowance). Price increases significantly above the floor are likely necessary to achieve California's ambitious 2030 climate target.

- **No serious action on oversupply.** Board staff continue to argue that the oversupply of allowances currently present in the program is a sign of the program's success, rather than a reflection of the program's lack of stringency (ARB 2018a: 22-24). ARB has offered no evidence to support this view. Staff also suggest that oversupply has no potentially deleterious effects, despite the findings of multiple independent studies that have identified serious environmental risks (e.g., Busch 2017, Cullenward et al. 2017, LAO 2017, Environmental Commissioner of Ontario 2018). However, the staff presentation indicates ARB has received stakeholder feedback calling for reductions in the number of allowances under the program caps and/or rules to adjust the value of banked allowances over time (ARB 2018a: 22).



Despite disputing the risks of current market oversupply conditions, ARB's proposed "allowance pool" transfers (ARB 2018c) would take modest action to address oversupply risks. ARB has proposed transferring up to 75.1M allowances from the post-2020 annual allowance budgets into two new price containment points. While these transfers are not equivalent to removing excess allowances from the market and therefore do not fully resolve concerns related to market oversupply, ARB's proposed transfers would make these allowances more expensive to purchase and therefore would tend to incentivize greater GHG reductions relative to the status quo. However, the magnitude of any potential benefits will depend on where ARB ultimately sets the price level of the two price containment points.

On the other hand, the scale of the proposed transfer (up to 75.1M allowances) represents only a small share of market oversupply projected through 2020 (270M ±70M allowances) (Busch 2017). These calculations do not include the excess 81.2M pre-2021 APCR allowances AB 398 requires ARB to place in two post-2020 price containment points. If market prices reach these levels, allowances in the price containment points will contribute to projected oversupply conditions (raising the total to 351.2M ±70M allowances).

- **No mechanism for managing a transition from low to high prices.** The likely consequence of extending the market design without adjusting for oversupply is that market prices are likely to stay low for several years, during which time the supply of allowances will exceed near-term demand and prices will likely incentivize relatively few GHG reductions from the cap-and-trade program. Eventually, declining program caps will become binding and likely lead to a transition to higher carbon prices. This presents two related problems. First, low prices in the near term may lead to regulated entities' underinvestment in GHG mitigation in advance of a market transition from low to high prices. Second, carbon prices may rise significantly and quickly once emitters consume the extra allowances in the market (i.e., as market oversupply conditions fade).

- **Tension between near-term price impacts and encouraging action to reduce climate pollution.** ARB's initial thinking on the trade-offs between program stringency and laxity indicate that the Board is particularly concerned about limiting near-term price impacts (ARB 2018a: 23). We believe there are technical reforms that could enable dynamic adjustments to program allowance budgets and/or banking rules that respond in real time to relative program laxity based on empirical metrics. Some of these interventions could improve market stringency while deferring price impacts to a later point in time. However, there is no avoiding the fundamental trade-off between price impacts and GHG emission reductions. No market design can guarantee large emission reductions at low prices. Deferring adjustments to program stringency would delay and likely reduce total GHG reductions from the cap-and-trade program.

- **No analysis of how the proposed market design will achieve the role identified for cap-and-trade in the 2017 Scoping Plan.** Finally, we note that the preliminary discussion draft of ARB's proposed regulations does not include any analysis that substantiates the role ARB identified for cap-and-trade in its 2017 Scoping Plan. We understand that ARB may be planning to release more information in the future. In particular, it will be important for ARB to illustrate how any trade-offs it proposes with respect to cap-and-trade program stringency are likely to deliver on the reductions needed to close the gap between California's regulatory programs and the Scoping Plan scenario.

There are no easy answers to the challenges identified above. Fundamentally, however, we believe ARB will need to manage a transition from today's low prices to significantly higher prices in the years to come. Rather than dispute the cause of today's low prices and avoid discussion of the need to increase program stringency to defer price increases, ARB may wish to consider how proactive market reforms could enable an earlier and more gradual carbon price trajectory that contributes to the state's ambitious climate targets. With the goal of informing a constructive discussion, we offer two conceptual thoughts:

- **Price containment point prices interact with market oversupply concerns.** ARB's proposal to set the two post-2020 price containment points at relatively high price levels (starting in 2021 at no lower than $70 in 2015 USD) has important advantages and disadvantages.

  On the one hand, this approach would largely avoid exacerbating market oversupply conditions by making a sizeable supply of excess allowances (at least 81.2M) available only at high prices (no less than $70 per allowance)—almost five times higher than today's costs (about $15 per allowance). So long as the market price remains below the price containment points, these excess allowances won't contribute to market oversupply. If market prices reach these levels, however, the allowances sold from the price containment points would enable higher GHG emissions and contribute to market oversupply. For the same reasons, if ARB were to set the price containment points at low price levels, the excess allowances in these accounts would likely enter circulation and exacerbate the market's oversupply problem.

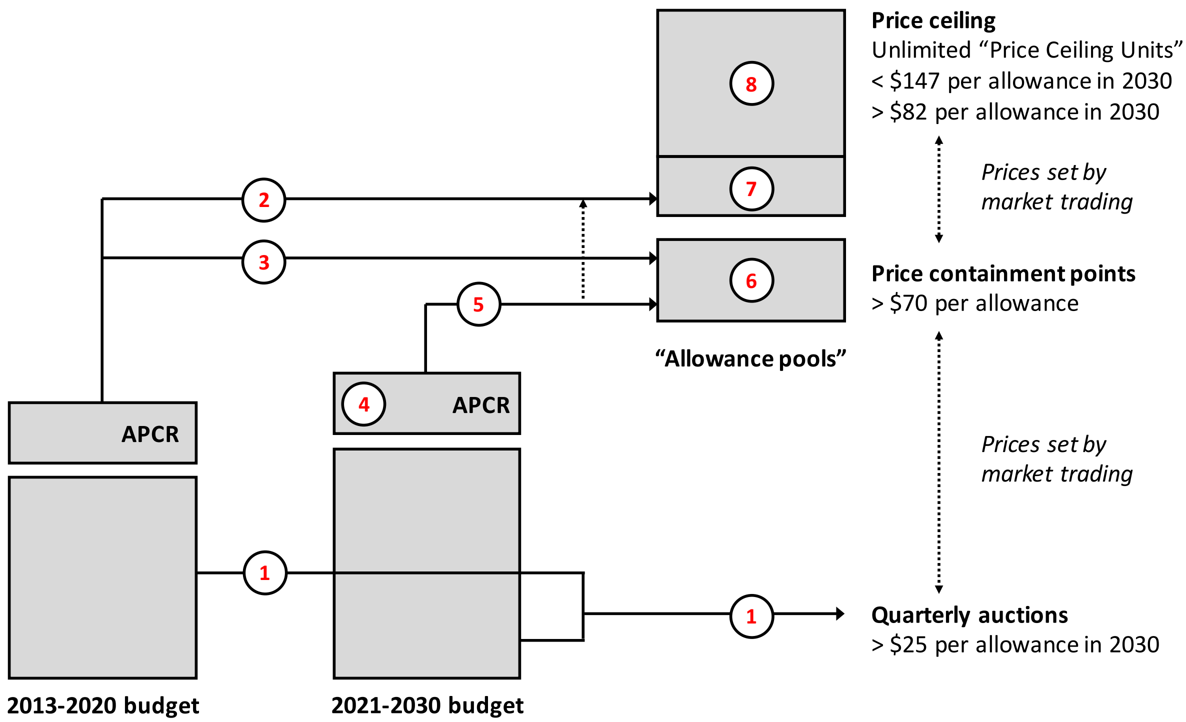
  ARB's proposal also has an important downside. Although high price containment points avoid worsening market oversupply—so long as prices stay below the containment points—the Board's proposal does not mitigate potential carbon price volatility in between current prices ($15) and the proposed price containment points (starting in 2021 at no lower than $70 in 2015 USD). Thus, ARB's proposed market design creates the potential for a disruptive market transition in the early 2020s (as oversupply conditions fade) without any guarantee of significant GHG emission reductions prior to that time (due to low prices from the near-term oversupply conditions).

- **An alternative paradigm for managing the transition to higher carbon prices?** To date, the cap-and-trade program has experienced low prices as a result of oversupply conditions, which themselves are attributable to the economic recession, the success of California's other clean energy policies, and reductions in the cost of low-carbon technologies (Cullenward et al., 2017). In this paradigm, carbon prices remain low so long as the supply of allowances exceeds near-term demand, but there are no mechanisms in the current market design to ensure an orderly transition from low to high prices once oversupply conditions are gone. The fundamental challenge is twofold. First, today's low prices bear little relationship to the costs ARB projects for the kinds of efforts needed to achieve California's ambitious 2030 climate target (ARB 2017a: 46). Second, tomorrow's carbon prices could rise too quickly as oversupply conditions fade in the early 2020s.

  To escape the constraints the current paradigm imposes, ARB may wish to consider a different approach to managing program costs. Rather than rely on allowance oversupply to keep costs low, ARB could evaluate other approaches. One option would be to re-orient its market design to carefully reduce allowance oversupply while containing price trajectories via lower price containment points and a graduated price ceiling level that starts at a lower initial price and increases more rapidly over time. This would require (1) a thoughtful study to evaluate market oversupply conditions and carefully address them via adjusting allowance budgets and/or banking rules (see Appendix 2), as well as (2) the establishment of price ceiling and/or price containment points at lower prices to contain costs within the Board's discretionary authority under AB 398. Collectively, these reforms would better enable the Board to balance the trade-offs between program stringency and costs, relying on explicit controls to manage costs and increasing the transparency of the program's implementation.

Appendix 1: ARB's proposed post-2020 market design

ARB has proposed modifying the market design by shifting several quantities of allowances from the pre- and post-2020 allowance budgets into several so-called "allowance pools" (ARB 2018c). The summary figure below indicates how various quantities of allowances would be transferred from annual allowance budgets into standard quarterly auctions, two new price containment points, and a new set of accounts at the post-2020 market price ceiling:



1. Allowance banking and auctions
2. 1/3 of pre-2020 APCR sent to price ceiling
3. 2/3 of pre-2020 APCR allowances sent to price containment points
4. Post-2020 budget carve-outs
5. Post-2020 budget carve-outs sent to two price containment points and/or ceiling
6. Two price containment points
7. Price ceiling account
8. Unlimited, non-tradable "Price Ceiling Units"

Notes: All prices are given in units of 2015 USD, consistent with ARB's new documents and the 2017 Scoping Plan. Figure not drawn to scale.

1. Allowance banking and auctions

Under current and proposed market regulations, regulated entities and third-party buyers can bank allowances for use in any future program years, subject only to corporate association-level holding limits (in 2018, up to 15.7M of current and each future year allowance vintage) (ARB 2017b). Allowances from the pre-2020 program budgets that are purchased at auction or freely allocated can be banked for post-2020 compliance purposes. Similarly, allowances from the post-2020 budgets that are purchased at auction or freely allocated can be banked for post-2020 compliance purposes. ARB has not proposed modifying the auction price floor, citing concerns about harmonizing WCI market design in Ontario and Québec; at the current schedule, the auction price floor would be $25.16 per allowance in 2030 (2015 USD).

2. 1/3 of pre-2020 APCR sent to price ceiling

AB 398 requires ARB to create a new price ceiling at which unlimited new compliance instruments will be made available for purchase (see item #8, below). AB 398 also requires ARB to transfer 1/3 of the allowances in the pre-2020 Allowance Price Containment Reserve (APCR) at the end of 2017 into a separate price ceiling account (see item #7, below) that would be offered for sale before ARB issues unlimited new Price Ceiling Units (see item #8, below; these former APCR allowances come from the original program allowance budgets). At the end of 2017, there were 121.8M allowances in the APCR; thus, 1/3 of these allowances (40.6M) will be transferred into the post-2020 price ceiling account.

3. 2/3 of pre-2020 APCR sent to two price containment points

AB 398 requires ARB to send the remaining 2/3 of the allowances in the APCR at the end of 2020 to two new "price containment points" (see item #6, below). At the end of 2017, there were 121.8M allowances in the APCR; thus, 2/3 of these allowances (81.2M) will be transferred into the two price containment points (40.6M each).

4. Post-2020 budget carve-outs

ARB finalized post-2020 market regulations in 2017, after the passage of AB 398 but before making an effort to comply with the statute's requirements. These regulations were approved by the Office of Administrative Law and therefore constitute current law. These regulations retained the structure of the pre-2020 APCR but did not include a price ceiling, which is inconsistent with AB 398 and therefore requires reform. Accordingly, ARB is taking current regulations as the starting point for reforms and proposing changes relative to this baseline. In the 2017 regulations, ARB set aside 52.4M allowances for the APCR (see § 95871, Table 8-2).

ARB has now proposed increasing the size of the post-2020 APCR set-aside, reflecting the logic the Board employed in the pre-2020 market design period. In 2010, ARB had considered reserving 4% of the 2013-2020 allowance budgets for the APCR, mirroring the then-proposed 4% limit on offsets use. When ARB ultimately adopted an offsets limit of 8%, the Board also increased the APCR set-aside to 8%. Consistent with that approach, ARB now proposes to increase the post-2020 APCR set-aside by 2% of the allowance budgets for the period 2026-2030, reflecting the 6% offsets limit that applies in this period (6% being 2% higher than 4%). This would result in an addition 22.7M post-2020 allowances being transferred to the new price containment points (distributed equally from all post-2020 annual budgets, rather than from 2026-2030 budgets only).

Thus, ARB has proposed increasing the total post-2020 budget carve-out from 52.4M allowances (as specified in current regulations) by an additional 22.7M allowances, for a total of 75.1M allowances.

5. Post-2020 budget carve-outs to two price containment points and/or price ceiling

ARB is considering sending all of the allowances set aside for the APCR from the post-2020 allowance budgets (including proposed additions, see items #3 and #4, above) to one or both of the two new price containment points (see item #6, below) and/or the price ceiling account (see item #7, below). Including proposed additions to the post-2020 APCR above what is currently in ARB's official market regulations, the total number of allowances in question is 75.1M (see item #4, above).

6. Two price containment points

AB 398 delegates broad authority to ARB to design two new price containment points, which are essentially pools of allowances made available for purchase at specified prices.

ARB has proposed that the lower of these two price containment points be no lower than $70 in 2021 (2015 USD). Under ARB's proposal, allowances in the two price containment points would be made available for sale at an annual offering, as well as on a quarterly basis if the previous quarter's auction clears at or above 60% of the lower of the two price containment point reserve prices.

7. Price ceiling account

AB 398 delegates broad authority to ARB to design a new market price ceiling. Pursuant to statute, ARB must offer unlimited compliance instruments for sale at the price ceiling. The Board has proposed setting the 2030 price ceiling price no lower than $81.90 per allowance and no higher than $147 per allowance (both units in 2015 USD).

ARB can also offer other compliance instruments for sale at the price ceiling level. For example, AB 398 requires that 1/3 of the allowances in the APCR at the end of 2017 be transferred to the price ceiling account (40.6M, see item #2 above). In addition, under current regulations, allowances that remain unsold at auction after 24 months are automatically transferred to the APCR. AB 398 requires that ARB to transfer any allowances remaining in the APCR at the end of 2020 into the price ceiling.

Because current market regulations restrict the rate at which previously unsold allowances can be re-introduced, at least some of the previously unsold allowances will remain unsold for 24 months, be transferred into the APCR, and eventually removed to the post-2020 price ceiling account. Even if all allowances re-introduced at auction sell, approximately 40M will ultimately be transferred to the post-2020 price ceiling (Busch 2017).

8. Unlimited, non-tradable "Price Ceiling Units"

ARB has proposed distinguishing the unlimited compliance instruments it must offer at the price ceiling from "normal" allowances that are part of the program's overall allowance budget. ARB proposes calling the new unlimited instruments "Price Ceiling Units" and making them subject to different rules. The Price Ceiling Units would be made available for purchase at an annual event that is separate from the quarterly auctions. The new Price Ceiling Units would not be tradable, but would instead be available for purchase in a manner that allows regulated entities to close any gaps in their annual compliance obligations in a timely manner.

AB 398 requires the Board to spend all revenue raised from sales of additional compliance instruments at the price ceiling on additional reductions of greenhouse gases—an environmental integrity provision (see Cullenward et al. 2018). Under ARB's proposal, only these Price Ceiling Units would be subject to AB 398's environmental integrity provision. All other, "normal" allowances offered for sale at the price ceiling (see item #7, above) would not be subject to this requirement.

Appendix 2: Overallocation / oversupply study needs

AB 398 requires ARB to evaluate and address as appropriate "concerns related to [allowance] overallocation" (Cal. Health & Safety Code § 38562(c)(2)(D)). In order to properly evaluate market overallocation / oversupply, a study would need to consider several important factors:

- The gap between pre-2020 allowance budgets and pre-2020 GHG emissions, both in terms of observed (through 2016) and projected (2017-2020) emissions;
- The role carbon pricing may have played in the difference between allowance budgets and actual emissions, including anticipatory mitigation undertaken by covered entities;
- An estimate of the extent to which extra allowances in the pre-2020 allowance budgets are being banked in private and government accounts, and a mechanism for tracking banking behavior on an ongoing basis;
- The supply of carbon offset credits through 2020 and their impact on the size of allowance banking;
- The balance of compliance instrument supply and demand across linked programs in California, Québec, and Ontario;
- The extent to which the delayed re-introduction of previously unsold allowances from undersubscribed auctions will result in the de facto retirement of some of these allowances; and,
- The carry-forward of pre-2020 APCR allowances into post-2020 price containment points.

We believe the existing literature provides a helpful start to answering many of these issues and are confident that further study could produce a thoroughly vetted analysis with broad stakeholder input to inform ARB's planning. We urge ARB to take seriously the need to design a cap-and-trade program that addresses the program's current challenges and to conduct a public estimate of market oversupply conditions to inform the Board's options.

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RESEARCH NOTE

Ready, fire, aim: ARB's overallocation report misses its target

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Executive summary

ARB's April 2018 Staff Report fails to "[e]valuate and address concerns related to overallocation" in the cap-and-trade program, as required by AB 398. Despite widespread concern that overallocation could cause emissions to exceed California's legally binding 2030 limit, the Report does not actually analyze this key question. More troublingly, the Report makes a fundamental methodological error that ARB specifically warned against in its original 2010 cap-and-trade regulatory process; once corrected, the Report's method leads to the conclusion that overallocation will cause the state to exceed its 2030 emissions limit.

Introduction

Last year's cap-and-trade extension bill, AB 398, directs the California Air Resources Board (ARB) to "[e]valuate and address concerns related to overallocation in the state board's determination of the number of available allowances for years 2021 to 2030, inclusive, as appropriate."[1] Allowance overallocation is a critical issue because it could undermine the effectiveness of the cap-and-trade program. ARB's 2017 Scoping Plan calls on the cap-and-trade program to deliver over 45% of the annual GHG emission reductions needed to achieve California's 2030 climate target.[2]

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1 Cal. Health & Safety Code § 38562(c)(2)(D) (as added by AB 398).

2 ARB, California's 2017 Climate Change Scoping Plan (Nov. 2017) at 26 (Table 2) (indicating that regulations are expected to reduce GHG emissions by 69 $MMtCO_2e$ in 2030 under the Scoping Plan Scenario), https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf; *id.* at 30 (indicating that the cap-and-trade needs to reduce another 60 $MMtCO_2e$ to achieve the SB 32 target for 2030). The share that cap-and-trade must contribute (60 $MMtCO_2e$) is 46.5% of the total reductions required relative to business-as-usual emissions in 2030 (60 + 69 = 129 $MMtCO_2e$).

As the Legislative Analyst's Office (LAO) has explained, overallocation could put the state's 2030 climate target at risk by potentially enabling market participants to bank excess allowances not needed in the program's initial phase for use in later years.[3] If too many allowances are banked, future emissions could exceed program budgets, undermining the cap-and-trade program's intended role as a "backstop" state climate policy. Allowance overallocation (also called oversupply) has been discussed extensively in independent expert reports,[4] in the media,[5] at ARB's public workshops,[6] in public comment letters to ARB,[7] in legislative committee hearings attended by ARB Chair Mary Nichols,[8] and in legislative committee reports.[9]

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3 LAO, Cap-and-Trade Extension: Issues for Legislative Oversight (Dec. 2017), http://lao.ca.gov/Publications/Report/3719.

4 *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), https://eco.on.ca/reports/2017-from-plan-to-progress/; Chris Busch, Oversupply Grows in the Western Climate Initiative Carbon Market, Energy Innovation Report (Dec. 2017), http://energyinnovation.org/wp-content/uploads/2018/02/WCI-oversupply-grows-February-update.pdf; Danny Cullenward & Andy Coghlan, Structural oversupply and credibility in California's carbon market, *Electricity Journal* 29: 7–14 (2016).

5 *See*, *e.g.*, Herman K. Trabish, Is cap and trade the climate solution? The jury's still out, *Utility Dive* (Jan. 19, 2018), https://www.utilitydive.com/news/is-cap-and-trade-the-climate-solution-the-jurys-still-out/514747/; Justin Gillis and Chris Busch, A Landmark California Climate Program Is in Jeopardy, *The New York Times* (Dec. 12, 2017), https://www.nytimes.com/2017/12/12/opinion/california-climate-program-emissions.html.

6 ARB hosted informal workshops on potential AB 398 implementation strategies on March 2, 2018, and April 26, 2018, documents available at https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm.

7 *See*, *e.g.*, comments on ARB's March 2, 2018, workshop from NextGen California, California Environmental Justice Alliance, the Natural Resources Defense Council, and Near Zero, https://www.arb.ca.gov/lispub/comm2/bccommlog.php?listname=ct-3-2-18-wkshp-ws.

8 Joint Legislative Committee on Climate Change Policies (JLCCCP), 2030 Target Scoping Plan (Jan. 4, 2018), http://climatechangepolicies.legislature.ca.gov/previous-hearings; Senate Environmental Quality Committee (SEQ), California's Cap-and-Trade Program: The Air Resources Board's 2018 Scoping Plan (Jan. 17, 2018), http://senv.senate.ca.gov/informationalhearings.

9 JLCCCP Oversight Hearing Background Document: 2030 Target Scoping Plan (Jan. 4, 2018),

In April 2018, ARB staff released a report (hereinafter, the "Post-2020 Caps Report" or "the Report") that provides the Board's first official response to AB 398's statutory direction to evaluate and address concerns related to overallocation.[10] The Report suffers from two major shortcomings.

First, despite the clear concern that overallocation could undermine the state's 2030 climate target, the Report makes no inquiry into the impact of overallocation on *annual* emissions in 2030. Instead, the Post-2020 Caps Report calculates the *cumulative* balance of projected emissions and compliance instrument budgets for the years 2021 through 2030, from which Board staff infer the cumulative greenhouse gas (GHG) emission reductions attributable to cap-and-trade. The Report does not analyze what is likely to happen in 2030 and therefore does not address the primary risk from allowance overallocation.

Taking overallocation risks seriously requires significantly more analysis than what ARB has provided. On this basis alone, the Post-2020 Caps Report does not provide a reasoned basis for satisfying AB 398's requirement to "[e]valuate and address concerns related to overallocation."

Second, the Report makes a fundamental error in its calculations that undermines its own conclusions. Specifically, the Report misses a key step in estimating emissions subject to the cap-and-trade program that ARB identified in 2010 as essential to any analysis of overallocation (see Appendix).[11] Once the Report's mistake is corrected—using the same method of adjustment the Board used in its original 2010 cap-setting regulatory process—ARB's own methods show that overallocation will cause the cap-and-trade program to deliver significantly fewer emission reductions than what is

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http://climatechangepolicies.legislature.ca.gov/previous-hearings; SEQ, California's Cap-and-Trade Program: The Air Resources Board's 2017 Scoping Plan – Background Document (Jan. 17, 2018), http://senv.senate.ca.gov/sites/senv.senate.ca.gov/files/hearing_background_final.pdf.

10 ARB, Supporting Material for Assessment of Post-2020 Caps (Apr. 2018), https://www.arb.ca.gov/cc/capandtrade/meetings/20180426/carb_post2020caps.pdf.

11 ARB, 2010 Cap-and-Trade Regulation, Staff Report: Initial Statement of Reasons (October 28, 2010), Vol. 1, Appendix E: Setting the Program Emissions Cap, at E7 through E-8, https://www.arb.ca.gov/regact/2010/capandtrade10/capv3appe.pdf.

called for in the 2017 Scoping Plan. Thus, the error undercuts staff's conclusion that an overallocated cap-and-trade program "achieves [the] reductions needed to meet the 2030 target."[12]

Rather than rely on an erroneous analysis that doesn't address the primary concern related to market overallocation, the Board should engage the substantial body of analysis that is now available to inform a serious discussion of potential impacts and solutions.

Post-2020 Caps Report: ARB's Methods

ARB staff's Post-2020 Caps Report estimates the cap-and-trade program's cumulative supply/demand balance over the period 2021 through 2030 by projecting emissions (demand) and estimating the number of compliance instruments available (supply), including allowances and carbon offsets. To evaluate the impact of allowance overallocation, the Report calculates the cumulative supply/demand balance for two scenarios. The first assumes no overallocation and the second assumes that 150 million allowances (150M) from the pre-2021 period will be banked for use in the post-2020 period, effectively increasing the supply of compliance instruments in that later period.

In both of ARB's scenarios, projected emissions (demand) exceed compliance instruments (supply); the difference (demand minus supply) is reported as the cumulative emission reductions from cap-and-trade from 2021 through 2030 (expressed in million tons of carbon dioxide equivalent, or $MMtCO_2e$). Table 1 reports the calculations published in ARB's Post-2020 Caps Report and in an accompanying workshop presentation.[13] Based on this analysis, Board staff conclude that overallocation will not put the state's 2030 climate target at risk.

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12 ARB, Workshop to Continue Informal Discussion on Potential Amendments to Cap-and-Trade Regulation (Apr. 26, 2018), slide 28, https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm.

13 ARB, Post-2020 Caps Report at 11 (Table 3) and 14 (Table 4); *see also* ARB, Cap-and-Trade Workshop, *supra* note 12 at slide 28.

Table 1: ARB's cumulative overallocation analysis for 2021-2030 ($MMtCO_2e$)

#	Series	Case A (No overallocation)	Case B (150M overallocation)
1	Covered emissions w/o cap-and-trade program (demand)	3,054	3,054
2	Post-2020 allowances (w/o Post-2020 Reserve)	2,532	2,532
3	Pre-2021 allowances (overallocation)	0	150
4	Offset credits	96	103
5	Total compliance instruments (supply) (#2 + #3 + #4)	2,628	2,785
6	Cumulative reductions from cap-and-trade (#1 – #5)	426	269

A detailed discussion of the report's methods follows, with corresponding lines in Table 1 in parentheses:

- **Projecting demand (#1).** ARB uses a straightforward method for projecting future covered emissions, which represents the future demand for cap-and-trade compliance instruments. However, ARB's method makes a fundamental error that, once corrected, shows that cap-and-trade is expected to fall short of the role identified for it in the Scoping Plan. We describe ARB's methods here and present the error in the next section.

  The Post-2020 Caps Report estimates GHG emissions through 2030 using the PATHWAYS model projections developed for ARB's 2017 Scoping Plan Scenario. The Scoping Plan Scenario models GHG emissions after taking into account the effect of all of California's climate regulations except for the impact of the cap-and-trade program; the projections therefore indicate expected GHG emissions without taking into account the effects of the cap-and-trade program.

The Post-2020 Caps Report separates the PATHWAYS projections into "covered sectors" and "non-covered sectors." As the Report explains:

> Cap-and-Trade covered emissions include the transportation, electricity, residential and commercial, and industrial sectors, and non-covered emissions are from the agricultural, recycling and waste, and high global warming potential [GWP] gas sectors.[14]

To calculate emissions from "covered sectors," ARB staff added up the GHG emissions projected from 2021 through 2030 from each of the four sectors identified above (transportation, electricity, residential and commercial, and industrial), based on PATHWAYS output.[15] We manually confirmed that this data source and method accurately reproduces the cumulative emissions ARB published in its Post-2020 Caps Report—a total of 3,054 million tons of carbon dioxide equivalent ($MMtCO_2e$).[16] Projected emissions are the same across ARB's two overallocation scenarios, which vary only in the number of allowances banked from the pre-2021 period into the post-2020 period.

- **Projecting supply (#2 through #5).** The Post-2020 Caps Report's supply projections are also straightforward. The Report analyzes two scenarios to evaluate potential overallocation outcomes: one in which zero pre-2021 allowances are banked for use in the post-2020 market period, and a second in which 150M pre-2021 allowances are banked for use in the post-2020 period.

  The calculation begins with the total supply of all allowances for vintage years 2021 through 2030, a total of 2,607M under current regulations.[17] Next, the calculations subtract ARB's proposed post-2020 Reserve allowances, a pool of allowances that were set aside from the post-2020 allowance budget. Including current post-2020 Reserve allowances (52M) and additional post-2020 Reserve allowances that

14 ARB, Post-2020 Caps Report at 10.

15 *Id*. at 11, Table 3, note ## (link to https://www.arb.ca.gov/cc/scopingplan/comparison_graphs_6cases101817.xlsm).

16 *Id*. at 11, Table 3.

17 *Id*. at 13-14.

Board staff proposed to set aside in a February 2018 discussion document (22.7M), there are about 75M post-2020 Reserve allowances.[18] The Post-2020 Caps Report assumes these 75M allowances will not be needed for compliance under the cap-and-trade program, and therefore removes them from the supply calculation (2,607M – 75M = 2,532M, as shown in Table 4 of the Post-2020 Caps Report). The Report also assumes that additional compliance instruments available for sale at the price ceiling will not be accessed.[19]

The supply estimate is then increased to account for the expected use of carbon offset credits. The Report assumes that carbon offsets usage will equal 3% of covered emissions from 2021-2025 and 4.5% from 2026-2030.[20] The total number of offset credits used varies slightly depending on how many emissions there are, which in turn depends on the number of pre-2021 allowances that are banked into the post-2020 period. In the first scenario, with no banking of pre-2021 allowances, the Report assumes 96M offset credits will be used; in the second scenario, with 150M banked pre-2021 allowances, the Report assumes 103M offset credits will be used.

Finally, the Report adds up these supplies across its two scenarios to evaluate potential overallocation outcomes. In the first scenario, zero pre-2021 allowances are used for post-2020 compliance, resulting in 2,628M total compliance instruments over the period 2021 through 2030. In the second scenario, 150M pre-2021 allowances are used for post-2020 compliance, resulting in a total supply of 2,785M total compliance instruments over the period 2021 through 2030.

- **Calculating GHG emission reductions (#6).** The final step in ARB's analysis is to calculate the GHG emission reductions the cap-and-trade program is projected to deliver in each scenario. Because the Post-2020 Caps Report projects emissions (demand) and compliance instruments (supply) on a cumulative basis, so too does ARB calculate

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[18] ARB, Preliminary Concepts: Price Containment Points, Price Ceiling, and Allowance Pools (Feb. 2018), https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm.

[19] ARB, Post-2020 Caps Report at 14.

[20] *Id.* at 14.

GHG emission reductions on a cumulative basis over the period 2021 through 2030.

Calculated GHG emission reductions are reported as the difference between projected emissions under the Scoping Plan Scenario (demand) and the number of compliance instruments (supply) available over the same period. Conceptually, this makes sense because, over a given period, the cap-and-trade program requires cumulative covered emissions to be no higher than the total number of available compliance instruments (allowances and offsets). As a result, if projected baseline GHG emissions are higher than the total number of compliance instruments, GHG emitters subject to the cap-and-trade program must reduce their emissions by a corresponding amount.

For each of the two scenarios described above, the Post-2020 Caps Report calculates GHG emission reductions. For the first scenario, in which zero pre-2021 allowances are used for post-2020 compliance, the Report's calculated GHG reductions are 426 $MMtCO_2e$ (3,054M – 2,628M = 426M). For the second scenario, in which 150M pre-2021 allowances are used for post-2020 compliance, the Report's calculated GHG reductions are 269 $MMtCO_2e$ (3,054M – 2,785M = 269M).

- **Drawing conclusions.** One curious feature of the Post-2020 Caps Report is that it never specifies a metric for evaluating whether or not the calculated GHG emission reductions are sufficient. Despite the lack of a clear metric, the Report concludes that even with 150 million excess allowances from the pre-2021 period, cap-and-trade will still "reduce emissions to help achieve the 2030 target."[21] ARB Assistant Division Chief Rajinder Sahota made similar comments in ARB's April 2018 workshop, saying that the staff analysis shows that a 150 million allowance overallocation "does not endanger" the chances of emissions in 2030 remaining below the limit.[22]

[21] *Id.* at 14.

[22] As transcribed from the workshop, Ms. Sahota's full comment was: "The banking question really is about protecting against windfall profits, and then also endangering the post-2020 period. In looking at the analysis that we did on overallocation, 150 [million allowances] and what that might mean for post-2020, we know that the caps are so steep relative to what the emissions would be without cap-and-trade, pulling that 150 [million allowances] forward does not endanger that."

> We assume that ARB is comparing the calculated GHG emission reductions discussed above against reductions called for from the ARB's 2017 Scoping Plan. The 2017 Scoping Plan concludes that under the Scoping Plan Scenario, cap-and-trade needs to deliver 236 $MMtCO_2e$ in cumulative reductions over the period 2021 through 2030.[23] In both of the Report's scenarios, projected GHG reductions are larger than this amount, suggesting that the cap-and-trade would provide the cumulative emissions cuts identified in the Scoping Plan.

Again, we note that the Report's analysis does not evaluate what impact overallocation has on the state's ability to meet its legally binding GHG emissions target in 2030. At best, the Report's methods might indicate whether expected *cumulative* cap-and-trade reductions match the cumulative reductions called for in ARB's Scoping Plan—but the Report never addresses the impact of overallocation on California's *annual* emissions in 2030. State law requires ARB to reduce emissions to hit an *annual* target in 2030, not a *cumulative* target over the period 2021 through 2030.[24] Even if projected cumulative reductions are equal to or greater than the cumulative reductions called for in the Scoping Plan, it is still possible for emissions to significantly exceed the 2030 limit.[25]

ARB's Erroneous Covered Emissions Projection

The Post-2020 Caps Report makes a fundamental error in the way it projects future GHG emissions, inflating projected "covered emissions" subject to the cap-and-trade program by approximately 277 $MMtCO_2e$ over the period 2021 through 2030. Once corrected for this error, the Report's calculations show that ARB's estimated overallocation of 150M allowances would cause the cap-and-trade program to be non-binding over the same period, and therefore fall well short of the reductions ARB called for in the final 2017 Scoping Plan.

Simply put, the Post-2020 Caps Report used the wrong data to project "covered emissions"—that is, the emissions actually subject to the cap-and-trade program. Rather than estimate future "covered emissions" subject to the cap-and-trade program, the Report instead projected emissions

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23 ARB, 2017 Scoping Plan, *supra* note 2 at 28.

24 Cal. Health & Safety Code § 38566.

25 *See*, *e.g.*, LAO, *supra* note 3.

from "covered sectors"—a broader category with emissions that are about 10% higher than "covered emissions." By projecting an erroneously high emissions trajectory, ARB's calculation also inflates the calculated GHG emission reductions attributable to cap-and-trade.

The core problem is this: not all emissions in "covered sectors" are "covered emissions" subject to the cap-and-trade program. "Covered sector" emissions include 100% of the emissions from sources classified as being in these four high-level sectors (transportation, electricity, residential and commercial, and industry). In contrast, "covered emissions" are essentially a subset of these emissions, although not a perfect subset.[26] Total statewide GHG emissions, which are subject to the legislative limits set for 2020 and 2030, are the sum of "covered sector" and "non-covered sector" emissions.

As Figure 1 illustrates, the difference between "covered emissions" and "covered sector" emissions is visually striking. Table 2 presents the difference in numerical terms. Each year for which there are data, the gap between "covered sector" emissions and "covered emissions" grew larger, starting at 30.6 $MMtCO_2e$ per year in 2011 and increasing to 37.5 $MMtCO_2e$ per year in 2015. Over these five years, the average difference was 34.8 $MMtCO_2e$.

We correct the Report's error by adopting ARB's historical practice of revising sector-wide emission estimates using facility-level data gathered through California's Mandatory Greenhouse Gas Reporting Regulation (MRR) (see Appendix). Just as ARB did in its original 2010 cap-setting regulatory process, which developed program caps through 2020, we employ the ratio of covered emissions subject to the cap-and-trade program (using MRR data) to total covered sector emissions (from the state GHG inventory). Consistent with the Board's previous cap-setting exercise, this approach uses actual historical data describing emissions subject to the cap-and-trade program to improve forecasting accuracy.

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26 "Covered emissions" are not a perfect subset of "covered sector" emissions because some covered emissions are categorized in non-covered sectors (agriculture, high GWP gases, or recycling and waste). For example, most emissions in the agriculture sector are not subject to the cap-and-trade program, but some emissions from agricultural energy use (such as the combustion of liquid fuels and natural gas) are, even though those emissions are counted in both the PATHWAYS model and the state greenhouse gas inventory as coming from the agriculture sector.

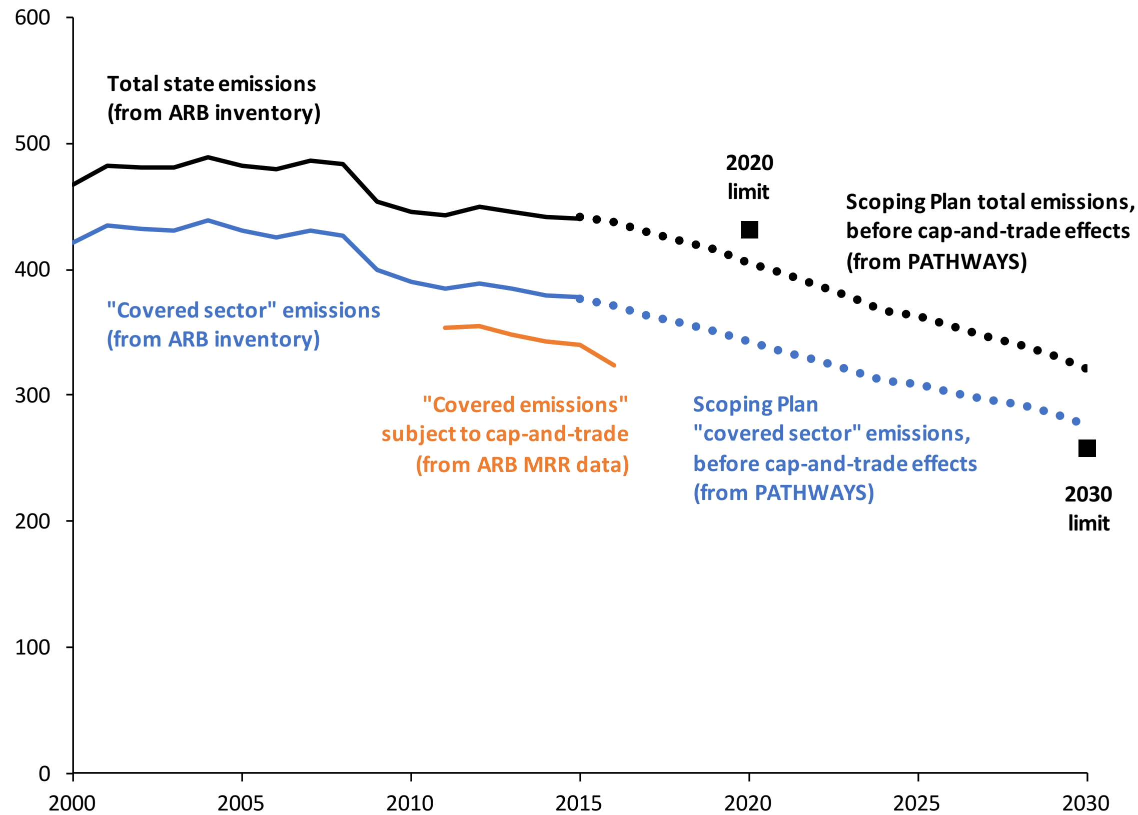

Figure 1: Comparison of statewide, covered sector, and covered emissions (MMtCO$_2$e). Total statewide emissions data are from ARB's GHG inventory (black solid line)[27] and the projection is from the PATHWAYS projection for the Scoping Plan Scenario (black dotted line).[28] Historical "covered sector" emissions (blue solid line) are derived from ARB's GHG inventory and projected "covered sector" emissions are from PATHWAYS (blue dotted line). Historical "covered emissions" (orange line) are reported under ARB's MRR regulation.[29] On average, annual emissions in "covered sectors" have been about 35 MMtCO$_2$e higher than "covered emissions" subject to the cap-and-trade program. ARB erroneously used these higher numbers to calculate the GHG emission reductions attributable to cap-and-trade in the post-2020 period.

27 ARB, California GHG Emission Inventory (2017), https://www.arb.ca.gov/cc/inventory/data/data.htm.

28 The PATHWAYS output file is available at https://www.arb.ca.gov/cc/scopingplan/comparison_graphs_6cases101817.xlsm.

29 ARB, Mandatory GHG Reporting Regulation, https://ww2.arb.ca.gov/mrr-data.

To correct the PATHWAYS projections for covered sector emissions, we multiply each year's projected emissions by the average ratio between actual historical covered emissions and sector-wide emissions over the period 2011 through 2015 (0.909, see Table 2). This correction reduces ARB's projected covered emissions 2021 through 2030 by a cumulative 277 $MMtCO_2e$.[30] Over the ten-year projection period from 2021 through 2030, this suggests that ARB over-estimated GHG emissions subject to the cap-and-trade program by approximately 277 $MMtCO_2e$.

Table 2: Comparison of covered sector emissions and covered emissions ($MMtCO_2e$)

Series	Source	2011	2012	2013	2014	2015	Avg. 2011-15
Covered sector emissions	State GHG Inventory	383.9	388.3	384.8	379.4	377.9	382.9
Covered emissions	MRR Data	353.3	355.4	348.5	342.9	340.4	348.1
Difference		30.6	32.9	36.3	36.5	37.5	34.8
Ratio, covered emissions (MRR) to covered sector emissions (Inventory)		0.920	0.915	0.906	0.904	0.901	0.909

Correcting the Post-2020 Caps Report

We replicated ARB's calculations from the Post-2020 Caps Report, correcting for the error in projected emissions described above. The corrected covered emissions projection for the period 2021 through 2030 is 2,777 $MMtCO_2e$ (3,054M – 277M = 2,777M), reflecting expected GHG emissions subject to the cap-and-trade program after California's non-cap-and-trade regulations take effect, but before the cap-and-trade program takes effect. We then examine the impact of this correction on the estimated reductions ARB expects from the cap-and-trade program over this period across its two overallocation scenarios (see Table 3).

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30 For the original and corrected GHG projection data, see the spreadsheet published along with this report on Near Zero's website, www.nearzero.org.

Table 3: Correction to ARB's cumulative overallocation analysis, 2021-2030 ($MMtCO_2e$)

#	Series	Case A (No overallocation)	Case B (150 M overallocation)
1	Erroneous covered emissions w/o cap-and-trade program (demand)	3,054	3,054
2	Correction to covered emissions (Near Zero calculation)	-277	-277
3	Corrected covered emissions (demand) (#1 + #2)	2,777	2,777
4	Post-2020 allowances (w/o Post-2020 Reserve)	2,532	2,532
5	Unused allowances at end of 2020	0	150
6	Offset credits	96	103
7	Total compliance instruments (supply) (#4 + #5 + #6)	2,628	2,785
8	Cumulative reductions from cap-and-trade (#3 – #7)	149	0 (*)

(*) Calculated reductions are negative (2,777M – 2,785M = -8M). This indicates the program is non-binding under these conditions and therefore produces no cumulative reductions.

In ARB's zero overallocation scenario (Case A), the corrected demand for compliance instruments (before cap-and-trade effects) remains larger than the supply, indicating the cap-and-trade program will reduce cumulative GHG emissions. Specifically, ARB assumes that cap-and-trade will reduce emissions until they are equal to the supply of compliance instruments, so the reduction in emissions due to cap-and-trade is 149 $MMtCO_2e$ (2,777M – 2,628M = 149M).

In ARB's 150M overallocation scenario (Case B), the corrected demand for compliance instruments (before cap-and-trade effects) is less than the supply of compliance instruments. According to ARB's methods, in this case the cap-and-trade program does not require any further reduction in GHG emissions. As a result, the calculated reductions attributable to cap-and-trade would be zero. In this case, ARB's method projects that statewide GHG emissions will exceed the 2030 limit.[31]

Figure 2 compares the reductions called for in the 2017 Scoping Plan against the calculations in the Post-2020 Caps Report (from Table 1) as well as corrected calculations (from Table 3).

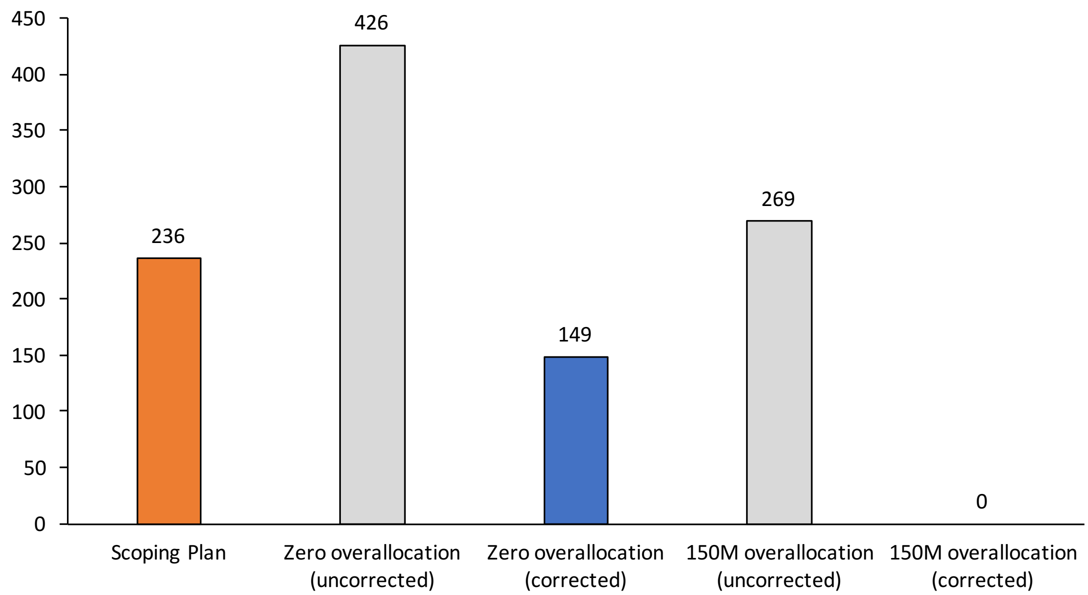

Figure 2: Calculated reductions from cap-and-trade, 2021 through 2030 ($MMtCO_2e$)
ARB's uncorrected estimates suggest that whether or not there are 150M overallocated pre-2021 allowances, the cap-and-trade program will deliver at least as many reductions as called for in the Scoping Plan. Once corrected for ARB's error, however, the Report's analysis indicates that the status quo market design is expected to fall short of the Scoping Plan's requirement—with or without 150M overallocated allowances.

In our view, neither the original Post-2020 Caps Report calculation (reported in Table 1) nor the corrected calculations (reported in Table 3) offer a reasonable basis for evaluating whether overallocation puts California's 2030 climate target at risk. Nevertheless, we have illustrated how a critical

31 A calculated effect of zero implies that California's greenhouse gas emissions trajectory would follow the PATHWAYS Scoping Plan scenario projection. In reality, a non-binding cumulative program cap would still impose supplemental reductions as a result of the auction price floor. However, the Scoping Plan analysis does not explicitly model the effects of price-induced mitigation from the cap-and-trade program.

error in ARB's calculations undermines the Post-2020 Caps Report's conclusions. Additional and more substantive analysis is needed to address the risks of overallocation.

Conclusion

ARB's Post-2020 Caps Report offers the Board's first formal analysis of how allowance overallocation might impact the cap-and-trade program's effectiveness in ensuring California meets its legally binding 2030 climate target. This issue is critical to state climate policy because the Board decided to rely on cap-and-trade to deliver over 45% of the annual GHG emission reductions needed to achieve California's 2030 climate target.[32] If overallocation leads to excess allowance banking in the cap-and-trade program, then climate emissions will not fall in line with program limits and the state will overshoot its 2030 target.

The Report falls short of AB 398's instruction to "[e]valuate and address concerns related to overallocation" on two grounds.

First, the Report does not address the primary concern related to overallocation—namely, the risk that excess allowances will be banked and used such that emissions in 2030 exceed the state's legally binding emissions limit. Instead of evaluating whether overallocation could lead to 2030 GHG emissions exceeding the state's climate target, ARB calculated the cumulative balance of market supply and demand over a ten-year period. This method is insufficient to address the serious risks LAO and independent researchers have identified. As a result, the Post-2020 Caps Report does not provide a reasoned basis for responding to AB 398's instruction to "evaluate and address concerns related to [allowance] overallocation" in its rulemaking process.

Second, the Report incorrectly asserts that overallocation of up to 150 million pre-2021 allowances will not impact the state's ability to meet its 2030

[32] ARB, 2017 Scoping Plan, *supra* note 2 at 26 (Table 2) (indicating that regulations are expected to reduce GHG emissions by 69 $MMtCO_2e$ in 2030 under the Scoping Plan Scenario); *id*. at 30 (indicating that the cap-and-trade needs to reduce another 60 $MMtCO_2e$ to achieve the SB 32 target for 2030). The share that cap-and-trade must contribute (60 $MMtCO_2e$) is 46.5% of the total reductions required relative to business-as-usual emissions in 2030 (60 + 69 = 129 $MMtCO_2e$).

climate target. The Report contains a fundamental analytical error that undermines its own conclusion. Once corrected for this factual error—using the same method the Board adopted in its original cap-and-trade rulemaking—the Report shows that the cap-and-trade program is expected to deliver significantly fewer emission reductions than what the Board called for in the 2017 Scoping Plan.

This error is not an esoteric technical detail. It is a question of basic emissions accounting. ARB properly addressed these issues when the Board set the original program caps in a 2010 rulemaking, observing that projections of "covered sector" emissions have to be adjusted downward to account for the fact that "covered emissions" subject to the cap-and-trade program are smaller than total "covered sector" emissions (see Appendix). Given the fundamental importance of cap-setting to the environmental and economic performance of California's cap-and-trade program, the lack of substantive analysis in the Report is striking—especially in comparison to the Board's prior efforts to analyze the same question in 2010.

We hope that ARB will acknowledge the shortcomings of its new Report, improve its analytical standards to maintain the scientific integrity for which the Board is known, and seriously engage the well-founded concern that overallocation risks undermining California's 2030 climate target.

Appendix: ARB's 2010 Cap-Setting Analysis

In a 2010 cap-and-trade rulemaking process, ARB developed the original cap trajectory through 2020. The Board's Initial Statement of Reasons (ISOR) explained that overallocation is a critical problem that could undermine the program's efficacy. Furthermore, staff showed how projections of broad sector-based emissions must be adjusted to account for the fact that covered emissions subject to the then-proposed cap-and-trade program would be lower than sector-wide totals. Moreover, in 2010 staff also identified the mandatory reporting regulation (MRR) data as an appropriate data source for calculating the difference between actual "covered emissions" and broad sector-based totals. We replicated the Board's exact methods from its 2010 rulemaking process to correct the Post-2020 Caps Report in this research note.

The following excerpt is from the ISOR Volume 1, Appendix E.[33] All text is original, except for text in [square brackets], which we added to clarify how terminology used in the 2010 ISOR relates to the terminology now in use today.

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2. Reliance on Mandatory Reporting Data to Ensure Accuracy in Cap Setting

Setting the cap to achieve an appropriate level of stringency is critical to the proper functioning of a cap-and-trade program. If the cap is set too tight, unacceptably high allowance prices will result. If the cap is set too loose, prices will be lower than expected and a weakened incentive to reduce emissions will be created. Accuracy in emissions estimates from covered entities is a key component of ensuring that the desired level of cap stringency is implemented. Throughout the regulatory process, staff heard concerns from environmental groups that the cap would be unintentionally set too lax—a condition sometimes referred to as "oversupply" or "overallocation."

33 ARB, 2010 Cap-and-Trade Regulation, ISOR, Vol. 1, Appendix E: Setting the Program Emissions Cap, at E-7 through E-8, https://www.arb.ca.gov/regact/2010/capandtrade10/capv3appe.pdf.

The over-allocation condition occurs if too many allowances are supplied to covered entities relative to expected business-as-usual emission levels. This issue arose in the early years of the European Union's Emission Trading Scheme (EU ETS). During the trial phase of the program, which ran from 2005–2007, caps were set without a good source of GHG emission data for the facilities covered in the program.

The lack of accurate emissions data led to initial cap levels that, although intended to require a reduction of 4 percent at the outset of the program, in actuality created a surplus of approximately 4 percent. This oversupply—8 percent beyond intended levels—coupled with the fact that allowances could not be saved from the trial periods for use in the later phases, led to a price crash in August 2006, when the first year of verified emissions data were made publicly available.*

In 2007, ARB put in place a mandatory reporting program to provide accurate greenhouse gas emissions data for the sources that will be covered in the first compliance period of the cap-and-trade program [the MRR regulation]. The data gathered through this program [the MRR data] will help ensure that the over-allocation issue is not repeated in the California context.

3. Adjustment of the Cap-and-Trade 2020 Target from Scoping Plan Levels Using Mandatory Reporting Data

The Scoping Plan's rough estimate of the target for the 2020 allowance budget (Point E in Figure E-1) was 365 $MMTCO_2e$. Since the plan was adopted, staff have developed more specificity on what emission sources within the different sectors will be covered in the cap-and-trade program. Staff have also used the 2008 facility-level data gathered through the mandatory reporting program [MRR data] to improve emissions estimates for the covered entities. Using these improved estimates, staff calculated a new broad scope 2020 allowance budget of 334 $MMTCO_2e$. This number was developed by multiplying the Scoping Plan 365 $MMTCO_2e$ 2020 budget estimate [based on "covered sector" emissions] by the ratio of the improved estimate of 2008 broad scope emissions (403 $MMTCO_2e$, de-

* Pricing Carbon: The European Union Emissions Trading Scheme. A. D. Ellerman, F. J. Convery, C. Perthuis, E. Alberola, and B. Buchner. Cambridge University Press. Cambridge, U.K. 2010. [Citation in original ARB document.]

termined using information from mandatory reporting of GHGs at the facility level [the MRR data]) to the 2008 emissions inventory estimate for broad-scope sector categories (440 $MMTCO_2e$, calculated used the Scoping Plan accounting [covered sector emissions from the state GHG inventory]).

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About Near Zero

Near Zero is a non-profit environmental research organization based at the Carnegie Institution for Science on the Stanford University campus. Near Zero provides credible, impartial, and actionable assessment with the goal of cutting greenhouse gas emissions to near zero. This research note is for informational purposes only and does not constitute investment advice.

Data used in this research note are available at our website.

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RESEARCH NOTE

California's "self-correcting" cap-and-trade auction mechanism does not eliminate market overallocation

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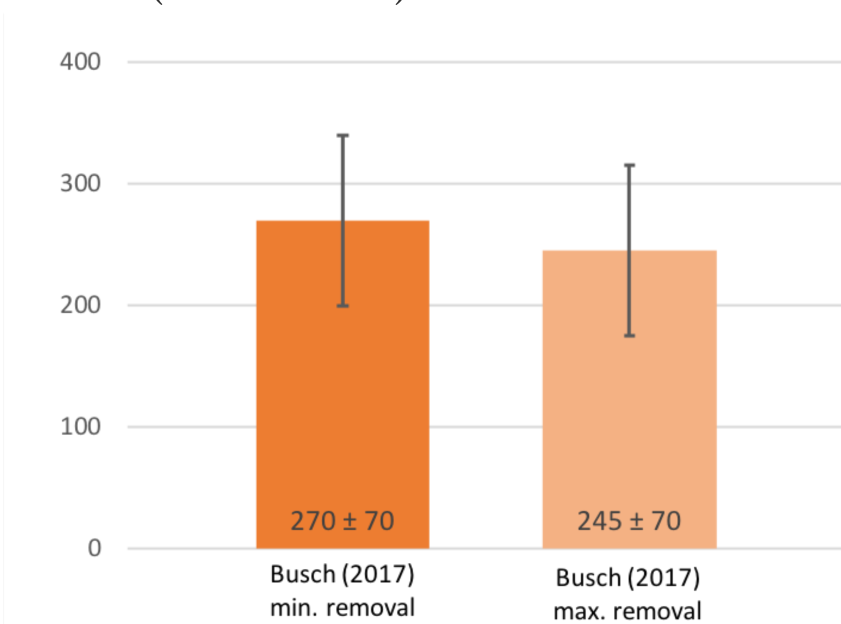
Executive summary

In recent public statements, ARB staff have suggested that California's "self-correcting" cap-and-trade auction mechanism will address overallocation—referring to a unique provision of the state's market rules that removes unsold allowances from the auction supply after 24 months. In the auction collapse of 2016 and 2017, nearly 120 million allowances went unsold and are now being reintroduced for sale at current auctions. To the extent some hit the 24-month threshold and are removed from future auction supplies, this would tend to reduce risks related to overallocation.

Our calculations show this "self-correction" mechanism will help reduce the extent of overallocation in the cap-and-trade market, but will address only a fraction of the overallocation expected by 2020 (Figure 1).

Figure 1: Market overallocation in 2020 with auction "self-correction" mechanism (million allowances)



While the magnitude of the effect is small, the exact size of the "self-correcting" mechanism depends on whether or not auctions are fully subscribed in 2018 and 2019. A prominent estimate of overallocation from Energy Innovation's Chris Busch included this mechanism and assumed that all auctions would sell out, resulting in an oversupply in 2020 of around 270 million allowances. Even if the remaining auctions are undersubscribed, we show here that, in a range of likely scenarios, at most 25 million additional allowances could be removed from the auction supply. While any assessment of overallocation should consider these potential effects, they are minor and do not eliminate the problem.

Introduction

Assembly Bill 398 requires ARB to "[e]valuate and address concerns related to overallocation in the state board's determination of the number of available allowances for years 2021 to 2030, inclusive, as appropriate."[1] Studies by independent experts have provided estimates of significant market overallocation in the Western Climate Initiative (WCI) cap-and-trade program through 2020, which could be carried over into the post-2020 period.[2]

In the debate over allowance overallocation (also known as oversupply), ARB staff[3] and others have suggested that independent estimates of overallocation fail to account for a "self-correction" mechanism built into the cap-and-trade program, whereby California allowances that remain unsold for more than 24 months are removed from the normal auction supply. The issue is particularly salient because during the auction collapse of 2016-17, ~118 million California allowances went unsold. As required by

1 Cal. Health & Safety Code § 38562(c)(2)(D) (as added by AB 398).

2 *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), https://eco.on.ca/reports/2017-from-plan-to-progress/; Chris Busch, Oversupply Grows in the Western Climate Initiative Carbon Market, Energy Innovation Report (Dec. 2017), http://energyinnovation.org/wp-content/uploads/2018/02/WCI-oversupply-grows-February-update.pdf.

3 Julie Cart, Checking the math on cap and trade, some experts say it's not adding up. CALmatters (May 22, 2018), https://calmatters.org/articles/checking-the-math-on-cap-and-trade-some-experts-say-its-not-adding-up/.

current regulations, ARB began reintroducing these previously unsold allowances in the November 2017 auction. Because of limits on the rate of reintroduction, however, some of the previously unsold allowances will inevitably remain unsold for more than 24 months and therefore be removed from the normal auction supply. How many will be removed from the auction supply depends on whether the next few auctions sell out or not.

We calculate that about one-third of California's previously unsold allowances (~38 million) will inevitably reach the 24-month limit and be removed from the normal auction supply. This result matches past independent analyses[4] and is consistent with ARB's discussion in its April 2018 report on overallocation, which also notes that additional allowances may be removed depending on auction results this year.[5]

Additional undersubscribed auctions—that is, auctions that fail to sell all available allowances—could increase the number of allowances removed from the auction supply. We calculate that, at most, a bit more than half (~66 million) of California's previously unsold allowances will be removed if the remaining 2018 auctions are undersubscribed.

Removing 38 to 66 million allowances from the normal auction supply would help address the problem of overallocation in the WCI cap-and-trade market, but would not fully address projected overallocation. For example, Energy Innovation estimated that by the end of 2020, the WCI market will be overallocated by about 270M (million) allowances (with an uncertainty range from 200M to 340M).[6] Their estimate transparently assumes that all auctions from the start of 2018 through the end of 2020 sell out. Consistent with that view, their analysis incorporated auction "self-correction" in line with the low end of the removal range both we and ARB calculate. If there are additional undersubscribed auctions, and the "self-correction" associated with this outcome were incorporated into Energy Innovation's estimate, then overallocation would decrease modestly. We

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4 Busch, *supra* note 2; Jackie Cooley, Dan McGraw, and Nicolas Girod, Welcome to the WCI: How Ontario Might Change the California-Quebec Outlook (Dec. 14, 2017), https://www.icis.com/globalassets/documents/forms/ppf-pdf/ontariowebinar-q4final2.pdf; *see also* Table 1 in this document.

5 ARB, Supporting Material for Assessment of Post-2020 Caps (Apr. 2018), https://www.arb.ca.gov/cc/capandtrade/meetings/20180426/carb_post2020caps.pdf.

6 Busch, *supra* note 2.

calculate that it would fall at most to about 245M allowances (with a range of 175M to 315M; see Figure 1 above).

Going forward, the auction's "self-correcting" mechanism will have only a minor effect in reducing allowance overallocation—that is, unless there is another substantial auction collapse, or an extended period in which auctions do not sell out. Neither we nor other analysts expect these problematic outcomes.

The 2016-2017 auction collapse was a highly unusual episode due to uncertainty about the future of the cap-and-trade system after 2020.[7] With the passage of AB 398, that uncertainty has now been resolved. Market participants now have an incentive to continue to purchase excess allowances in expectation of higher future prices, as floor prices continue rising and as caps tighten. Under these conditions, any unsold allowances that result from modestly undersubscribed auctions in the future are likely to be reintroduced and purchased by market participants before reaching the 24-month limit.

ARB's "self-correcting" auction mechanism

The WCI cap-and-trade program features a significant number of allowances that went unsold when first offered at auction. From February 2016 through February 2017, demand for allowances contracted sharply across a series of five cap-and-trade auctions conducted by California and Québec. The collapse in demand left ~118 million of California's state-owned emission allowances unsold; ~25 million of Québec's allowances went unsold, too. (Separately, ~4 million of Ontario's allowances went unsold later in 2017, prior to Ontario's entry into the WCI market.)

Regulations in each WCI jurisdiction require these allowances to be reintroduced—that is, offered again for sale at a future auction—after two consecutive quarterly auctions clear above the price floor.[8] The number of allowances that can be reintroduced in a given auction by each jurisdiction

7 Danny Cullenward & Andy Coghlan (2016), Structural oversupply and credibility in California's carbon market. *Electricity Journal* 29: 7–14.

8 Cal. Code Regs., title 19, § 95911(f)(3)(B).

cannot exceed 25% of their newly offered allowances, and the unsold allowances are reintroduced starting with those that went unsold earliest.[9]

However, California regulations also specify that any California allowances that remain unsold for more than 24 months will be removed from the normal auction supply. This feature is unique to California's regulations and is not shared among WCI market participants. Neither Ontario nor Quebec's regulations include a similar provision at present for removal of allowances that remain unsold, and thus their unsold allowances will continue to be reintroduced, subject to the rules described above, until they are resold at auction.

Under current rules, California allowances that remain unsold for 24 months will first be retired to account for emissions associated with electricity imported through the California Independent System Operator's Energy Imbalance Market (EIM Outstanding Emissions).[10] Any remaining allowances will roll over to the state's Allowance Price Containment Reserve (APCR).[11] Our calculations in this report do not include potential retirements to account for EIM Outstanding Emissions in 2018 or 2019, but we believe that they would not affect our calculations of how many allowances would be reintroduced or removed in each scenario.

Although this "self-correcting" auction mechanism helps address allowance overallocation, accounting for the full effect is complex. Allowances transferred to the APCR are removed from the normal auction supply, but would still be available for sale at specified allowance prices (currently $54.26 or more per allowance, compared with recent prices around $15 per allowance). From one perspective, the fact that these allowances are removed from the auction supply will tend to reduce overallocation concerns because a reduction in auction supplies will increase prices and induce further emission reductions. On the other hand, these allowances will still be available for purchase, meaning that the total number of allowances has not changed—only the price at which they are made available.

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9 For California, this includes both state-owned and consignment allowances. *Id.* at § 95911(f)(3)(C); *see also* ARB, Guidance on Treatment of Unsold Allowances Following an Undersubscribed Auction (Dec. 1, 2017), https://www.arb.ca.gov/cc/capandtrade/guidance/guidance_unsold_allowances.pdf.

10 Cal. Code Regs., title 19, § 95911(g).

11 *Id.*

The ultimate impact on emission reductions and market prices depends on the reforms ARB adopts under AB 398. ARB is currently considering regulations that would transfer any allowances left in the APCR at the end of 2020 to new price containment points[12] or possibly the price ceiling[13] account; these "allowance pools" that function in a similar manner compared to the current APCR, albeit at different prices.[14] Neither the ultimate destination of newly transferred APCR allowances nor the prices at which they would be made available in the post-2020 market has been determined.[15]

In this note, we focus on the fate of allowances that went unsold in 2016-2017. For simplicity, we treat transfers of allowances from the normal auction supply to the APCR as a reduction in allowance overallocation. However, we stress that a fuller accounting of proposed market design changes is needed in the AB 398 implementation process to identify the effect of these transfers on post-2020 greenhouse gas emissions, and therefore the program's role in achieving California's 2030 emissions limit.[16]

Calculating "self-correction"

Reintroduction of the ~118 million California allowances that went unsold in 2016-2017 began in November 2017, after the previous two auctions cleared above the price floor. At the time of this research note, a combined ~38 million of these allowances have already been reintroduced and sold in the November 2017, February 2018, and May 2018 auctions, leaving ~80 million allowances still unsold.

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12 Cal. Health & Safety Code § 38562(c)(2)(B) (as added by AB 398).

13 *Id*. at § 38562(c)(2)(A) (as added by AB 398).

14 ARB, Preliminary Concepts: Price Containment Points, Price Ceiling, and Allowance Pools (Feb. 2018), https://www.arb.ca.gov/cc/capand-trade/meetings/20180302/ct_price_concept_paper.pdf; *see also* Danny Cullenward, Mason Inman, and Michael Mastrandrea, Implementing AB 398: ARB's initial post-2020 market design and "allowance pool" concepts, Near Zero Research Note (Mar. 16, 2018), http://www.near-zero.org/wp/2018/03/16/implementing-ab-398-arbs-initial-post-2020-market-design-and-allowance-pool-concepts/.

15 ARB, Preliminary Discussion Draft Regulations (Feb. 2018), https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm.

16 Cullenward et al., *supra* note 14.

The fate of the remaining unsold allowances depends on the outcomes of the next three auctions: August 2018, November 2018, and February 2019. At that point, all the allowances that went unsold in the 2016-2017 market collapse will have either been: (1) reintroduced and sold, (2) retired to account for EIM Outstanding Emissions, or (3) removed from the normal auction supply after reaching the 24-month limit.

For the calculations presented here, we assume that all auctions through February 2019 will feature sufficient sales such that allowances reintroduced from the 2016-17 auction collapse will be sold. Based on an analysis of the rules governing the order of allowances sales, we operationalize this condition by assuming that at least 60% of allowances for sale are sold in each auction. If sales were to fall below this threshold—which we think is unlikely—then some of the reintroduced allowances would go unsold a second time, leading to further removals from the normal auction supply. As long as sales remain above this 60% threshold, the two remaining 2018 auctions will determine the range of "self-correcting" auction outcomes.

Whatever the outcome of upcoming auctions, a certain number of allowances will inevitably be removed from the normal auction supply. California regulations limit the reintroduction of previously unsold allowances at any given auction.[17] When there are a large number of allowances that go unsold—as was the case in the 2016-17 auction collapse—the limit means that not all allowances can be reintroduced prior to the 24-month threshold. Thus, even if all auctions continue to sell out through 2019, a significant number of allowances will still be removed from the normal auction supply. In this case, we calculate that ~38 million allowances will be removed through this mechanism (see Figure 2 and Table 1 below).

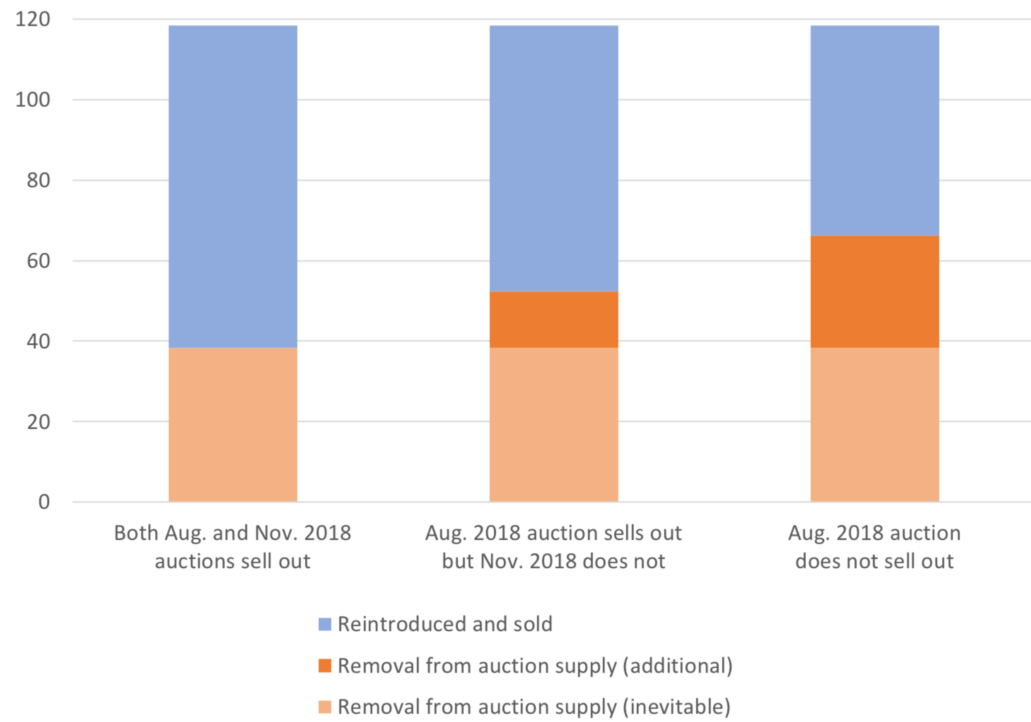
The ultimate number of allowances removed from the normal auction supply depends on two additional factors: how many auctions fail to sell out in 2018, and the timing of any such undersubscribed auctions. On the first factor, more allowances will be removed if both remaining auctions in 2018 are undersubscribed. Second, an undersubscribed auction that occurs earlier (rather than later) will cause more allowances to be removed. Because previously unsold allowances cannot be reintroduced until two consecutive auctions clear above the price floor, an undersubscribed auction will

[17] Cal. Code Regs., title 19, § 95911(f)(3)(C); ARB, *supra* note 9.

pause the reintroduction of previously unsold allowances for at least two quarters, leading to more allowances hitting their 24-month threshold.

If one of the remaining auctions in 2018 does not sell out, we calculate that ~14 million additional allowances will be removed from the normal auction supply. If the two remaining auctions in 2018 do not sell out, we calculate that ~28 million additional allowances would be removed.

Figure 2: Possible outcomes for California's unsold 2016-17 allowances (millions of allowances)



Comparison to other estimates of "self-correction"

Our calculations are in close agreement with recent estimates from Energy Innovation, ARB, and the consultancy ICIS. Table 1 summarizes these results.

Energy Innovation assumed that all auctions would sell out, calculating that 41.6 million allowances would be removed from the normal auction supply.[18] The Energy Innovation report used an ICIS projection for auction quantities that is slightly lower than the actual 2018 auction amounts.

[18] Busch, *supra* note 2.

Compared to the Energy Innovation assumptions, our calculations (based on more recent data) indicate that slightly more allowances will be reintroduced to auction in 2018, and thus slightly fewer allowances will inevitably be removed. For more details about uncertainties, see this research note's Appendix.

ARB's April 2018 report on overallocation states, "Due to low demand for allowances through 2017, approximately 40 million allowances will be transferred to the Reserve and removed from general circulation. Depending on auction results for this year, additional previously unsold allowances may also be transferred to the Reserve."[19]

ICIS examines three possible scenarios in a 2017 analysis.[20] If all auctions sell out, ICIS calculates a minimum removal of 38.6 million allowances. If February 2018 had not sold out or February and May 2018 had not sold out, this rises to 64.7 million or 77.8 million allowances, respectively. These estimates are roughly similar to our estimates, differing because our estimates incorporate data on the February and May 2018 auction outcomes, which were not available at the time of the ICIS study.

Table 1: Comparing estimates of "self-correction"
(millions of 2016-2017 unsold allowances removed from normal auction supply)

Source	Number of undersubscribed auctions through end of 2018		
	None	1	2
Near Zero (this report)	38.3	52.4	66.3
Energy Innovation	41.6	-	-
ARB	~40	-	-
ICIS	38.6	64.7	77.8

19 ARB, *supra* note 5 at 16.

20 Cooley et al., *supra* note 4 at slide 22.

Implications for overallocation

Many independent analysts have concluded that the WCI market has a significant overallocation of compliance instruments.[21] Some stakeholders have since suggested that independent reports are not credible because they do not properly account for the "self-correcting" auction mechanism described in this note. For example, ARB's April 2018 analysis of overallocation asserts that it is "likely that the vintage 2013 through 2030 unused allowances are less than third-party estimates," citing the "[m]echanism of moving into the APCR allowances that remain unsold for eight auctions [24 months], which will move at least 40 million unsold auction allowances to the Reserve."[22]

As a threshold matter, we note that several of the most prominent independent reports on allowance overallocation have explicitly accounted for California's auction mechanisms. For example, Energy Innovation included the inevitable transfer of previously unsold allowances to the APCR based on the explicit assumption that all auctions in 2018 would sell out. To the extent this assumption turns out to be wrong—that is, if upcoming auctions turn out to be undersubscribed—then Energy Innovation's estimated overallocation numbers would need to be updated. But it is incorrect to argue that reports like Energy Innovation's fail to account for the self-correcting auction mechanism in California's market regulations.

The analysis in this research note evaluates the extent to which California's "self-correction" auction mechanism could reduce the extent of overallocation in the WCI market. We show that if all auctions sell out, approximately 40 million allowances will be removed from the auction supply (consistent with ARB, Energy Innovation, ICIS, and other estimates). Alternatively, if one or two auctions are undersubscribed, up to ~66 million allowances would be removed from the future auction supply.

These effects should be included in estimates of allowance overallocation, but even at the upper end of possible impacts, the effect is small relative to the total overallocation calculated by independent analysts. For example,

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[21] For a partial list of studies, *see* Mason Inman, Danny Cullenward, and Michael Mastrandrea, Ready, fire, aim: ARB's overallocation report misses its target. Near Zero Research Note (May 7, 2018), http://www.near-zero.org/wp/2018/05/07/ready-fire-aim-arbs-overallocation-report-misses-its-target/.

[22] ARB *supra* note 5.

Energy Innovation estimated that by 2020, the WCI market would have an overallocation of about 270 million allowances (with an uncertainty range from 200 to 340 million).[23] This estimate includes the minimum number of allowances removed from auction supply as described above. If two auctions in 2018 and 2019 are undersubscribed, then the Energy Innovation estimates should be reduced by up to 25 million allowances. In this case, the adjusted Energy Innovation analysis would report overallocation of about 245 million allowances in 2030 (with an uncertainty range from 175 to 315 million).

Market design choices affect overallocation

An analysis of the risks of allowance overallocation needs to factor in the fate of allowances that will be made available at the new Reserve tiers mandated by AB 398, including 81 million allowances from the pre-2020 APCR and up to 75 million allowances from post-2020 budgets.[24] These allowance pools are not included in the 2020 overallocation estimates discussed above, and these pools will grow larger if undersubscribed auctions lead to additional transfers to the APCR.

The ultimate impact of excess pre-2021 allowances—including unsold allowances that are transferred to the APCR—depends on the prices ARB sets for the post-2020 price containment points and price ceiling. We urge ARB to evaluate these design choices. If excess pre-2021 allowances are carried into the post-2020 market without adjusting program cap levels and are made available at relatively low prices, then they will exacerbate overallocation. If prices are set higher, overallocation risks will diminish, but remain present.

The lower the prices at which ARB makes pre-2021 allowances available in the post-2020 market, the more likely these allowances are to re-enter the market, even after removal from the normal auction supply. Thus, the choices ARB makes in its post-2020 market design could undermine the "self-correcting" auction mechanism's efficacy as a tool to address market overallocation.

23 Busch, *supra* note 2.

24 Cullenward et al., *supra* note 14.

Conclusion

We analyze the impact of California's "self-correcting" auction mechanism on allowance overallocation in the WCI cap-and-trade program, focusing on the ~118 million California-owned allowances that went unsold in the auction collapse of 2016-17.

Consistent with others' estimates, we find that about one-third (~38 million) will inevitably remain unsold for more than 24 months and therefore be removed from the normal auction supply, even if all upcoming auctions are fully subscribed. Energy Innovation's report—arguably the most prominent analysis of allowance overallocation—appropriately included this effect in its estimates.

If the August 2018 auction is undersubscribed, then regardless of the outcomes of the November 2018 and February 2019 auctions, slightly more than half of the previously unsold allowances (~66 million) will be removed from the auction supply. If the August 2018 auction sells out, but the November 2018 auction is undersubscribed, less than half of the previously unsold allowances (~52 million) will be removed.

This "self-correction" mechanism will help reduce the extent of overallocation in the WCI market, but will address only a fraction of the overallocation expected by 2020. Our results continue to indicate that allowance overallocation is significant and presents risks to California's ability to achieve its 2030 climate target.

However, we note that the overallocation estimates discussed in this note do not account for the fact that market participants could eventually access allowances removed from the auction supply in the post-2020 market period. The likelihood that those allowances will be sold again depends on choices ARB makes in its AB 398 implementation process. If these allowances are accessed in the future, they will enable higher emissions and cause the program to be less effective at reducing emissions than the adjusted calculation discussed here suggests.

The large buildup of unsold allowances in 2016-2017 was a highly unusual episode that was associated with uncertainty about the future of the cap-and-trade system after 2020. With the passage of AB 398, that uncertainty has now been resolved. If covered emissions continue to remain below program caps, auctions could conceivably fail to sell out for an extended period. But market participants also have an incentive to continue to purchase excess allowances in expectation of higher future prices as caps tighten. It will be important to carefully observe auction and emission outcomes during in the coming years.

We conclude that California's "self-correcting" auction mechanism will have only a limited effect on overallocation. Absent another crisis in market confidence—which neither we nor other analysts are predicting—the mechanism will only modestly reduce the supply of excess allowances in California's cap-and-trade program. In turn, the choices ARB makes with respect to the allowances transferred out of the auction supply could reverse the beneficial environmental effects of the state's "self-correcting" auction mechanism.

Appendix: Sensitivity analysis

The primary uncertainty about how many allowances will be removed from the normal auction supply concerns whether all of the auctions in 2018 will sell out or not.

There are also much smaller uncertainties related to the size of the February 2019 auction, the last auction at which any allowances unsold in 2016-2017 could be reintroduced. These smaller uncertainties are due to: (1) uncertainty about the number of allowances that will be in the 2019 industrial allocation and (2) uncertainty about the number of allowances that will be optionally consigned by utilities.

For the results described earlier in this report, we chose values for California's 2019 industrial allocation and optional consignment that were the same as in 2018 (industrial allocation of 41.6M allowances, and optional consignment of 10.4M allowances). If the industrial allocation is higher and/or the optional consignment lower, then allowance reintroductions will be lower. This will lead to, at most, about 2M fewer allowances being reintroduced and sold, and therefore 2M more allowances transferring from the normal auction supply to the APCR. For example, if the industrial allocation in 2019 is 20M higher than in 2018, and optional consignment is zero, then for the case in which all auctions sell out, we estimate that 40.2M allowances are removed from the auction supply, 1.9M higher than the 38.3M estimate we report in the body of this research note.

Varying the size of the 2019 industrial allocation and optional consignment does not have an effect on the high end of estimates for removal from the normal auction supply because in those high removal scenarios, because there are no reintroductions of allowances in 2019 due to the required delay in reintroductions following an undersubscribed auction.

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About Near Zero

Near Zero is a non-profit environmental research organization based at the Carnegie Institution for Science on the Stanford University campus. Near Zero provides credible, impartial, and actionable assessment with the goal of cutting greenhouse gas emissions to near zero. This research note is for informational purposes only and does not constitute investment advice.

The data in this research note are available at our website.

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RESEARCH NOTE

Ontario's exit exacerbates allowance overallocation in the Western Climate Initiative cap-and-trade program

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Executive summary

New data show that the net result of Ontario's brief participation in California and Québec's Western Climate Initiative (WCI) cap-and-trade program was to inflate the program's supply by 13.2 million allowances, adding to concerns about allowance overallocation.

This result assumes that Ontario allowances held by California and Québec entities continue to remain valid for compliance purposes following Ontario's revocation of its cap-and-trade program. Despite indications that California and Québec policymakers prefer this outcome, the legal mechanics of recognizing allowances from a non-existent cap-and-trade program are still somewhat uncertain.

The new data also provide clear evidence of cross-border trading in secondary markets by market participants, increasing the number of allowances held by entities in California and Québec compared with what was purchased at quarterly auctions or otherwise directly allocated by governments. The evidence strongly suggests that California and Québec entities have purchased a substantial net number of allowances from Ontario entities on the secondary market.

If policymakers designing reforms to address Ontario's exit wish to distinguish between entities that were forced to purchase Ontario allowances at auction and those that voluntarily accepted the risks of acquiring Ontario allowances on the open market, they will need more data than what is publicly available at present. Regulators in California and Québec have complete data that is capable of distinguishing between these purchase types on an allowance-by-allowance basis. Reporting data on aggregate cross-border allowance flows should be possible without disclosing sensitive market information or individual entities' trading positions.

Ontario's participation inflated market supply

On Friday June 15, 2018, Ontario's then-Premier-designate, Doug Ford, announced his intention to end Ontario's cap-and-trade program and withdraw from the WCI market, following through on months of public promises during his campaign.[1] Ontario, which began its cap-and-trade program in 2017, had officially linked to the WCI market just a few months earlier, on January 1, 2018. The same day as Ford's announcement, California and Québec moved to freeze transfers of compliance instruments between market participants registered in Ontario and those registered in either California or Québec.[2]

One stated goal of this trading freeze was to ensure that the environmental integrity and stringency of the WCI market is maintained.[3] Absent a trading freeze, Ontario entities would otherwise have been able to freely sell any allowances they held to other market participants in California and Québec, thereby injecting the market with excess allowances no longer needed for compliance in Ontario.

But such transfers could have occurred prior to the June 15 trading freeze, in anticipation of—or reaction to—a Ford win. Ford's party was leading in the polls for months, and the trading freeze came a week after the election itself on June 7, 2018. Going forward, we anticipate that no additional transfers will be made, both because the trading freeze remains in effect and because on July 3, 2018, Ontario formally revoked its cap-and-trade regulation and issued new rules that prohibit Ontario entities from trading any compliance instruments in their possession. [4]

While the trading freeze might well have prevented additional flows of allowances into the remaining WCI jurisdictions between June 15 and July 3,

1 Ontario Office of the Premier-designate, Premier-Designate Doug Ford Announces an End to Ontario's Cap-and-Trade Carbon Tax (June 15, 2018), https://news.ontario.ca/opd/en/2018/06/premier-designate-doug-ford-announces-an-end-to-ontarios-cap-and-trade-carbon-tax.html.

2 ARB, June 15, 2018 Market Notice, https://arb.ca.gov/cc/capandtrade/auction/marketnoticejune2018.pdf. We note that it is not clear who imposed the trading freeze, which we understand was implemented through the WCI-wide CITSS system managed by WCI, Inc.

3 *Id.*

4 Government of Ontario, O. Reg. 386/18: Prohibition Against the Purchase, Sale and Other Dealings with Emission Allowances and Credits, https://www.ontario.ca/laws/regulation/r18386.

it was insufficient to fully protect the environmental integrity of the WCI market. A net total of 13.2 million allowances were transferred from Ontario to California and Québec prior to the June 15 trading freeze.

Last week, the California Air Resources Board (ARB) released the first public data on market holdings since these developments via its quarterly compliance instrument report:

> On July 3, 2018, the Government of Ontario filed a regulation that revoked the Ontario cap-and-trade regulation. As of that date, there are 13,186,967 more compliance instruments held in California and Québec accounts than the total number of compliance instruments issued by those two jurisdictions alone.[5]

The net result of market auctions and trading during Ontario's participation was to increase supply in the WCI market by 13.2 million allowances. In other words, California and Québec entities now hold 13.2 million allowances more than they would have if Ontario had never linked with the WCI market, increasing market-wide allowance overallocation.[6]

Allowance overallocation grows

In reporting a net addition of 13.2 million allowances to the oversupplied WCI market, ARB downplayed the scale of the impact, claiming that this volume "represents approximately 1% of the total allowances in California and Québec entity accounts for vintage years through 2021."[7]

But Ontario's withdrawal has larger implications for estimates of allowance overallocation in the WCI market. ARB and others had anticipated that Ontario's participation would likely *increase* demand for allowances and thus *reduce* oversupply in the WCI market.

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[5] ARB, Linked California and Québec Cap-and-Trade Programs Carbon Market Compliance Instrument Report (July 9, 2018) (hereinafter WCI 2018 Q2 Compliance Report), https://www.arb.ca.gov/cc/capandtrade/complianceinstrumentreport.xlsx.

[6] For a partial list of studies on overallocation, *see* Mason Inman, Danny Cullenward, and Michael Mastrandrea, Ready, fire, aim: ARB's overallocation report misses its target. Near Zero Research Note (May 7, 2018), http://www.nearzero.org/wp/2018/05/07/ready-fire-aim-arbs-overallocation-report-misses-its-target/.

[7] WCI 2018 Q2 Compliance Report, *supra* note 5.

For example, in its April 2018 report on post-2020 caps, ARB stated:

> The degree to which entities from linked programs abate emissions will influence the demand for allowances from California, potentially reducing the amount of unused allowances before 2021. *If this were the case, there would be fewer pre-2021 unused allowances available to put towards emissions after 2021.* [Emphasis in original.] [8]

Independent estimates of WCI-wide allowance supplies reached similar conclusions. A prominent estimate of overallocation from Energy Innovation's Chris Busch assumed that through 2020, there would be a net flow of 20 million allowances from California and Québec *into* Ontario, assuming Ontario remained in the WCI program.[9]

Thus, relative to *ex ante* expectations, the net transfer of 13.2M allowances from Ontario to California and Québec is more significant that it at first appears. Accounting for the fact that Ontario's brief participation in the WCI market added 13.2M allowances, rather than consumed 20M, Dr. Busch's estimates would need to be increased by 33.2M allowances—such that the overallocation projected through 2020 would increase, all other assumptions equal, to about 300M ±70M allowances.

Stranded assets in California and Québec?

The net flow discussed above assumes that Ontario allowances held by California and Québec entities will remain valid, despite Ontario's revocation of its cap-and-trade program. However, the legal mechanics of how this will be ensured are far from clear, and stranded assets are possible on both sides of the trading freeze.[10]

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8 ARB, Supporting Material for Assessment of Post-2020 Caps (Apr. 2018) at 19, https://www.arb.ca.gov/cc/capandtrade/meetings/20180426/carb_post2020caps.pdf.

9 Chris Busch, Oversupply Grows in the Western Climate Initiative Carbon Market, Energy Innovation Report (Dec. 2017), http://energyinnovation.org/wp-content/uploads/2018/02/WCI-oversupply-grows-February-update.pdf

10 Julie Cart, Ontario ready to pull out of carbon market, leaving California in limbo, CALmatters (June 27, 2018), https://calmatters.org/articles/california-cap-and-trade-ontario-canada/.

Because allowances from any WCI jurisdiction are fully interchangeable in California and Québec under current market regulations,[11] the origin of an allowance makes no difference for compliance purposes. Nevertheless, Ontario's decision to revoke its cap-and-trade program and withdraw from the WCI market raises legal questions about Ontario allowances.

California and Québec have informally signaled their intention to recognize Ontario allowances held by WCI market participants after Ontario's withdrawal, consistent with current market regulations in each jurisdiction. However, further action may be necessary to ensure this outcome.

It is not clear to us whether the Ontario allowances "exist" in any meaningful sense following Ontario's revocation of its cap-and-trade program. Regulators in California and Québec could determine, for example, that Ontario allowances held in California and Québec continue to "exist" and therefore are valid for compliance purposes, but there could be complicated legal questions if Ontario disputes the recognition of allowances created by its now-nonexistent regulatory program.

Alternatively, regulators in California and Québec might decide to issue new compliance instruments (or re-allocate existing allowances) to replace Ontario allowances held by entities in California and Québec. The remaining WCI jurisdictions have legal authority to issue or re-allocate compliance instruments pursuant to their authorizing statutes, but would need to promulgate formal regulations to effect this outcome.

Whatever the mechanism by which WCI jurisdictions intend to recognize Ontario allowances, it is clear that these actions will increase the net supply of allowances in the WCI market and exacerbate the program's overallocation problem, unless additional steps are taken to account for the net flow of allowances discussed above.

Evidence of cross-border transfers in secondary market trading

Thus far we have discussed only the total net flow of allowances between Ontario and the remaining WCI jurisdictions. Analyzing the net flows of

[11] Cal. Code Regs., tit. 19, §§ 95942, 95943; Government of Quebec, Regulation respecting a cap-and-trade system for greenhouse gas emission allowances (chapter Q-2, r. 46.1), section 37.

allowances by vintage year sheds further light on how the balance of allowances has shifted across borders.

Some allowance vintage years have been offered for sale at either current or advance auctions in the joint WCI quarterly auctions that involved Ontario. As a result, cross-border flows of allowances for these vintage years could reflect quarterly auction purchasing behavior, as market participants are free to choose whether and at what price and quantity to bid in auctions. It is possible that Ontario entities' bids differed significantly from those of entities in California and Québec, resulting in a net flow of allowances either into or out of Ontario from the auctions. Whatever the outcome of quarterly auctions, these vintage years were also subject to secondary market trading as well.

In contrast, flows in other vintage years evident from the data can only be due to secondary market trading, as some vintage years were not offered for sale at quarterly auctions during Ontario's joint participation in WCI auctions in 2018. Table 1, below, indicates the net flow for each category of allowance vintages.

Table 1: Net allowance flows from Ontario to California and Québec (millions)

Availability during open trading with Ontario	Vintage year(s)	Net flow from Ontario to California/Québec
Only available through secondary market trading	2017, 2019, 2020	11.1
Available at advance auction or through trading	2021	3.4
Available at current auction or through trading	2016, 2018	–1.3
Total net flow	**2016-2021**	**13.2**

The data are broken out on a single vintage-year basis in Table 2, at the end of this research note. We distinguish between three categories of vintages in Table 1 by their availability during the period of open trading among California, Québec, and Ontario entities:

- Vintage 2017 allowances were offered for sale at current auctions held in 2017, and vintage 2019 and 2020 allowances were offered for sale at advance auctions held in 2016 and 2017—all prior to Ontario's linkage with the WCI market in 2018. Thus, for these three vintages, the net flow of 11.1 million allowances from Ontario to California and Québec could only be due to secondary market trading.

- Vintage 2021 allowances were and are offered for sale in advance auctions in 2018. A total of 3.6 million vintage 2021 Ontario allowances were sold in the first two auctions of 2018.[12] The net flow of 3.4 million allowances listed above suggests that either (1) California and Québec entities purchased almost all vintage 2021 Ontario allowances offered at auction, or (2) Ontario entities traded most of the 2021 Ontario allowances they purchased at auction to California and Québec entities in secondary market trading. (It is also possible that a combination of these two factors occurred.)

- Finally, both vintage 2016 and 2018 allowances were offered for sale in current auctions in 2018. In addition to offering current 2018 vintage year allowances, the 2018 auctions also feature previously unsold vintage 2016 allowances from California and Québec.[13] Ontario's program started in 2017, so it features no vintage 2016 Ontario allowances. As a result, it is unsurprising that the net flow for 2016 vintage allowances (8.3 million) is into Ontario: any successful auction bids from Ontario entities received a proportional share of all allowances types offered in the current auctions, including vintage 2016 California and Québec allowances. In contrast, the net flow for 2018 vintage allowances (6.9 million) is in the opposite direction, from Ontario to California and Québec. The net flows for these vintages could be due to a combination of auction purchasing behavior and secondary market

[12] ARB, Joint Auction #14 Summary Results Report (Feb. 28, 2018) at 2 (reporting 2.09M vintage 2021 Ontario allowances sold); ARB, Joint Auction #15 Summary Results Report (May 23, 2018) at 2 (reporting 1.47M vintage 2021 Ontario allowances sold).

[13] Mason Inman, Michael Mastrandrea, and Danny Cullenward, California's "self-correcting" cap-and-trade auction mechanism does not eliminate market overallocation, Near Zero Research Note (May 23, 2018), http://www.nearzero.org/wp/2018/05/23/californias-self-correcting-cap-and-trade-auction-mechanism-does-not-eliminate-market-overallocation/.

trading, but it is not possible to distinguish further based on public information.

Although net flows of allowances from the quarterly compliance reports do not provide sufficient information to measure the overall volume of cross-border trading in secondary markets, they strongly suggest that significant secondary market trading activity drove the net transfer of allowances into California and Québec accounts. Additional information is needed to distinguish between entities that now hold Ontario allowances from successful auction bids and entities that hold Ontario allowances acquired from voluntary secondary market trading.[14]

We note that while public data does not permit sufficient analysis at this time, regulators in California and Québec have complete data that would enable such an analysis. Furthermore, the results of such an analysis could be publicly reported without identifying individual entities' trading strategies or other confidential market behavior.

Implications for state climate policy

New data released after Ontario's withdrawal from the WCI cap-and-trade program indicate several important issues for state policy:

- Ontario's exit has increased the supply of compliance instruments in the remaining WCI market by 13.2 million allowances, exacerbating the extent to which the WCI market is overallocated.

- The effect of this increase in supply is more significant than it at first appears, as many (including ARB) expected that Ontario would be a net purchaser, rather than net supplier, of allowances. For example, Energy Innovation's Dr. Busch assumed that Ontario would purchase a net 20M allowances through 2020, rather than supply a net 13.2M, and therefore his overallocation estimate of 270M ±70M should be increased to roughly 300M ±70M allowances by 2020, all other assumptions being equal.

[14] *See*, *e.g.*, Letter from California Senator Bob Wieckowski to ARB Chair Mary Nichols (June 21, 2018) (asking ARB to provide information sufficient to distinguish between purchasers that involuntarily acquired Ontario allowances at auction versus entities that voluntarily acquired Ontario allowances on the secondary market).

- If all Ontario allowances held in California and Québec are recognized as valid for compliance in the WCI program, then overallocation will significantly increase.
- Substantial evidence suggests that secondary market trading drove the net flow of compliance instruments out of Ontario, indicating that the trading freeze did not fully contain the environmental consequences of Ontario's exit.
- Policymakers that intend to distinguish between entities that involuntarily purchased Ontario allowances at auction and those that voluntarily acquired allowances on the secondary market need additional information. Public data are insufficient to analyze this question. Regulators in California and Québec have full data and should be able report cross-border flows in the secondary market without compromising the position of individual traders or compliance entities.

Table 2: Net allowance flows from Ontario to California and Québec (millions)

Vintage year	Net flow from Ontario to California/Québec	Available from quarterly auctions?	Available on secondary market?
2016	–8.3	Current auction	Yes
2017	8.7	No	Yes
2018	6.9	Current auction	Yes
2019	-0.1	No	Yes
2020	2.5	No	Yes
2021	3.4	Advance auction	Yes
Net total	**13.2**	N/A	Yes

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About Near Zero

Near Zero is a non-profit environmental research organization based at the Carnegie Institution for Science on the Stanford University campus. Near Zero provides credible, impartial, and actionable assessment with the goal of cutting greenhouse gas emissions to near zero. This research note is for informational purposes only and does not constitute investment advice.

The data in this research note are available at our website.

www.nearzero.org

RESEARCH NOTE

Tracking banking in the Western Climate Initiative cap-and-trade program

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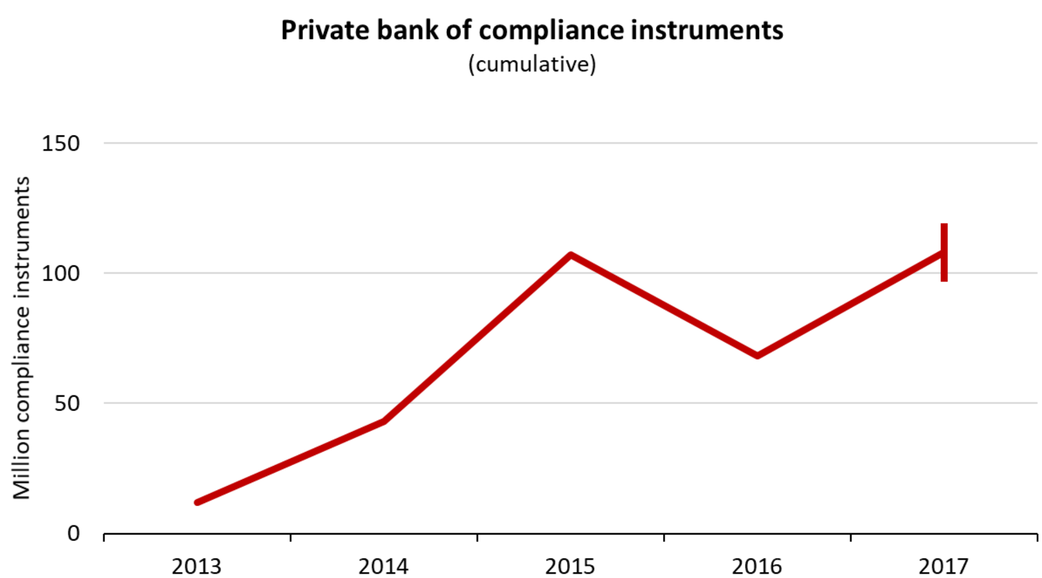
Executive Summary

We present a method for tracking the private bank of compliance instruments in the Western Climate Initiative (WCI) cap-and-trade program, drawing on official market data. Banking metrics allow policymakers and the public to track the extent to which independent analysts' concerns about allowance overallocation are manifesting in practice. Accordingly, we recommend that the California Air Resources Board (ARB) include a banking metric in its official cap-and-trade reporting, as the Board currently does for its Low Carbon Fuel Standard program.

Our metric indicates that the private bank is already quite large. Approximately 108 million compliance instruments were held in private accounts at the end of 2017, beyond what market participants need for the 2015-2017 compliance period. So long as annual program caps remain above actual covered emissions and quarterly auctions continue to sell out—conditions that have held true so far in 2018—the private bank will continue to grow.



Our metric accounts for the fact that regulated emitters naturally seek to increase the number of compliance instruments they hold as a compliance deadline approaches. We measure only those instruments held in excess of outstanding compliance obligations, such that our banking metric is strictly independent from this natural market behavior.

In addition to tracking market health, banking metrics offer a basis for implementing program reforms that are conditional on market participants' observed behavior. In reaction to excess allowance supply conditions, the RGGI and EU ETS carbon markets recently enacted dynamic program adjustments that reduce allowance supplies on the basis of observed banking outcomes. One advantage of dynamic program adjustments, such as those implemented in RGGI and the EU ETS, is that they tighten markets only if undesirable conditions manifest in practice; if the balance of market supply and demand stays within a desired range, no action is taken.

Dynamic cap adjustments enable regulators to avoid significant delays associated with waiting for lagged data to be released before beginning a lengthy rulemaking process to address any problems revealed by those data. As a result, a cap-and-trade program with dynamic cap adjustments has a higher likelihood of delivering desired emission reductions compared to one with a multi-year gap between detection of any problems and the completion of a responsive rulemaking process.

Introduction

A key debate in California climate policy concerns cap-and-trade market overallocation—the extent to which the supply of compliance instruments exceeds demand. If market participants purchase and hold a large number of excess compliance instruments, regulated emitters could use these instruments in later years to comply with the cap-and-trade program such that emissions overshoot the declining program cap.[1] This outcome would

[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), https://eco.on.ca/reports/2017-from-plan-to-progress/; Legislative Analyst's Office, Cap-and-Trade Extension: Issues for Legislative Oversight (Dec. 2017), http://lao.ca.gov/Publications/Report/3719; Chris Busch, Oversupply Grows in the Western Climate Initiative Carbon Market, Energy Innovation Report (Dec. 2017), http://energyinnovation.org/wp-content/uploads/2018/02/WCI-oversupply-grows-

undermine the cap-and-trade program's intended role as a backstop measure in the 2017 Scoping Plan, where it is assumed to "close the gap" between the emission reductions achieved by California's regulatory measures and the state's binding limit on 2030 greenhouse gas emissions.

Many independent analyses have concluded that the WCI market has a significant allowance overallocation problem. We find these independent analyses to be both credible and concerning, but we note that their projections are necessarily uncertain because they depend on future demand for allowances. Their accuracy can and should be measured over time by comparing projections of allowance overallocation against empirical metrics that track actual allowance banking in the WCI market.[2]

To that end, we adapt methods previously developed by ARB for tracking private banking behavior in the WCI market. We define private banking as the market-wide number of compliance instruments held in excess of compliance obligations at any given point in time. Our analysis shows that at the end of 2017, approximately 108 million compliance instruments were banked in private accounts.

The banking metric developed here can be tracked over time as new allowance auction and program compliance data are released. If the private bank continues to grow as projected, this would suggest that allowance overallocation concerns are indeed as serious as independent analysts have suggested; conversely, if the private bank holds steady or starts to decline, this would indicate that allowance overallocation concerns have been (at least partially) mitigated. So far, observable banking data are consistent with independent studies that project significantly higher allowance banking outcomes by the end of 2020.

We recommend that ARB include a banking metric in its official cap-and-trade data reporting. Banking metrics not only increase transparency in the operation of the cap-and-trade program, but also facilitate an opportunity

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February-update.pdf; Danny Cullenward & Andy Coghlan, Structural oversupply and credibility in California's carbon market, *Electricity Journal* 29: 7–14 (2016).

2 The WCI market functionally includes only California and Québec. Ontario linked to the WCI market in January 2018 and participated in two quarterly auctions. Following its June 2018 elections, Ontario announced its intention to withdraw from the WCI market, stopped participating in joint auctions, and revoked its cap-and-trade regulation in July 2018.

for policymakers to design program reforms that adjust the supply of allowances in relation to observed banking behavior. As we and others have pointed out in the AB 398 implementation process, allowance overallocation conditions spurred both the Regional Greenhouse Gas Initiative (RGGI) and the European Union Emissions Trading System (EU ETS) to adopt data-driven strategies to manage the risks of market overallocation. Specifically, regulators in these jurisdictions have relied on metrics that track banking behavior to dynamically adjust program stringency.[3]

Estimating the private bank of compliance instruments

We define private banking as the difference between the number of compliance instruments currently held in private accounts and the number of compliance instruments needed to satisfy compliance entities' outstanding emission liabilities. Banking metrics are calculated at specific points in time. For example, the bank of compliance instruments as of the end of 2017 is the difference between the number of compliance instruments held in private accounts on December 31, 2017, and total compliance obligations that are still outstanding through that same point in time.[4] Put another way, this represents compliance instruments held beyond those needed for the second compliance period's obligations (2015-2017).

We calculate the private bank as follows:

$$\textit{Private Bank}_t = \textit{Compliance Instruments}_t - \textit{Outstanding Obligations}_t$$

Where $\textit{Private Bank}_t$ is the bank of compliance instruments (including both allowances and offset credits) measured at the end of year *t*; $\textit{Compliance Instruments}_t$ is the number of compliance instruments held in private accounts at the end of the same year; and $\textit{Outstanding Obligations}_t$ is the compliance obligations incurred by regulated parties for cumulative emissions

[3] Regional Greenhouse Gas Initiative (RGGI), more information available at https://www.rggi.org/program-overview-and-design/elements; European Union Emissions Trading System, "Market Stability Reserve," more information available at https://ec.europa.eu/clima/policies/ets/reform_en.

[4] Compliance obligations are satisfied when emitters surrender compliance instruments, which are transferred from entities' private accounts to permanent retirement accounts. Compliance obligations that are still outstanding at a given point in time have not yet been satisfied by surrendering compliance instruments.

through the end of the same year that have not yet been satisfied by retiring compliance instruments.

We calculate that at the end of 2017, private entities had banked 108 (±11) million excess compliance instruments. See Figure 1 and Table 1 for full results and see the Appendix for complete detail on the methods and data we use. A summary follows:

- **Compliance instruments:** We use ARB's Compliance Instrument Reports (CIRs) to measure the number of compliance instruments held in private accounts.[5] CIRs are released quarterly with data on private holdings of allowances and offsets by vintage year and account type, drawn directly from the WCI Compliance Instrument Tracking System Service (CITSS).[6] In general, we use fourth quarter (Q4) CIRs to measure the number of compliance instruments held in private accounts at the end of a given year.

  We limit the allowances included in this term to only those with vintage years equal to or less than the current year, *t*. Thus, our metric captures only those compliance instruments held in private accounts that can be used for compliance purposes in the same year for which the banking metric is calculated. We exclude all holdings of future year vintages—*e.g.*, those allowances purchased at advance auctions—until such time as they become current year vintages.

  In addition to measuring allowances held in private accounts, we also include offsets because these credits can be used instead of allowances for compliance purposes, subject to quantitative limits.[7] Including offsets implicitly assumes that the number held in private accounts does not exceed the cumulative limits imposed on their future use, which we believe is a reasonable assumption for the foreseeable future and which can be monitored going forward. For context, private accounts contained 47.5 million offset instruments at the end of 2017. Some of

[5] ARB, Compliance Instrument Report, https://www.arb.ca.gov/cc/capandtrade/complianceinstrumentreport.xlsx.

[6] WCI, Inc., Compliance Instrument Tracking System Service, https://www.wci-citss.org/.

[7] Current regulations specify a quantitative usage limit of 8% of a covered entity's compliance obligation for each compliance period through 2020. Cal. Code Regs., title 19, § 95854(b). AB 398 lowers this usage limit to 4% for the years 2021-2025 and 6% for the years 2026-2030. Cal. Health & Safety Code § 38562(c)(2)(E) (as added by AB 398).

these offsets will be used to satisfy a portion of the outstanding compliance obligation for the 2015-2017 compliance period, substituting for allowances that would otherwise be used for compliance purposes. In contrast, the maximum cumulative allowable offset usage for 2018-2030 under existing program caps and usage limits would be 248 million instruments.[8] This comparison indicates that even if none of the currently held offsets were used to satisfy outstanding compliance obligations, sufficient permission exists for them to be fully used in the future and therefore they should reasonably be considered part of the overall private bank of compliance instruments.

- **Outstanding obligations:** To calculate a running total of cap-and-trade compliance obligations for 2013-16, we use historical data on covered emissions for California and Quebec.[9] We then subtract actual compliance submissions made in California and Quebec. As a result, we capture only those compliance obligations that have been incurred through the end of a given calendar year, *t*, but not yet satisfied by retiring allowances or offsets in a formal compliance submission.

  Official data on covered emissions for 2017 have not yet been released for California or Quebec. We use an estimate of 2017 covered emissions for each jurisdiction from the Environmental Commissioner of Ontario (ECO)[10] and calculate an illustrative uncertainty range of ±3% around ECO's central estimate to evaluate the sensitivity of our 2017 results.

  We account for the distinction between compliance submission requirements in California and Quebec. In Quebec, 100% of a multi-year

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8 The number of permissible offset credits depends on future emissions because the offsets limit is expressed as a percentage of those emissions. To calculate this figure, we take the offset usage limits in current regulations and in AB 398 and apply those limits to the annual cap-and-trade allowance budgets in current regulations. Other reasonable assumptions could be made here but the total permissible offset usage would still be significantly larger than the number of offsets held in private accounts.

9 Covered emissions data for California are from annual compliance reports; covered emissions for Quebec are from an annually updated report. See Appendix for details.

10 Environmental Commissioner of Ontario, Ontario's Climate Act: From Plan to Progress (Jan. 2018), https://eco.on.ca/reports/2017-from-plan-to-progress/.

compliance obligation is due the November after the end of the compliance period. In contrast, California has annual compliance obligations that are due the November following each program year. For all but the final year of a compliance period, entities have a compliance obligation for 30% of their annual covered emissions. For the final year of a multi-year compliance period, the remainder of compliance obligations come due (*i.e.*, up to 70% for each earlier year and 100% of the final period year). We rely on official regulatory data to track retirements of allowances and offsets pursuant to these compliance events.[11]

- **Effect of Ontario's withdrawal:** Our calculations are consistent with Ontario's brief entry into and early departure from the WCI program. We do not include compliance instruments issued by the Ontario government, nor do we include compliance obligations under Ontario law. However, remaining market participants in California and Quebec currently hold a substantial number of Ontario allowances, which remain valid for compliance purposes in California and Quebec and therefore contribute to the private bank in 2018. As of Q2 2018, ARB reports that Ontario's departure led to an increase in the supply of compliance instruments held in private accounts in California and Quebec by 13.2 million allowances.[12] Although we do not report results for 2018 and therefore do not capture these new developments, future updates to this banking metric will reflect the presence of Ontario allowances in private accounts of entities in California and Quebec. See the Appendix for additional technical details on how we accounted for Ontario's entry and exit in the primary reporting data used to construct our banking metric.

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11 ARB, 2013 Compliance Obligation Summary; ARB, 2013-14 Compliance Report; ARB, 2015 Annual Compliance Obligation Summary; ARB, 2016 Annual Compliance Obligation Summary, available at https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm; MDDELCC, Report on the 2013-2014 Compliance Period of the Québec Cap-and-Trade System for Greenhouse Gas Emissions Allowances (C&T system), http://www.mddelcc.gouv.qc.ca/changements/carbone/documentation-en.htm#compliance.

12 Michael Mastrandrea, Danny Cullenward, and Mason Inman, Ontario's exit exacerbates allowance overallocation in the Western Climate Initiative cap-and-trade program, Near Zero Research Note (July 16, 2018), http://www.nearzero.org/wp/2018/07/16/ontarios-exit-exacerbates-allowance-overallocation-in-the-western-climate-initiative-cap-and-trade-program/.

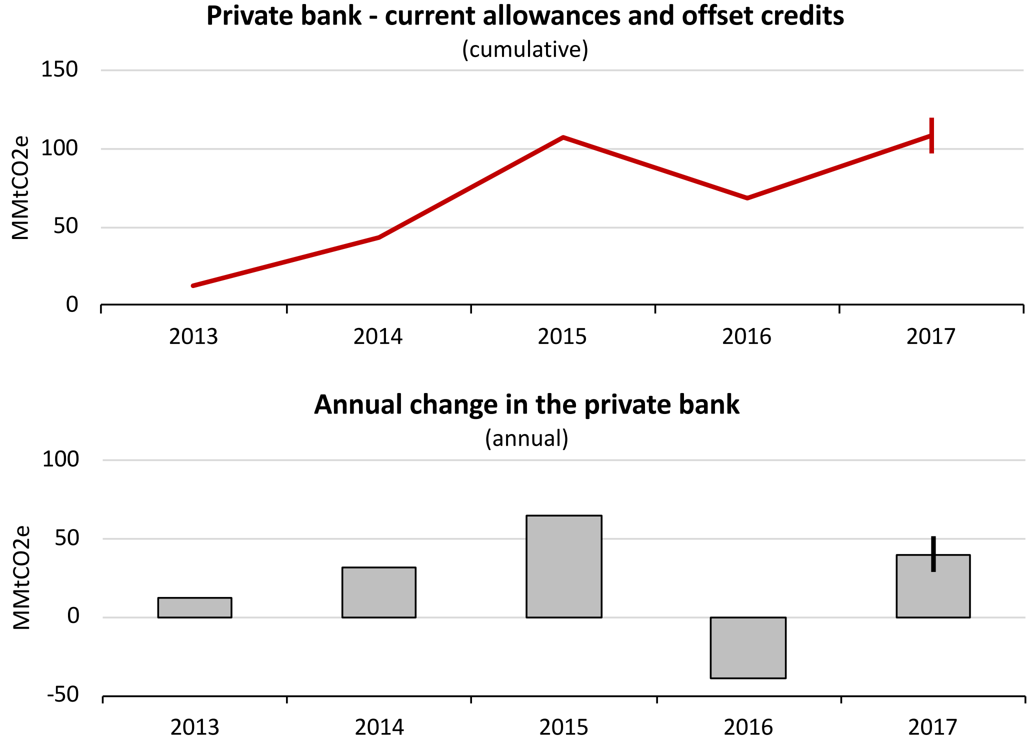

Figure 1. Private banking of excess compliance instruments. *The top panel shows the running total of the number of compliance instruments banked in private accounts, calculated as the number of compliance instruments above and beyond the need to satisfy outstanding compliance obligations for covered emissions subject to the cap-and-trade program. The lower panel shows the annual change in the cumulative private banking metric. Data for 2017 in both panels include an uncertainty range reflecting the fact that 2017 emissions are projected, not officially reported.*

Table 1: Banking metrics (million metric tons CO_2-equivalent, or $MMtCO_2e$)

	2013	**2014**	**2015**	**2016**	**2017**
Total private bank (cumulative)	11.9	43.1	107.1	68.3	108.1 (±11.3)
Annual change in the private bank	11.9	31.2	64.0	−38.7	39.7 (±11.3)
Covered emissions	163.4	164.4	397.9	382.4	375.6 (±11.3)
Outstanding compliance obligations	163.4	284.4	397.9	678.2	956.6 (±11.3)
Compliance instruments in private accounts	175.3	327.4	505.0	746.5	1,064.6

The annual change in our banking metric is related to the number of allowances and offsets introduced to the market each year. Figure 2 shows the supply of allowances and offsets introduced to private accounts by calendar year. Allowances are separated into direct allocations, current year auctions (including consignment allowance sales), and advance year auctions. When the supply of compliance instruments that passes into private accounts is greater than the covered emissions in a given year, the bank increases; conversely, in 2016, WCI auction sales collapsed, causing the banking metric to decline for that year.

Note that advance year allowances are excluded from our banking metric until their vintage year becomes current, as discussed further below.

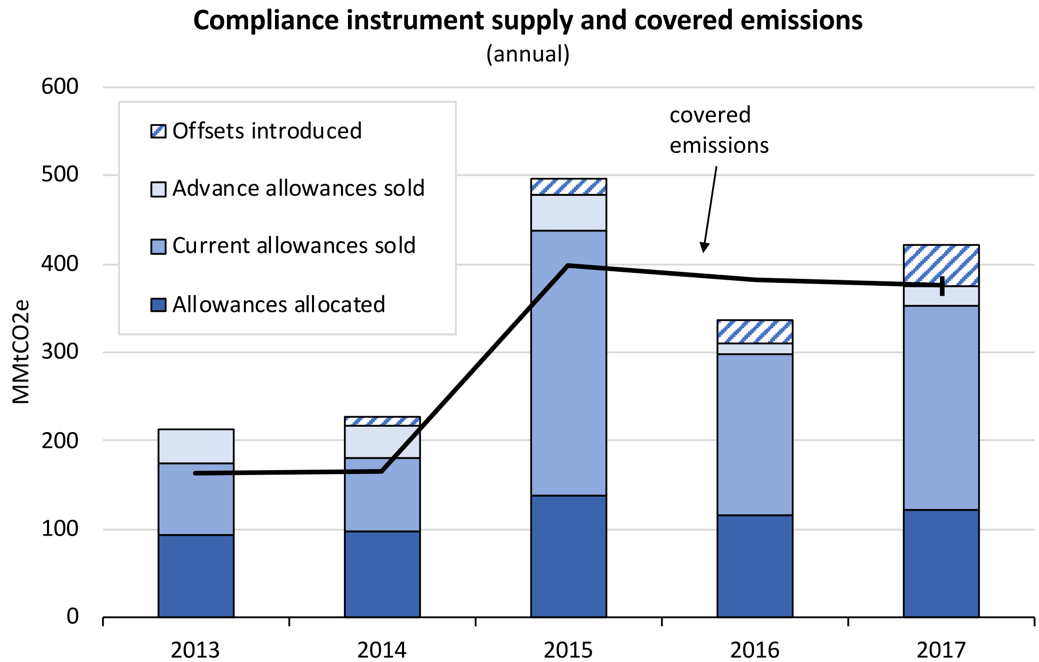

Figure 2. Annual compliance instrument supply and covered emissions. *The bottom panel shows covered emissions compared against the number of instruments entering private accounts. When emissions are lower than the sum of the number of compliance instruments entering private accounts, there is a surplus and the bank increases. Covered emissions in 2013 and 2014 include electricity generators and large industrial facilities in California and Quebec. In 2015, covered emissions expanded to include fuel distributors. While total emissions instruments issued in 2016 exceeded covered emissions as in other years, several auctions failed to sell out; the unsold allowances are now being re-introduced at auction.*

Additional allowance pools

In addition to the private bank of allowances tracked in the banking metric discussed above, three other pools of allowances are relevant in the context of evaluating overallocation and banking.

- **Advance auction sales:** WCI auctions include a "current auction" of allowances with the vintage of the current calendar year and a separate "advance auction" of a limited number of allowances with a vintage of three years in the future.[13] For example, in 2014, quarterly auctions in

[13] Current auctions also include the re-introduction of previously unsold allowances, which are sometimes of an earlier vintage year. *See* Mason Inman, Michael Mastrandrea, and Danny Cullenward, California's "self-correct-

California and Quebec sold 84.8M vintage-2014 allowances at current auctions and 34.6M vintage-2017 allowances at advance auctions. All of these allowances were transferred into private accounts.

Although sales in advance auctions increase the number of allowances held in private accounts, these purchases are not necessarily an indication of growing market overallocation because they cannot be used for compliance obligations prior to their vintage year. Advance auction purchases can occur regardless of whether the market is oversupplied or undersupplied. Instead, purchases in advance auctions are primarily used as a hedge against future price increases and/or as an investment based on the prospect of rising allowance prices.

Accordingly, we exclude allowances purchased in advance auctions from our banking calculations until such time as allowances of the same vintage year are available in current auctions. Once time passes such that the vintage year of allowances purchased at advance auctions becomes current, these allowances contribute to the valid supply of compliance instruments and are therefore reflected in our banking metric. For example, the 34.6M vintage-2017 allowances sold at advance auctions in 2014 do not count towards the banking metric until the year 2017, at which point vintage-2017 allowances are "current" and therefore usable for compliance purposes arising from covered emissions through 2017.

By excluding allowances acquired at an advance auction from our private banking metric until such time as the banking metric's year matches their vintage, we express no assumption or judgment about their eventual use. Accordingly, the number we report is a conservative estimate of the total market-wide private bank.

- **Unsold allowances:** In addition to allowances held in private accounts, government accounts hold a significant number of previously unsold allowances. In the 2016 and 2017 auctions, 143 million allowances owned by California or Quebec went unsold in current auctions and were transferred to temporary government accounts. Pursuant to

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ing" cap-and-trade auction mechanism does not eliminate market overallocation, Near Zero Research Note (May 23, 2018), http://www.near-zero.org/wp/2018/05/23/californias-self-correcting-cap-and-trade-auction-mechanism-does-not-eliminate-market-overallocation/.

market rules, these previously unsold allowances are now being reintroduced for sale in current auctions.

California has a distinct market design that differs from Quebec's. If California's state-owned allowances remain unsold for more than 24 months, they are removed from the normal auction supply. Quebec's current regulations do not contain a similar stipulation. We calculate that this "self-correction" mechanism will help reduce the extent of overallocation in the WCI market, removing a minimum of 38 million allowances from the normal auction supply, if auctions continue to sell out, and as many as 52 million allowances, if the November 2018 auction does not sell out, but this will address only a fraction of the overallocation expected by 2020.[14] (We note that overallocation estimates from Dr. Chris Busch accounted for allowances removed via this "self-correction" mechanism, under the assumption that current auctions would continue to sell out—which so far has proven true.)

Of the 143 million California- and Quebec-owned allowances that went unsold in 2016-2017, 60 million have already been reintroduced and sold at auction through August 2018 (including 16 million sold in November 2017). Those that were sold in 2017 are included in the private bank for 2017 and those that were sold in 2018 (or future years) will be included in future years' banking metrics. All told, an additional 75 to 89 million California and Quebec allowances that went unsold in 2016-2017 will likely be added to the private bank of 108 million measured as of the end of 2017, with the exact amount dependent on the outcomes of the next two quarterly auctions (Q4 2018 and Q1 2019). However, we stress that these expected sales are not included in the banking metric developed here, which incorporates only those sales that occurred by the end of 2017.

- **Reserve accounts:** For the period 2013 through 2030, current regulations set aside an additional 213 million allowances in two government accounts: California's APCR and Quebec's reserve. These allowances will become available if allowance prices rise significantly above current levels, and/or if ARB re-allocates a portion of these allowances into so-called price containment points or other accounts accessible at

[14] *Id.*

lower prices in the post-2020 market design currently under development in California.[15] Because market prices remain close to the price floor, these allowances have not been purchased to date and therefore are not counted in the banking metric presented here. If any of these allowances are purchased in the future, however, they would show up in the CIRs and therefore be counted in future years' banking metrics.

Estimates of banking in other emissions trading systems

Three non-WCI emissions trading systems illustrate how policymakers can observe banking and use data-driven strategies to manage the risks of market overallocation.

We first consider the Regional Greenhouse Gas Initiative (RGGI), a cap-and-trade program that applies to electricity sector emissions in nine states in the eastern United States. RGGI has recognized that it has repeatedly experienced a large overallocation of allowances, leading to a large private bank of allowances.[16]

To account for the negative consequences of allowance overallocation, RGGI has already implemented two one-time adjustments that lower the system's emissions cap for future years. RGGI participants have also agreed on a third intervention to lower the cap, to be implemented over the period 2021-2025. The third adjustment of the cap is tied directly to the calculated size of the bank of allowances after satisfying compliance obligations for the current compliance period, 2018-2020, following this equation:[17]

Banked allowances = allowances in private accounts - emissions

For *allowances in private accounts*, RGGI considers allowances of vintages up to the end of the current compliance period (*i.e.*, up to the end of 2020).

15 Danny Cullenward, Mason Inman, and Michael Mastrandrea, Implementing AB 398: ARB's initial post-2020 market design and "allowance pool" concepts, Near Zero Research Note (Mar. 16, 2018), http://www.near-zero.org/wp/2018/03/16/implementing-ab-398-arbs-initial-post-2020-market-design-and-allowance-pool-concepts/.

16 RGGI, *supra* note 3.

17 Regional Greenhouse Gas Initiative (RGGI), Model Rule 2017 (Dec. 19, 2017), https://www.rggi.org/sites/default/files/Uploads/Program-Review/12-19-2017/Model_Rule_2017_12_19.pdf.

For *emissions*, RGGI counts all covered emissions in the system for the current compliance period (2018-2020). Thus, the program features a dynamic cap adjustment based on the extent to which market participants voluntarily bank extra allowances into future market periods.

Second, the European Union recently implemented a Market Stability Reserve (MSR) to increase the stringency of its carbon market, known as the EU ETS. Like the WCI and RGGI programs, the EU ETS has experienced a significant market overallocation problem. Because the EU ETS lacks a price floor, however, carbon prices had remained low for several years, falling between approximately \$5 to \$10 per tCO_2e despite Europe's climate policy ambitions. To address this challenge, the EU climate regulator created the MSR, which dynamically updates the supply of allowances based on market banking behavior. If there are more than 833 million allowances in circulation, market regulators will withdraw allowances and thereby reduce supply; in contrast, if market circulation shrinks to less than 400 million allowances, the regulator will add additional allowances to increase supply.[18] Since the MSR was implemented, EU ETS prices have recovered and, as of August 2018, now exceed prices in the WCI market.[19]

Third, California's own Low Carbon Fuel Standard (LCFS) features a market-based system of emissions reduction credits. ARB's LCFS Data Dashboard shows the number of emissions deficits (compliance obligations) and credits issued, along with the cumulative bank of credits in each quarter (see panel 3 of the online dashboard). ARB calculated that the bank was 9.8 million credits at the end of 2017 (the latest data available at the time of writing); this banked quantity is nearly as large as the annual compliance obligation in 2017, 10.0 million credits.[20] We believe ARB could take a similar approach to analyzing the supply and demand balance for credits in the statewide cap-and-trade program for greenhouse gases. In-

18 Torbjørg Jenvnaker and Jørgen Wettestad, Ratcheting Up Carbon Trade: The Politics of Reforming EU Emissions Trading (2017), *Global Environmental Politics* 17(2): 105-124.

19 Sandbag, EU ETS Carbon Price Viewer, https://sandbag.org.uk/carbon-price-viewer/.

20 ARB, Low Carbon Fuel Standard Data Dashboard (version as of April 25, 2018), https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm.

deed, ARB has previously considered banking metrics similar to the concept proposed here.[21]

As these examples show, both ARB and other leading climate regulators have successfully tracked banking behavior in emissions trading programs around the world. The RGGI and EU ETS examples also indicate how a metric of observed banking behavior can be used to inform program stringency via dynamically adjusted program caps.

Conclusion

We develop a method for tracking the private bank of compliance instruments in the WCI cap-and-trade program. Our metric indicates that there is a large bank of compliance instruments—approximately 108 million instruments at the end of 2017. So long as program caps remain far above covered emissions and auctions continue to sell out—conditions that have held true in 2018—the private bank will continue to grow.

Observed banking behavior suggests that market participants consider purchasing allowances beyond their immediate compliance needs to be a sound investment—either sufficiently valuable in relation to the rising floor price, as a financially attractive option with a rate of return similar to or better to other opportunities they have, or perhaps as a hedging strategy that reduces exposure to potentially higher compliance costs in the program's later years. Given that the auction floor price is mandated to rise 5% per year plus inflation, allowance banking provides a relatively low-risk if modest return, with the potential for substantially higher returns when overallocation conditions diminish and market prices rise.

Banking provides important contributions to the cap-and-trade program's performance. Some non-compliance entities provide liquidity to the market—for example, allowing compliance entities that are not bidders on the primary market to obtain allowances on the secondary market, and also facilitating futures trading that would not be possible without sophisticated intermediaries. However, excess banking across the entire market can lead

21 ARB, Updated Economic Analysis of California's Climate Change Scoping Plan (Mar. 24, 2010) at 30, https://www.arb.ca.gov/cc/scopingplan/economics-sp/updated-analysis/updated_sp_analysis.pdf.

to artificially low prices and enable higher emissions in later years that put California's climate goals at risk.

As shown in this report, banking outcomes can be tracked objectively using public market data. Furthermore, these metrics could easily be integrated into ARB's official market reporting. In turn, official reporting would enable a number of important improvements to cap-and-trade program governance. For example, a banking metric would measure the extent to which concerns about allowance overallocation manifest in practice. Whether or not the bank of allowances will grow to the levels projected by independent analysts is, at its core, an empirical question that will be revealed in time.

Nevertheless, we caution that a pure "wait and see" approach is unlikely to detect the full extent of overallocation in time to make appropriate interventions. Instead of waiting for lagged data releases to indicate a problem that has already manifested, and then initiating processes to address the problem, policymakers could consider anticipatory reforms that apply only if banking metrics reach predetermined thresholds. Recent advances in the RGGI and the EU ETS markets offer examples of how this principle can be applied in practice. This type of reform has the distinct advantage of enabling policymakers to cut years of lag from the data reporting and rulemaking process, increasing the odds that a cap-and-trade program delivers on desired emission reductions.

Appendix: Method for calculating banked compliance instruments

We define the private bank as follows:

$$Private\ Bank_t = Compliance\ Instruments_t - Outstanding\ Obligations_t$$

Where *Private Bank*$_t$ is the bank of compliance instruments measured at the end of year *t*; *Compliance Instruments*$_t$ is the number of compliance instruments held in private accounts at the end of the same year; and *Outstanding Obligations*$_t$ is the compliance obligations incurred by regulated parties for cumulative emissions through the end of the same year that have not yet been satisfied by retiring compliance instruments.

Below we describe our full methodology for calculating banked compliance instruments. For more details on data sources, including links to online data sources, see the accompanying spreadsheet, which is posted on our website.

- **Compliance instruments:** We use ARB's fourth quarter (Q4) Compliance Instrument Reports (CIRs) to directly observe private holding of offsets and allowances for most years in our banking metric.[22] There are two exceptions. First, ARB did not report CIRs in 2013, so we used data on allowance allocation[23] and auction sales[24] for both California and Quebec for this year. Second, the CIR for Q4 2017 includes Ontario's allowances and required further adjustment, as described below.

- **Outstanding obligations:** Outstanding compliance obligations are defined as the total compliance obligations incurred up to a given date minus all compliance submissions up to that same date.

22 ARB, *supra* note 5.

23 ARB, Public Data on Allowance Allocation, https://www.arb.ca.gov/cc/capandtrade/allowanceallocation/publicallocation.htm; MDDELCC, Le marché du carbone, Documentation: Allocation gratuite d'unités d'émission, http://www.mddelcc.gouv.qc.ca/changements/carbone/documentation.htm#allocation.

24 Data for auctions that included California and any linked jurisdictions are available at https://www.arb.ca.gov/cc/capandtrade/auction/auction.htm; data for Quebec-only auctions are available at http://www.mddelcc.gouv.qc.ca/changements/carbone/avis-resultats-en.htm.

Total compliance obligations are based on official government summaries of the emissions subject to the cap-and-trade program in California [25] and Quebec. [26] We use the primary data that ARB and MDDELCC use to define legal compliance obligations under their respective cap-and-trade program regulations for the years 2013 through 2016, and a projection of emissions in 2017, as discussed below.

Compliance submissions are required every year in California and following the end of multi-year compliance periods in Quebec. We used official data on the number of allowances and offsets submitted in each compliance event.

By distinguishing between satisfied and outstanding compliance obligations, our metric accounts for the natural "stockpiling" behavior observed in the market as major compliance deadlines approach. This feature is essential because entities will tend to increase their holdings of compliance instruments toward the end of multi-year compliance periods, when the bulk of the multi-year compliance obligation comes due in the following November. Again, our metric fully accounts for this dynamic and measures only the compliance instruments held in excess of outstanding compliance obligations.

- **Projected emissions in 2017:** Because our banking metric uses official data on covered emissions, but official data are lagged by nearly a year, it is necessary to estimate 2017 emissions in order to calculate the banking metric for 2017. We use estimates of 2017 covered emissions

25 California covered emissions are drawn from annual compliance reports. We use these data, rather than annual reported emissions from the Mandatory Greenhouse Gas Emissions Reporting (MRR) regulations, because the compliance reports address actual calculated compliance obligations and sometimes differ slightly from MRR reported emissions. For example, if ARB were to determine that a covered entity under-reported emissions in its MRR submission, a later edition of MRR data would include a revised value for their emissions for that year. If the revision were less than 5%, however, that entity would not be obligated to surrender additional compliance instruments (per Cal. Code Regs., tit. 19, § 95858), leading to a small difference between revised MRR emissions and aggregate compliance obligations for that year. We use the annual compliance reports because the banking metric tracks the number of compliance instruments held in private accounts relative to outstanding compliance obligations, not relative to actual emissions.

26 Quebec covered emissions are from the MDDELCC report titled "Émissions de gaz à effet de serre déclarées et vérifiées des établissements visés par le RSPEDE," at http://www.mddelcc.gouv.qc.ca/changements/carbone/etablissements-SPEDE.pdf.

from the 2018 Environmental Commissioner of Ontario (ECO) report on the WCI market.[27] ECO assumed that from 2016 to 2017, California covered emissions will decline 1.9% and Quebec covered emissions will decline 1.0%. We adopt ECO's estimate as our central estimate for projected 2017 emissions and include an error range of ±3% around this projection to illustrate the sensitivity of our metric to uncertainty about 2017 covered emissions.

The uncertainty range in our banking metric (108M ±11M compliance instruments at the end of 2017) reflects the underlying uncertainty in projected emissions. Once official data are released for 2017 covered emissions in California and Quebec, we will update our calculations and our estimate of banking through the end of 2017. That official reporting will soon be followed by Q4 2018 CIR data that will allow us to estimate a banking metric for 2018, based on a new projection for 2018 covered emissions in California and Quebec.

We emphasize that any projection of emissions could be used in this banking metric. None of the participating WCI governments generates an official projection, so we were forced to use an independent estimate. We believe that the ECO report offers a credible basis for projecting emissions that occurred in 2017, but anyone who prefers a different estimate can readily substitute that number into our calculations to generate a different banking estimate for the year 2017.

- **Adjustment for Ontario in Q4 2017:** CIRs describe the state of the WCI market several days after the end of their eponymous quarter. As a result, the Q4 2017 CIR measures private holdings in early January 2018, not the end of December 2017. At that point Ontario had joined the WCI program and the compliance instruments held by Ontario entities were included in the WCI-wide CITSS accounting data in the CIR. However, Ontario and the California-Quebec markets were not linked in 2017, so we could not use the Q4 2017 CIR data to measure WCI-wide allowance banking at the end of December 2017. Instead, we used the Q3 2017 CIR to observe private holdings of offsets and allowances as of the end of Q3 2017.

  To then estimate what allowance holdings the Q4 2017 CIR would have reported if it had excluded Ontario allowances, we added the Q4

[27] ECO, *supra* note 10.

2017 current auction sales of California and Quebec allowances and subtracted the number of allowances submitted to ARB at the November 2017 compliance event.

We note that this is a one-time adjustment to the methods employed in our metric. Beginning with the Q2 2018 CIR, ARB is once again reporting compliance instrument holdings for California and Quebec entities only, consistent with Ontario's withdrawal from the WCI cap-and-trade program. Thus, for the banking metric in 2018 and in future years, no further adjustments will be needed, as the Q4 CIRs will directly measure the appropriate data once again.[28]

Although this modification was necessary to estimate privately held allowances at the end of 2017, we retained the use of the Q4 2017 CIR to observe the number of offsets held in the California-Quebec market on the assumption that very few offset credits would have traded hands in the first few days of 2018. (California issues the vast majority of the offsets credits in the WCI program and Ontario has not issued any to date.) If this assumption proves incorrect and Ontario entities were in fact holding a substantial number of the offsets reported in private accounts in the Q4 2017 CIR, any error will manifest only in the 2017 banking metric because future years' banking metrics will be based on accurate holdings reported in future years' Q4 CIRs.

[28] Similar adjustments can be made if Ontario or other jurisdictions join the WCI program in the future.

Acknowledgements

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About Near Zero

Near Zero is a non-profit environmental research organization based at the Carnegie Institution for Science on the Stanford University campus. Near Zero provides credible, impartial, and actionable assessment with the goal of cutting greenhouse gas emissions to near zero. This research note is for informational purposes only and does not constitute investment advice.

Data used in this research note are available at our website.

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Wednesday, January 17, 2018
California State Capitol, Room 3191
9:30 a.m.

California's Cap-and-Trade Program: The Air Resources Board's 2017 Scoping Plan

BACKGROUND INFORMATION

Introduction

In 2006, AB 32 (Núñez and Pavley, Chapter 488, Statutes of 2006) was signed into law, which requires the Air Resources Board (ARB) to determine the 1990 statewide greenhouse gas (GHG) emission level and achieve a reduction in GHG emissions to that level by 2020. In addition to calling on ARB to inventory GHGs in California (including carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) and approve the aforementioned statewide GHG emissions limit, AB 32 also requires ARB to (1) implement regulations that achieve the maximum technologically feasible and cost-effective reduction of GHG emissions, (2) identify and adopt regulations for discrete early-action measures, and (3) prepare and approve a scoping plan, to be updated at least once every five years, to achieve the maximum technologically feasible and cost-effective reduction of GHG emissions. Due to a variety of factors, most importantly being the great recession that started in 2008, California will achieve the goals of AB 32 in advance of the 2020 deadline.

In 2016, the Legislature approved, and the Governor signed, SB 32 (Pavley, Chapter 249, Statutes of 2016), which requires ARB to ensure that statewide GHG emissions are reduced to at least 40% below the 1990 level by December 31, 2030. This new goal is known as the SB 32 target.

The following year, AB 398 (E. Garcia, Chapter 135, Statutes of 2017) was enacted to extend the authority of ARB to implement a cap-and-trade program to reduce GHG emissions throughout the state. AB 398 specified a variety of requirements on the post-2020 cap-and-trade program, most notable are (1) requiring the banking of allowances from the current cap-and-trade program into the post-2020 program, (2) specifying industry assistance factors for the post-2020 program, and (3) **requiring that all GHG rules and regulations adopted by ARB must be consistent with the updated scoping plan.**

2017 Scoping Plan Update

The initial scoping plan prepared pursuant to AB 32 was approved by ARB on December 12, 2008. Public Resources Code §38561 also requires the scoping plan to be updated at least once every five years and the initial scoping plan was updated and approved on May 22, 2014.

AB 398 required ARB to subsequently prepare another update to the scoping plan by January 1, 2018. This update was approved by ARB on December 14, 2017.

Low Carbon Fuels Standard

The scoping plan must achieve “the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions.” There are aspects of the 2017 Scoping Plan, however, that arguably do not meet this requirement. For example, groups like NextGen California have argued that the Low Carbon Fuels Standard, which reduces the Carbon Intensity (CI) of fuels in California, has an “excessively conservative” target of an 18% reduction in CI. According to NextGen, ARB has not provided evidence that a higher CI target is unattainable and “a higher price would send a strong market signal to incentivize innovative clean technology and maximize the climate, air quality and economic development benefits to California.”

Allowances and Banking

There is also no discussion of the oversupply and banking of allowances in the cap-and-trade program in the 2017 Scoping Plan. The Brattle Group, CalCarbonInfo, and other analysts agree that supply of allowances has significantly exceeded demand and will likely continue to do so past 2020. The Legislative Analyst’s Office recently published a report that finds “since entities can use banked allowances from earlier years to comply in later years … banking creates a risk of not achieving [the SB 32 target].” Chris Busch from Energy Innovation recently published a report that found the oversupply of allowances in the program will allow covered entities to forego 26% of WCI[1]-wide emissions reductions in the lowest possible scenario of allowance oversupply. In the highest possible scenario of allowance oversupply, that number increases to 45%. This would seem to contradict the requirement that the scoping plan achieve the maximum technologically feasible and cost-effective reductions in GHG emissions by allowing under-compliance with the SB 32 target through an oversupply of allowances in the cap-and-trade program.

[1] The Western Climate Initiative (WCI) is a non-profit corporation formed to provide administrative and technical services to support the implementation of state and provincial GHG emissions trading programs. Currently the WCI includes the State of California and the Canadian provinces of Quebec and Ontario.

Industry Assistance Factors

Given that the 2017 Scoping Plan fails to pursue maximal GHG emissions reductions, it is notable that ARB has proposed to adjust the industry assistance factors for the third compliance period of the current cap-and-trade program (i.e., pre-2020). It is important to note that while AB 398 specified the industry assistance factors ARB must use post-2020, the legislation gave no statutory direction to ARB to adjust those factors pre-2020 and doing so would forego even more GHG emissions reductions. This means that GHG emissions reductions ARB determined to be technologically feasible and cost-effective, and would minimize leakage, are now being sacrificed. This could unnecessarily make progress toward the SB 32 target further out of reach.

Future Action Assumptions in the 2017 Scoping Plan

The 2017 Scoping Plan contains assumptions about Legislative action, both policy and fiscal, as well as technological advances. For example, the 2017 Scoping Plan assumes that cap-and-trade auction revenues will be deposited into the Greenhouse Gas Reduction Fund (GGRF) and will be used to further the purposes of AB 32 and facilitate reduction of GHG emissions. However, neither ARB nor the current Legislature can predict or bind the spending decisions and priorities of a future Legislature and a future Legislature may choose to spend cap-and-trade auction revenues in a way that is not outlined in their scoping plans.

Indeed, there is significant legal question as to whether the cap-and-trade revenues in the 2020-2030 timeframe are bound by the same spending requirements as the current cap-and-trade program revenue. In order to ensure compliance with the SB 32 target, ARB should have contingency plans if those investments are not made, and possibly should not rely on such assumptions in their scoping plans at all.

On the policy level, grid regionalization[2] could deliver GHG emissions reductions benefits, but achieving grid regionalization is another assumption in the 2017

[2] Grid regionalization refers to combining the energy markets of several western states. Doing so could allow excess solar energy produced during the day in California to be exported out of state, or

Scoping Plan that requires action by the Legislatures and Governors of several states. What makes this assumption even more suspect is that all indications are that other states are unwilling to partner with California due to, among other things, ideological differences over climate change policies and the impacts those policies have on the energy sector.

It is seemingly an overly ambitious assumption in the 2017 Scoping Plan that there will be more than a 45% decrease in fossil fuel demand for transportation by 2030. *If these, and other, assumptions in ARB's current and future scoping plans do not come to pass, where does that leave the state in its progress toward the SB 32 target?*

Perhaps equally as important to answer is what, if any, retrospective analyses on previous scoping plans ARB has done to determine where the modeling and assumptions in those plans have not been accurate, where programs in those plans have under- or over-performed on GHG emissions reductions, and where there may be any systematic biases or patterns where such forecasts turned out to be incorrect. Without this knowledge, the state is in jeopardy of not achieving the SB 32 target.

Why California Puts a Price on Carbon

Unpriced carbon dioxide, and other greenhouse gas, emissions are what economists call an "externality," meaning GHGs are a side effect or consequence of an industrial or commercial activity that affects other parties without this being reflected in the cost of the goods or services involved. A price on GHG emissions forces the true cost of the emissions (whether in regard to climate change, public health, etc.) to be realized by the industry and the consumer creating the climate pollution.

One quantification for the externality of carbon dioxide emissions is the Social Cost of Carbon (SCC). The SCC is a price tag for the long-term damage done by a ton of carbon dioxide emissions in a given year. This dollar figure also includes the value of damages avoided for emission reductions.

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excess wind energy produced at night in Wyoming to be shipped into California, potentially reducing the need for fossil-fuel-based energy.

The SCC is meant to be a comprehensive estimate of climate change damages and includes changes in net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning. However, there is no consensus yet on what should be accounted for in the SCC.

Despite this, under the previous administration, the federal Environmental Protection Agency (EPA) and other federal agencies have made estimates for the SCC that they use to determine the climate impacts of rulemakings.

Estimates for the SCC increase over time because future emissions are expected to produce larger incremental damages as physical and economic systems become more stressed in response to greater climatic change, and because the gross domestic product (GDP) is growing over time and many damage categories are modeled as proportional to gross GDP.

Below are SCC estimates previously published by the federal EPA. The discount rate in the columns can be thought of as the interest rate for the cost of the impacts from carbon dioxide. There is a lack of consensus in the scientific community on the appropriate discount rate, which changes the SCC greatly.

Discount Rate and SCC			
Year	**5%**	**3%**	**2.5%**
2015	$11	$36	$56
2020	$12	$42	$62
2025	$14	$46	$68
2030	$16	$50	$73
2035	$18	$55	$78
2040	$21	$60	$84
2045	$23	$64	$89
2050	$26	$69	$95

The federal EPA does not currently include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature because of a lack of precise information on the nature of damages, and because the science incorporated into these models naturally lags behind the most recent research.

Of note, the SCC is not necessarily an appropriate dollar figure to use for the cost of other GHGs, such as methane and nitrous oxide.

In addition to the SCC, the 2017 Scoping Plan discusses, as required by AB 398, the Social Cost of methane, minimum auction prices, and the cost to achieve the SB 32 target. Extending the cap-and-trade program was recommended in the initial scoping plan as the most cost-effective strategy to achieving the SB 32 target.

Cap-and-Trade

The original cap-and-trade program was recommended in the initial scoping plan as a central approach to flexibly and iteratively reduce emissions over time. Pursuant to legal authority under AB 32, ARB adopted cap-and-trade regulations and those regulations were approved on December 13, 2011.

Beginning on January 1, 2013, the cap-and-trade regulation sets a firm, declining cap on total GHG emissions from sources that make up approximately 85% of all statewide GHG emissions. Sources included under the cap are termed “covered entities.” The cap is enforced by requiring each covered entity to surrender one “compliance instrument” for every emissions unit (i.e., metric ton of carbon dioxide equivalent or $MTCO_2e$) that it emits at the end of a compliance period.

Over time, the cap declines, resulting in GHG emission reductions. Two forms of compliance instruments are used: allowances and offsets. Allowances are generated by the state in an amount equal to the cap and may be “banked” (i.e., allowing current allowances to be used for future compliance). An offset is a credit for a real, verified, permanent, and enforceable emission reduction project from a source outside a capped sector (e.g., a certified carbon-storing forestry project). Some fraction of allowances are allocated freely to covered entities, a small portion is set aside as part of an allowance price-containment reserve, and the rest is auctioned off quarterly.

Offsets and freely allocated allowances have been controversial and have been criticized for reducing the effectiveness of the cap-and-trade mechanism in achieving AB 32 goals. While covered entities have argued that all of the allowances should be free, others have argued that emitters should be required to pay for polluting California's air and the global climate.

Offsets, such as carbon sequestration in trees, reduce the cost of compliance, which may reduce the effectiveness of cap-and-trade. Although offsets are capped and must meet the condition of additionality (i.e., a reduction is only additional if it would not have occurred without the financial incentive provided by the offset credit), critics often cite that the carbon sequestered in trees is not permanently sequestered and can be easily released in forest fires, so reforestation is an invalid application of additionality.

Use of Cap-and-Trade Auction Revenue

Since November 2012, ARB has conducted eight California-only and 13 joint California-Québec cap-and-trade auctions. To date, $6.45 billion has been generated by the cap-and-trade auctions and deposited into the GGRF.

State law specifies that the auction revenues must be used to facilitate the achievement of measurable GHG emissions reductions and outlines various categories of allowable expenditures. Statute further requires the Department of Finance, in consultation with ARB and any other relevant state agency, to develop a three-year investment plan for the auction proceeds, which are deposited in the GGRF. ARB is required to develop guidance for administering agencies on reporting and quantifying methodologies for programs and projects funded through the GGRF to ensure the investments further the regulatory purposes of AB 32.

Proceeds from cap-and-trade auctions provide an opportunity for the state to invest in projects that help California achieve its climate goals and provide benefits to disadvantaged communities. Several bills in 2012, one in 2014, and one in 2016 provide legislative direction for the expenditure of auction proceeds including SB 535 (de León, Chapter 830, Statutes of 2012), AB 1532 (J. Pérez, Chapter 807, Statutes of 2012), SB 1018 (Committee on Budget and Fiscal Review, Chapter 39, Statutes of 2012), SB 862 (Committee on Budget and Fiscal Review, Chapter 36, Statutes of 2014), and AB 1550 (Gomez, Chapter 369, Statutes of 2016).

These statutes also require a state agency, prior to expending any money appropriated to it by the Legislature from the fund, to prepare a description of 1) proposed expenditures, 2) how they will further the regulatory purposes of AB 32, 3) how they will achieve specified GHG emission reductions, 4) how the agency considered other objectives of that act, and 5) how the agency will document expenditure results.

Legal Consideration of Cap-and-Trade Auction Revenue

Regulatory fees established prior to 2010 (due to Proposition 26) are subject to the *Sinclair Paint* test, which helps determine whether a levy is a fee or a tax.

Sinclair Paint Co. v. State Board of Equalization, 15 Cal. 4th 866 (1997) considered the legitimacy of a fee levied to support the implementation of the Childhood Lead Poisoning Prevention Act, which provided evaluation, screening, and medical follow-up services to children at risk of lead poisoning. The program was entirely supported by fees imposed on former and current manufacturers of lead or products containing lead, based on the manufacturers "market share" responsibility for the contamination. The California Supreme Court in *Sinclair Paint* found that a levy is a legitimate fee as long as the revenue of the levy does not exceed the costs of the regulatory activity and the levy is not imposed for an unrelated revenue purpose, and the levy allocated to the payer bears a fair or reasonable relationship to the payer's burdens on or benefits from the regulatory activity.

The *Sinclair Paint* test is a two-part test: 1) nexus and 2) proportionality. The *Sinclair Paint* test nexus component, which is derived from the case above, requires that a clear nexus must exist between an activity for which a fee is used and the adverse effects related to the activity on which that fee is levied. The *Sinclair Paint* test proportionality component, also derived from the case above, requires those burdened with a fee proportionally benefit from the fee.

The 2012-13 Budget analysis of cap-and-trade auction revenue by the Legislative Analyst's Office (LAO) noted that, based on an opinion from the Office of Legislative Counsel, the auction revenues should be considered "mitigation" fee revenues, subject to the *Sinclair Paint* test. The LAO concluded, based on the opinion, that in order for their use to be valid as mitigation fees, revenues from the cap-and-trade auction must be used to mitigate GHG emissions or the harms caused by GHG emissions.

In 2012, the California Chamber of Commerce filed a lawsuit against ARB claiming that cap-and-trade auction revenues constitute illegal tax revenue. In November 2013, a Sacramento Superior Court ruling declined to hold the auction a tax, concluding that it is more akin to a regulatory fee.

In February of 2014, the plaintiffs filed an appeal with the 3rd District Court of Appeal in Sacramento. Arguments were heard before the appellate court in January of 2017. On April 6, 2017, the appellate court issued a ruling that again declined to hold that the cap-and-trade auctions are a tax.

3rd District Court of Appeal Ruling

The appellate court ruled that ARB did not exceed its authority in creating the cap-and-trade program, stating that "the Legislature gave broad discretion to the Board to design a distribution system, and a system including the auction of some allowances did not exceed the scope of legislative delegation. Further, the Legislature later ratified the auction system by specifying how to use the proceeds derived therefrom."

The appellate court also stated clearly "that the auction sales do not equate to a tax" explaining that "the hallmarks of a tax are: 1) that it is compulsory; and 2) that the payor receives nothing of particular value for payment of the tax, that is, the payor receives nothing of specific value for the tax itself. Contrary to plaintiffs' view, the purchase of allowances is a voluntary decision driven by business judgments as to whether it is more beneficial to the company to make the purchase than to reduce emissions …these twin aspects of the auction system, voluntary participation and purchase of a specific thing of value, preclude a finding that the auction system has the hallmarks of a tax."

Going further than the superior court, the appellate court also found that "the purchase of emissions allowances, whether directly from the Board at auction or on the secondary market, is a business driven decision, not a governmentally compelled decision [and] unlike any other tax … the purchase of an emissions allowance conveys a valuable property interest—the privilege to pollute California's air—that may be freely sold or traded on the secondary market."

As a result, the appellate court found that "the *Sinclair Paint* test is not applicable [to the cap-and-trade program], because the auction system is unlike other governmental charges that may raise the "tax or fee" question resolved thereby. The system is the voluntary purchase of a valuable commodity and not a tax under any test."

Effect of AB 398 on Cap-and-Trade Auction Revenue

On July 25, 2017, Governor Brown signed AB 398 (E. Garcia, Chapter 135, Statutes of 2017), which, among other things, extended authorization for ARB to utilize the cap-and-trade program to reduce GHG emissions after December 31, 2020.

There have been questions about whether or not AB 398, which was passed by a two-thirds vote in the Legislature, had any impact on the current cap-and-trade program set to expire December 31, 2020, and the revenues it generates. In the formal opinion of Legislative Counsel, AB 398 did not immediately change the character of cap-and-trade revenue.

Specifically, Legislative Counsel has determined that the revenues generated through December 31, 2020 by the current cap-and-trade program continue to be subject to a trust and, therefore, must continue to be appropriated in a manner that is reasonably related to GHG emissions reductions through December 31, 2020.

What is noteworthy is that Legislative Counsel has not come to the same determination regarding the revenue generated by the cap-and-trade program post-2020, meaning the nature of GGRF moneys could potentially change in the coming decade.

Conclusion

Given the uncertainty of the legal requirements on the cap-and-trade auction revenue and the lofty assumptions that are required in order to predict 10-13 years into the future, *a question arises as to the usefulness and accountability of the scoping plan as it currently exists in statute and is prepared by ARB.*

The Paris Agreement offers an example of how accountability can work when dealing with ambitious plans. In a process called the "global stocktake," every five years (two years after plans are submitted) the signatories to the agreement account for what they have achieved so far, and what must still be done, to achieve the goals of the Paris Agreement. Doing so provides countries with a factual basis for strengthening their actions on climate change.

Having an independent, retrospective analysis on previous scoping plans is a key step to determining where the modeling and assumptions in those plans have not been accurate, where programs in those plans have under- or over-performed on GHG emissions reductions, and where there may be any systematic biases or patterns where such forecasts turned out to be incorrect. Without this knowledge, the state is in jeopardy of not achieving the SB 32 target.

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CALIFORNIA
AIR RESOURCES BOARD

Joint Oversight Hearing of the Senate Environmental Quality Committee and Senate Budget and Fiscal Review Subcommittee No. 2 on Resources, Environmental Protection, Energy and Transportation

January 17, 2018

California Air Resources Board- Responses to Questions

1. The Scoping Plan focuses on cumulative greenhouse gas (GHG) emissions reductions ARB intends to achieve over the period 2021 through 2030. SB 32 (Pavley, Chapter 249, Statutes of 2016) requires real GHG emissions in the year 2030 to be 40% below California's 1990 level. It is entirely possible that if emissions cuts are front-loaded then the state would meet the Scoping Plan's cumulative reduction metrics, but fail to meet the SB 32 statutory target for 2030. This risk seems more pressing given ARB's reliance on cap-and-trade in the late 2020s. California's cap-and-trade program features unlimited banking, which makes it fundamentally a cumulative pollution control instrument, rather than a program that requires any specific annual emissions levels. What measure does ARB have in place to ensure that annual emissions decline to meet the SB 32 target? Can ARB provide an explicit outline for how and when regular reviews will occur, and what actions would be taken if there is indication that California may not meet the SB 32 target?

   Response: The California Air Resources Board's (CARB) inventory and recent Scoping Plan modeling indicate we're on track to meet our AB 32 (Nuñez, Chapter 488, Statutes of 2000) greenhouse gas (GHG) target of 1990 levels of emissions by 2020. To track progress against the State's statutory GHG reduction targets, each year CARB posts an annual GHG inventory, publically available on our website[1]. To further understand how GHG emissions may change year-to-year CARB tracks other factors like economic activity, fuel use, climate conditions, growth in renewables, deployment of cleaner vehicles, and others. All of these metrics, including the GHG inventory, are publicly available data. Cap-and-Trade[2], is just one of several policies in the Scoping Plan to chart

[1] https://www.arb.ca.gov/cc/inventory/data/data.htm
[2] https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm

the path to 2030, we need to track all of the policies and sectors not covered by Cap-and-Trade to ensure needed reductions.

If it appears emissions are not declining as needed, recognizing that year-to-year variability due to climate, global fuel prices, or economic factors can influence emissions, CARB would evaluate which sectors are not responding as anticipated, review all programs that cover those sectors, and ascertain why as well as assessing the best path forward to ensure California stays on track to meet its legislatively established GHG targets.

Reporting and oversight opportunities are listed in the attachment and include statutorily required updates to the Scoping Plan, AB 32 reporting requirements, annual updates to the GHG inventory, annual oversight hearings by the Joint Committee on Climate Change policies, and CARB Board updates.

The Cap-and-Trade Program does not include unlimited banking, market participants have always been subject to holding limits. Most businesses are not choosing to purchase and bank up to their holding limits, most likely due to the carrying costs associated with purchasing and holding millions of allowances.

2. The Scoping Plan assumes that cap-and-trade will fill the gap between the emissions reductions ARB projects from known measures and what is required to meet the SB 32 target. For 2030, the Scoping Plan assumes that cap-and-trade will reduce emissions by 34 to 79 million tons. Does ARB have an estimate of which sectors would actually achieve those reductions as a result of cap-and-trade and how? If not, how does ARB plan to use the state GHG inventory to evaluate and monitor whether cap-and-trade is delivering the necessary reductions called for in the 2030 Scoping Plan?

   Response: The Cap-and-Trade Program is designed to prompt covered businesses to implement the lowest-cost emissions reduction actions first. As regulators, we do not always have perfect information on where the lowest-cost emissions reductions can occur which is why the Cap-and-Trade Program delivers reductions at lower costs than other prescriptive alternatives. Some sectors will respond more quickly to a carbon price than others. For example, the electricity sector is already responding to today’s carbon price since the price has been incorporated into dispatch models in response to the Cap-and-Trade Program. The ability of each sector to react to a carbon price without merely reducing production is something that CARB has been evaluating for the past few years and discussing with industry and stakeholders.

The GHG inventory allows for a transparent review of not only the total GHG emissions, but also the trends in GHGs by economic sector. CARB tracks and publishes this information each year. As noted in the response to Question 1, if it appears emissions are not declining as needed, recognizing year to year variability due to climate, global fuel prices, or economic factors that can influence emissions, CARB would evaluate which sectors are not responding as anticipated, review all programs that cover those sectors, and ascertain why as well as assessing the best path forward to achieve the reductions necessary to meet the Legislatively established GHG targets.

3. What is ARB's plan to establish key milestones or mid-term targets so the state can assess its progress toward the SB 32 target and take early action if necessary?

    Response: As noted in the attachment and above, opportunities to review the State's progress toward achieving our GHG targets include statutorily required updates to the Scoping Plan, AB 32 reporting requirements, annual updates to the GHG inventory, annual oversight hearings by the Joint Committee on Climate Change policies, and CARB Board updates. As with all of CARB's programs, effective and transparent monitoring and mid-course adjustments, as needed, are the right approach to ensure the State achieves its targets.

4. In the Scoping Plan, the Low Carbon Fuels Standard (LCFS) is assigned an 18% Carbon Intensity (CI) reduction target. In comment letters to ARB, groups like NextGen California have argued that the 18% CI target is "excessively conservative" and that the CI target could be set "significantly above 20%". What are ARB's reasons for choosing 18% as the CI target for the LCFS? If ARB subsequently determines a higher CI reduction is warranted, will it need to amend the Scoping Plan first?

    Response: The Scoping Plan[3] provides a high-level strategy for achieving the 2030 target; 18 percent is consistent with CARB's adopted mobile source strategy, which is primarily designed to reduce criteria and toxics pollutants, and also provide GHG co-benefits. In establishing this 18 percent CI reduction target, as part of the public process, CARB developed the Biofuel Supply Module,[4] to better understand the potential biofuel supply available to

[3] https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm
[4] https://www.arb.ca.gov/cc/scopingplan/meetings/meetings.htm

California. As we move through the targeted rulemaking to enhance the LCFS program this year[5], CARB has the ability to propose targets that differ from what is in the Scoping Plan as we will have more detailed discussions and analyses as part of the focused rulemaking. The process to propose the Carbon Intensity target is underway and has been the focus of several workshops to date. Many of the advocacy groups mentioned in your letter have been sharing their analyses and talking to CARB staff.

5. There is no discussion of the oversupply and banking of allowances in the cap-and-trade program in the Scoping Plan. The Brattle Group, CalifomiaCarbon.info, and other analysts agree that supply of permits has significantly exceeded demand and will likely continue to do so past 2020. The Legislative Analyst's Office recently published a report that finds "since entities can use banked allowances from earlier years to comply in later years ... banking creates a risk of not achieving [the SB 32 target]." Chris Busch from Energy Innovation recently published a report that found the oversupply of allowances in the program will allow covered entities to forego 26% of WCI-wide emissions reductions in the lowest possible scenario of allowance oversupply to 45% of WCI-wide emissions reductions in the highest possible scenario of allowance oversupply. What mechanisms does ARB have today, or may have in the future, to ensure that (1) banking of oversupplied allowances does not undermine ARB's planned reductions from the cap-and-trade program through 2030 and (2) that the program produces a sufficient carbon price in the coming years to continue to incentivize emissions reductions when factually emissions today are well below program caps?

   Response: The term “oversupply of allowances” refers to the fact that the State is on track to beat the 2020 target and may have unused allowances. Some believe those unused allowances may hinder our ability to achieve the 2030 target.

   As you note, there have been several analyses that have looked at this issue. However, each has their limitations, while there are others that indicate there is no oversupply when we look long term, or oversupply is not the right lens when looking at Program performance. Importantly, AB 398 (E. Garcia, Chapter 135, Statutes of 2017) directs CARB to look at this issue. And, we plan to do that over this year as part of our public process for amending the Cap-and-Trade Regulation to reflect the direction in AB 398.

[5] https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/lcfs_meetings.htm

Some believe we are ahead of schedule because businesses took early action by reducing emissions and should not be penalized for doing so. Others believe that unused allowances should be removed from the system regardless of the impact on the economy and fuel and energy costs for consumers, even if costs increase today.

While CARB has no public analyses to share at this time, we have some preliminary thoughts. Many analyses don't note that the price per allowance is critical to ensure actions are taken to reduce emissions. They also do not acknowledge that most of the current allowances are held in the State's accounts and not in businesses' accounts[6]. As long as allowances are in our accounts, one cannot emit against that allowance. Further, the analyses make assumptions about how many allowances are actually banked by covered businesses in the Program. Many businesses in the Program cannot spend significant capital to buy and hold allowances for the future. Even if an entity were to tie up their capital, the Cap and Trade regulation limits stockpiling under the existing holding limits. While there is a connection between supply and demand and prices for allowances, none of the analyses reflect the new direction in AB 398. The legislation includes considerable direction on the treatment of allowances with different price containment points, which will require careful analysis with opportunities for public process and input over the coming months.

CARB will evaluate the concerns expressed around demand versus supply and how the carbon price should be structured across the price containment points to ensure there is sufficient incentive to reduce GHGs, while not unduly raising allowance prices, which may translate to increased costs for consumers. We already know at current allowance prices, actions are being taken to reduce GHGs, even though emissions are below the caps.

A refined approach should be considered to shape the program to meet multiple objectives and concerns. And, AB 398 provides direction on many of these objectives, including reducing emissions while minimizing leakage and costs to consumers.

6. The Scoping Plan does not contain any explicit analysis of what cap-and-trade market prices are required to deliver the reductions ARB calls for from the cap-and-trade program. Appendix E provides some discussion, but provides no

[6] https://www.arb.ca.gov/cc/capandtrade/complianceinstrumentreport.xlsx

basis for the assumptions ARB makes about market prices and specifically disclaims that these assumptions "should not be used as a forecast of emission responses to allowance prices." What market prices does ARB think will be necessary to achieve the role ARB established for the cap-and-trade program in the Scoping Plan? On what basis does ARB make such an analysis? Please provide the "Uncertainty Analysis Tool" used to create the figures and analysis in Appendix E2.

Response: In the development of the recent Scoping Plan, CARB modeled a range of prices for the Cap-and-Trade Program; specifically, the floor price and top strategic reserve price were used as the bookend values for allowances. As many economists and experts have previously noted, it is very difficult to identify the exact price for carbon that will result in an exact quantity of emissions reductions. This is one of the biggest challenges with a carbon tax — you don't know where to appropriately set the tax so as not to miss the target or achieve the target at a higher cost than necessary — and this is one of the biggest advantages of a Cap-and-Trade Program — we do not need an exact price and we can allow the market to find the lowest-cost reductions first. Today's allowance prices, as incorporated into the electricity dispatch models are already reducing GHG emissions. And an escalating price signal that keeps up with inflation is needed to ensure the carbon price signal is not muted over time.

CARB did perform an uncertainty analysis of the Scoping Plan and the tool for that analysis was posted to our website on the Scoping Plan page in December[7]. The analysis found that portfolio of measures in the 2017 Scoping Plan has the highest certainty of achieving the SB 32 2030 target.

7. Among other things, the Scoping Plan discusses, as required by AB 398 (E. Garcia, Chapter 135, Statutes of 2017), the Social Cost of Carbon and Methane, the 2020 APCR price level, minimum auction prices, and the cost per MMTC02e to achieve the SB 32 goal. What is the minimum or maximum price the Legislature can expect that the ceiling will not be set beneath or above? How does a hard price ceiling impact California's current program linkages? What input has ARB solicited from our current partners about the price ceiling required in order to preserve the current linkages?

[7] https://www.arb.ca.gov/cc/scopingplan/uncertainty_analysis_nov2017.xlsx

Response: AB 398 includes several factors that CARB is required to consider when setting the price ceiling. Some of those factors include the social cost of carbon and the existing strategic reserve price tiers. This will be the subject of public process and input- however it is important to note that CARB does not foresee setting a price ceiling in 2021 below the current lower tier of the strategic reserve in 2020 – which would be about $60. Based on the uncertainty analysis conducted for the 2017 Scoping Plan Update[8], a price lower than the current Allowance Price Containment Reserve could reduce our certainty of achieving the 2030 target.

Another aspect of including and setting the price ceiling is our linkage with the Quebec and Ontario Programs — which provides further benefits through market liquidity and greater GHG reductions through collaborative climate change mitigation efforts. Due to the nature of linkage, any price ceiling we set will create an indirect ceiling on prices in the linked jurisdictions programs. For this reason, there must be close collaboration to ensure the price ceiling set here does not inadvertently erode the ability of linked programs to also achieve their own targets and jeopardize linkage. Because where California sets the price ceiling will impact the stringency of their programs, both Ontario and Quebec have expressed a strong interest in working closely with CARB as we work through the public process to develop proposals for a price ceiling.

8. The Scoping Plan refers to a "firm, declining cap" in the cap-and-trade program and a "strict overall emissions limit that decreases each year", but AB 398 instructs ARB to create a hard price ceiling for the cap-and-trade program and, if allowances are sold through that ceiling mechanism, obtain ton-for-ton emissions reductions to cancel out the emissions above the ceiling. What does ARB think would be the source of those ton-for-ton reductions? What impact would these price ceiling sales and corresponding ton-for-ton reductions have on California's GHG inventory? Under what circumstances does ARB believe these corresponding ton-for-ton reductions would contribute to complying with the SB 32 target for 2030?

    Response: How a price-ceiling is set, is critical in this Program. We will want to ensure there is little chance of breaching the price ceiling feature, which, if poorly designed and breached could create the risk of exceeding our 2030 GHG target. Another challenge in implementing the price ceiling is ensuring

[8] https://www.arb.ca.gov/cc/scopingplan/2030sp_appe_econ_final.pdf

environmental integrity if emissions exceed our caps. In other words, we need to ensure excess GHG emissions beyond our caps are offset by reduced emissions elsewhere. We would need to find other GHG reductions on a ton-per-ton basis to compensate for all excess emissions beyond our caps. This means looking for reductions outside of the covered sectors and most likely includes reductions associated with natural and working lands, such as enhanced sequestration in forestry, and range and agricultural lands. In short, our efforts on setting a price ceiling will be focused on balancing the need to maintain a sufficient carbon price signal for investment in technology and research to ensure we achieve our 2030 target, while ensuring we can minimize leakage and cost impacts to residents.

9. If the cap-and-trade program continues to experience oversupply conditions for several more years, many experts expect that market prices are likely to remain relatively low. However, the declining program caps could eventually lead to a scarcity of allowances in the mid-2020s, with relatively high carbon prices. Please describe how ARB expects the transition to unfold from a market with extra allowances to one with a scarcity of allowances, and how will the choices ARB makes in implementing AB 398 affect both the price signal the program sends to reduce emissions in the near-term as well as the program's ability to close the gap between measures identified in ARB's Scoping Plan and the SB 32 target?

    Response: CARB expects a smooth transition due to cost-containment features that already exist in the program and the new features included in AB 398. One key feature of the Cap-and-Trade Program is the ability for businesses to reduce emissions early and 'bank' those allowances for future use. This can significantly lower the cost of meeting emissions limits by providing temporal flexibility and encouraging early action. Banking allows businesses to plan and appropriately manage their costs for the Cap-and-Trade program through limited hedging up to the holding limits. The continued use of banking, carefully designed price containment tiers as required by AB 398, allocation to minimize leakage, a steadily escalating auction floor price, and sufficient offset supply should provide for a smooth carbon price trajectory through 2030.

10. As the Scoping Plan has moved through several drafts, the expected emissions reductions from direct reduction policies like the Short-Lived Climate Pollutant program, Zero-Emission Vehicles, etc. have remained fairly constant. The cumulative amount of GHG emissions reductions expected from the cap-and-

trade program, on the other hand, has fluctuated drastically over the last year: from 191 MMTC0 2e to 296 MMTC02e, and was finally determined to be 236 MMTC0 2e. Please explain and justify the drastic changes in these projections.

Response: As the Scoping Plan took over two years to develop[9], CARB updated modeling assumptions over time as new information became available. This was to help ensure the most recent data was used in the final plan. We also received legislative direction that warranted changes to the final Scoping Plan, such as removing the refinery measure. Other notable changes included a reduction in the reference scenario once additional coal divestitures were fully reflected. In consultation with the State's energy agencies, the reference scenario with respect to Renewable Portfolio Standard performance was changed to reflect over-performance of that policy. And, per AB 398 we removed the refinery measure, which results in the Cap-and-Trade Program making up the reductions that were previously attributed to that measure. In the final Scoping Plan, CARB also found that we needed fewer reductions to achieve the 2030 target than originally modeled; the Renewable Portfolio Standard increased from 40 percent to 50 percent between 2020 and 2030 and would contribute less to the total reductions needed, and that the Cap-and-Trade Program needed to increase in its role to account for the refinery measure. This is all detailed in the modeling output files and supporting documentation that was posted to CARB's website[10].

11. AB 398 extends the cap-and-trade program as a part of California's overall GHG emissions reductions efforts post 2020. Part of the design for the post-2020 cap-and-trade program was setting the initial industry assistance factors to the same level as the 2015-2017 compliance period. Notably, AB 398 did not make any such changes to the current cap-and-trade program and its implementation through the end of 2020, but ARB has proposed to adjust the assistance factors for the third compliance period of the current cap-and-trade program nonetheless. Given the lack of statutory direction for such an action, why has ARB proposed this change and how does ARB's reasoning for the proposed change relate to its statutory authority to design the cap-and-trade program to minimize leakage?

[9] https://www.arb.ca.gov/cc/scopingplan/meetings/meetings.htm
[10] Ibid

Response: AB 32 and AB 398 require that CARB minimize leakage. In this context, leakage refers to the relocation of emissions, jobs, and production outside of the State in response to the Cap-and-Trade. Allocation to industry is to mitigate against leakage. Assistance factors are one of several factors used in allocation to industry for leakage prevention. With AB 398 setting the assistance factors at 100 percent from 2021 through 2025, with data that shows we are on track to achieve the 2020 target early, and the much deeper reductions needed in the next decade, staff believes a smooth allocation path between 2017 and 2021 is the most conservative path to protect against emissions leakage, enable earlier investments in onsite equipment upgrades, and allow for economic growth.

Importantly, a 100 percent assistance factor does not mean businesses get all the allowances they need to comply with the Program—they still need to reduce onsite or seek out additional allowances. By 2030, businesses will receive about half of the allowances they receive today as the allocation continues to drop each year at the same rate as the overall caps in the Program[11]. Between 2021 and 2030, the cap decline rate is almost double what it is today.

For background, when the Program was initially designed, assistance factors were set at 100 percent and were proposed to drop each compliance period as there was an expectation for carbon pricing or carbon regulations to phase-in in other regions. The Board directed staff to continue to evaluate this issue and new studies and ongoing engagement, with public process, have been underway at CARB since 2016[12]. As this work was going to continue during the second compliance period, in the abundance of caution, the Board kept assistance factors at 100 percent for the second compliance period. Staff has continued to evaluate data from focused studies and continues to discuss this with each industrial sector as part of developing proposals for assistance factors for the third compliance period. Importantly, we have yet to see the expansive use of carbon pricing or other GHG regulations, consequently the leakage risk has not changed significantly since the beginning of this Program. Moving forward, we are hopeful actions under the Paris Agreement will help increase the use of regional policies aimed at addressing GHGs, which would mean that California industry and their competitors in other regions will face similar requirements.

[11] https://www.arb.ca.gov/cc/capandtrade/meetings/20171012/ct_presentation_11oct2017.pdf (slides 10-12)
[12] https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm (May 2016)

CARB's early estimates indicate that a change in the assistance factors to 100 percent in the third compliance period would result in providing approximately 2-3 percent of the 1 billion allowances available in 2018 through 2020. We believe the impact on GGRF will be fairly small, which has to be carefully weighed against the possibility of leakage.

12. Recently ARB lost a lawsuit in bankruptcy court against the La Paloma Generating Company. Ultimately, the affected facility's outstanding compliance obligation under the cap-and-trade program was discharged in bankruptcy and the successor company will not be liable for surrendering compliance instruments for these discharged liabilities. Given the case's outcome and the potential for future bankruptcy proceedings involving large GHG emitters covered under the cap-and-trade program, how does ARB intend to ensure the GHG emissions reductions required to maintain the environmental integrity of the cap-and-trade program? What measure is ARB putting in place to ensure a similar situation cannot occur in the future?

    Response: On November 9, 2017, a Bankruptcy Court in Delaware held that the new owner of the La Paloma Generating Station, a covered source in California's Cap-and-Trade Program, did not assume any obligation for emissions that occurred at the source prior to the bankruptcy sale. The Court also found that CARB could expressly create such liability in a future regulation amendment. On November 20, 2017, CARB appealed the court's decision. CARB's long-standing interpretation of the Cap-and-Trade Regulation is that the regulation as a whole requires a new owner of an emissions source to assume any outstanding obligation that occurred prior to the change in ownership.

    Even while appealing the decision, CARB will commence a narrow rulemaking to expressly clarify that a successor entity after a change of ownership is responsible for any outstanding, pre-sale compliance obligation of the predecessor entity. We expect this rulemaking will conclude in mid-2018. In the specific La Paloma case, if CARB is unsuccessful on appeal, we will ensure environmental integrity in the program through the retirement of allowances equivalent to any outstanding emissions associated with this particular situation.

13. What is the process for ARB to work with, and the scope of, the Independent Emissions Market Advisory Committee?

Response: This committee is designated in statute to "evaluate the economic and environmental performance of the Cap-and-Trade Program and other climate policies.[13]" The committee, when formed, will include representation from the Governor's Office, Senate, Assembly, and Legislative Analyst's Office. The group is to be convened by the California Environmental Protection Agency to provide an external and independent review of CARB's programs and may choose to provide recommendations as part of that review. As the committee works through its charge, CARB staff will make themselves available to discuss our climate programs as needed.

14. AB 398 defines "direct environmental benefits in the state" 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." Given that, how does ARB intend to apply the requirement that compliance obligation under cap-and-trade post-2020 may "be met by surrendering offset credits of which no more than one-half may be sourced from projects that do not provide direct environmental benefits in state"? Does ARB interpret the statute to mean that for every offset surrendered that does not provide a direct environmental benefit in the state that one more must be surrendered that does provide a direct environmental benefit in the state? Or does ARB interpret statute to mean that a covered entity could surrender offsets totaling half of the allowable limit, all of which provide no direct environmental benefit in the state?

Response: Offsets are an important cost-containment feature in the Program which allows covered businesses to purchase reductions from sectors not covered by the program. AB 398 provides direction on offset usage limits and sets aside half of the limit to be only met through offsets that provide direct environmental benefits to the State. This criterion is to ensure a significant volume of offsets is generated in state and those co-benefits are realized in state. CARB has received considerable public comment on this provision and how to interpret how the 50 percent requirement applies[14]. For this to be a successful cost-containment feature in the Program, maximum flexibility will be important. AB 398 also includes a reduction in the offset usage limits which is expected to already reduce how many offsets from outside of the State can be used in the Program. CARB will be working

[13] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398 (Section 38591.2)
[14] https://www.arb.ca.gov/lispub/comm2/bccommlog.php?listname=ctoct122017wkshp-ws

through the public process to design this feature over the next year to propose language in response to the direction in AB 398.

While GHG reductions anywhere are a benefit everywhere when considering climate change, it is important to note that direct environmental benefits may take different forms and may differ by project type. For example, ozone depleting substances projects support job creation and utility rebate programs in State through the decommissioning of old refrigerators and destroying the high global warming potential refrigerant gases in the appliances. However, the destruction facilities for the gases are not located in California and the material is sent to other states that have allowed for the permitting of those destruction facilities. In this situation, the State benefits from avoided potent greenhouse gases from leaking from the old refrigerators and in- state job creation; however, the ultimate destruction of the gases occurs outside the State to ensure these gases are never released into the air. This is just one example of the types of questions CARB will need to engage in with stakeholders as part of the public process, in implementing the direction in AB 398.

15. The Scoping Plan contains assumptions about Legislative behavior, both policy and fiscal, as well as technological advances:

    a. The Scoping Plan assumes that cap-and-trade auction revenues will be deposited into the Greenhouse Gas Reduction Fund (GGRF) and will be used to further the purposes of AB 32 and facilitate reduction of GHG emissions. However, neither ARB nor the current Legislature can bind the spending decisions of a future Legislature, and a future Legislature may choose to spend cap-and-trade auction revenues differently. How does ARB plan to meet its targets if GGRF expenditure does not match the expectations in the Scoping Plan?

       Response: The California Climate Investments (CCI) ensure that all Californians benefit from the state's climate program, including those who live in disadvantaged communities and in low-income households[15]. In the context of the programs that CARB administers, CCI has been used to provide expanded access to clean transportation options like new technology cars, and expanded transit availability in a way that increases equity for these communities. Across other implementing agencies, CCI also funds home

[15] http://www.caclimateinvestments.ca.gov/

weatherization projects for low-income households and urban forestry and greening projects. CCI ensures greater equity in distribution of climate benefits, and helps us make progress toward our goals through some demand side reductions for energy and fuels, but the cap in the Cap-and-Trade Program applies regardless. If the expenditures are re-directed to other types of projects, covered businesses, including utilities, fuel suppliers, and industry will need to do more to meet the targets.

b. The Scoping Plan also assumes more than a 45% decrease in fossil fuel demand for transportation by 2030, which seems overly ambitious. Given the uncertainty regarding federal fuel economy standards and the need for waivers to expand many state programs, how is this assumption justified?

   Response: The transportation sector accounts for 50 percent of the State's GHG emissions; correspondingly, the 45 percent decrease in fossil fuel demand by 2030 modeled in the Scoping Plan is largely built on our existing new vehicle standards and programs under our control – like innovative clean transit and other in-use programs. CARB would vigorously fight any attempt to restrict our ability to set GHG standards. If we ultimately lost, it would imperil our ability to meet the air quality and GHG targets. We would have to make up the reductions through new programs aimed at the transportation sector– as well as emission reductions from other sectors, as necessary. Losing these standards would also drastically impair our ability to continue to make progress on criteria and toxics emissions from this sector.

c. Grid regionalization is another assumption in the Scoping Plan that requires action by the Legislatures and Governors of several states. How does ARB plan to respond if regionalization does not occur in the way assumed by the Scoping Plan?

   Response: For the electricity sector, CARB did not rely on regionalization to help ensure we meet the SB 350 (De Leon, Chapter 547, Statutes of 2015) renewable energy target of 50% by 2030.

d. Zero Net Energy policies for buildings have been determined by the Legislative Analyst's Office to be overly expensive and not effective in reducing GHG emissions. What is ARB's justification for these and other assumptions made in the Scoping Plan, and what will ARB do to ensure compliance with the SB 32 cap if these assumptions turn out to be false?

Response: CARB did not rely on Zero Net Energy policies to achieve the 2030 target in the Scoping Plan. It is identified as a policy that warrants further evaluation and research, and has the potential to help achieve our long-term climate goals. For CARB, it's not just theoretical, our new laboratory under development in Southern California will be a Zero Net Energy facility. Zero Net Energy buildings have grown in both the private and public sector. In California, there exist about a dozen Zero Net Energy buildings developed and operated by both private and public entities[16].

16. In the 2008 Scoping Plan, ARB estimated future GHG emissions. We now know that while certain conditions like the drought and unexpected shutdown of the San Onofre Nuclear Generating Station increased emissions above what was expected, the recession caused GHG emissions to fall far below what was expected. We understand that forecasting is an inexact science, but in order to avoid repeating previous mistakes, has ARB performed any retrospective analyses on previous Scoping Plans to determine where the modeling and assumptions in those plans have not been accurate, where programs in those plans have under- or over-performed on GHG emissions reductions, and where there may be any systematic biases or patterns where such forecasts turned out to be incorrect? And if so, how are these analyses made available to the Legislature and public for review and comment? Does ARB have, or plan to develop, any public mechanisms to track implementation of the 2030 Scoping Plan going forward?

    Response: Many of the measures in the first Scoping Plan have their own trackable metrics, in addition to the annual change in aggregate GHGs – against which CARB tracks progress towards the State's climate targets. The data shows that the initial Scoping Plan and the approach of a mix of prescriptive, incentive, and market mechanism policies was the right choice as the State is on track to achieve the 2020 target early, all while the economy has grown. In the initial Scoping Plan, we estimated program performance based on the information available at the time. Subsequently the lower costs and faster deployment of clean technologies far outpaced those early expectations.

[16] https://newbuildings.org/wp-content/uploads/2016/10/GTZ_2016_List.pdf

After discussions with the economic reviewers for the most recent Scoping Plan Update, CARB conducted an uncertainty analysis that let us consider the impact of uncertainty across three metrics - the cost of emission reductions, the amount of reductions that can be achieved, and future economic conditions (business as usual).

As noted previously, data, including annual GHG inventory is made publically available, metrics are included in the latest Scoping Plan Update, and a number of opportunities for oversight and review exist as shown in the attachment.

With recent legislation, in addition to the information state agencies make available, there are additional opportunities for reviewing the economic and environmental performance of the Scoping Plan in aggregate and individual measures. AB 398 calls for an independent emissions advisory committee to report annually on the economic and environmental performance of Cap-and-Trade, and other related climate policies. AB 398 also calls for the Legislative Analyst's Office to annually report to the legislature on the economic impacts and benefits of specified greenhouse gas targets.

17. Given that California only emits around 1% of global GHGs, it has been said that the point of our climate policies is to create a model that can be exportable. Given the abundance of expertise in California, at ARB and other state agencies, as well as the general wealth of the state, how can our model be replicated by more conservative and/or less wealthy jurisdictions, particularly in developing countries?

Response: California's biggest impact is our leadership through the thoughtful design and successful implementation of climate policies that result in reductions in GHGs, improved public health, and economic growth. We have a working model that includes regulations, incentives, and market-based programs that has been proven to reduce emissions while maintaining a strong and growing economy. There is a tremendous interest in our programs and policies by other governments – both developed and developing.

For developing countries, we can help through capacity building so that the political and technical experts in those regions hear that many of the questions and concerns they have, were the same ones we had as we embarked on our efforts over a decade ago. We can help foster dialogue between our industry and their industry on emissions reductions technologies and strategies.

Not all of what we have done may relate directly to other regions whose emissions sources or economies are different, but we also have foundational knowledge that is important for any effort to address GHGs—such as GHG inventory and GHG reporting programs.

On a practical level, we benefit when programs similar to ours are adopted by other jurisdictions. Cleaner vehicles and fuels help improve their local air quality, which sometimes impacts our air quality — pollutant transport from Mexico and China. Further, as other jurisdictions adopt standards for clean vehicles or renewable electricity, the result is larger markets for these technologies which helps reduce costs through economies of scale and creates new business opportunities.

During a time when little is happening at the federal level, we have the opportunity and, in particular, the responsibility to help where we each can.

JOINT LEGISLATIVE COMMITTEE ON CLIMATE CHANGE POLICIES

ASSEMBLYMEMBER EDUARDO GARCIA, CHAIR
SENATOR HENRY STERN, VICE CHAIR

INFORMATIONAL HEARING:

CAP AND TRADE
MAY 24, 2018
9:30-11:30AM
STATE CAPITOL ROOM 437

BACKGROUND ON CAP AND TRADE

The Global Warming Solutions Act of 2006 (AB 32, Núñez/Pavley) authorized the State Air Resources Board (ARB) to utilize market-based compliance mechanisms to meet the 2020 target. ARB identified cap and trade as that mechanism in the first Scoping Plan in 2008, and completed the regulatory process to establish the program in 2010.

Under the current Cap-and-Trade Program, covered sectors are given a limit on how much they can pollute (the "cap"). An "allowance" is the amount of permissible pollution from covered entities. One allowance is one metric ton of carbon dioxide equivalent. ARB issues allowances equal to the cap, and decreases the supply of allowances by 3% annually. ARB allocates free allowances to entities in sectors that need to prevent leakage, assistance with transition, or to manage consumer costs. Covered entities are allowed to buy additional credits through quarterly, ARB-managed auctions. The first auction occurred on November 14, 2012. The proceeds from those auctions are deposited into the Greenhouse Gas Reduction Fund. As of August 2017 the Legislature has appropriated $6.1 billion from the state's Greenhouse Gas Reduction Fund.

ARB pulls out a small amount of allowances under the cap into the "Allowance Price Containment Reserve" (APCR) as a cost containment mechanism when allowance prices are high or are expected to be high in the future. Increasing the supply of allowances available for sale will reduce the cost of each allowance to participating entities. A price floor, otherwise known as the Auction Reserve Price, is the minimum price that can be paid for an allowance at ARB's quarterly auctions. ARB's price floor at the first auction in November 2012 began at $10 per metric ton. The price floor is increased 5% each year (plus inflation). The current price floor is $14.53 per metric ton.

Covered entities can also trade allowances though a secondary market outside of ARB's auction or bank allowances to protect against shortages or higher prices in the future. There are limits to how many allowances a covered or voluntary entity can bank for future use. Covered entities can also purchase offset credits to be used for up to 8% of their compliance obligation. An offset credit, like an allowance, represents one metric ton of carbon dioxide equivalent. Offsets are generated by emissions-reducing or carbon-sequestering activities not covered by the Cap-and-Trade Program. Revenue for offsets goes toward the eligible projects, and is not a part of the Greenhouse Gas Reduction Fund.

IMPLEMENTATION OF AB 398

AB 398 (E. Garcia, 2017) authorized ARB to continue the Cap-and-Trade Program until 2030 with several key changes to the way the program operates post-2020:

- Establish a price ceiling and two price containment points
- Evaluate and address concerns related to overallocation of allowances in the market
- Require no less than half of all offset credits surrendered to deliver "direct environmental benefit" and lower the percentage of the entire compliance obligation that can be met with offset credits to 4% between 2021-2025 and 6% between 2026-2030
- Increase industry assistance factors
- Establish allowance banking rules
- Establish the Compliance Offsets Protocol Task Force
- Finalize the 2030 Target Scoping Plan by January 1, 2018

AB 398 further directed the California Environmental Protection Agency to convene an Independent Emissions Market Advisory Committee to report on the environmental and economic performance of the regulation and other relevant climate policies.

ARB adopted the 2030 Target Scoping Plan on December 14, 2017. The Plan identified that 236 million metric tons of carbon dioxide equivalent (MMTCO2e) of the cumulative reductions needed to achieve the 2030 target would come from the Cap-and-Trade Program. Analyzed another way, the Cap-and-Trade Program will account for 46.5% or 60 MMTCO2e of the annual reductions needed in 2030 to reach the mandate established by SB 32 (Pavley, 2016) – the most reductions California has put on the program since it was established.

ARB has conducted nine public workshops on the post-2020 program since 2016, recently releasing a preliminary discussion draft and two other discussion documents detailing staff considerations for AB 398 implementation.[1] While several issues have been covered in those documents and workshop discussions, this hearing will focus on potential allowance oversupply and defining "direct environmental benefit" related to offset usage post-2020.

ALLOWANCE OVERSUPPLY

When ARB developed the first cap and trade regulation in 2010, staff and stakeholders engaged in a robust discussion about setting the cap to ensure an appropriate level of market stringency. Referenced in Appendix E: Setting the Program Emissions Cap,[2] ARB staff outlined their final approach to striking the right balance between setting the cap too high (resulting in low costs and potentially insufficient emissions reductions) and setting the cap too low (resulting in higher costs for compliance). High costs after 2020 are designed to be contained within California's program by two price containment points and a price ceiling pursuant to AB 398, making the discussion about revisions to the cap for the 2030 target a distinct policy discussion about market stringency and the ability of California to meet our ambitious climate targets.

[1] California Air Resources Board, "Cap-and-Trade Regulation Public Meetings," available at https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm

[2] California Air Resources Board, "Appendix E: Setting the Program Emissions Cap," available at https://www.arb.ca.gov/regact/2010/capandtrade10/capv3appe.pdf

In 2010, ARB staff used mandated reporting data to calculate historic emissions trends from covered sectors, and then projected that historical trend forward to establish the business as usual scenario. The staff analysis referenced the over-allocation issue in the European Union's emissions trading scheme, citing the lack of accurate emissions data as a key reason the covered emissions were overestimated and too many allowances were issued in that program. As ARB stated in their 2010 analysis:

> *In 2007. ARB put in place a mandatory reporting program to provide accurate greenhouse gas emissions data for the sources that will be covered in the first compliance period of the cap-and-trade program. The data gathered through this program will help ensure that the over-allocation issue is not repeated in the California context.*[3]

In 2018, however, staff is using the PATHWAYS model to estimate covered emissions by subtracting the projected emissions of the known commitments from the business as usual scenario for 2021-2030. External analysis replicated the process ARB used in 2010 and found that the business as usual estimate ARB is currently using is approximately 34.8 MMT higher each year than the mandated reporting data would indicate; that annual difference could result in 277 MMT cumulatively between 2021 and 2030.[4]

Further analysis from ARB assumes that the current rate of offset usage (approximately 4% of the compliance obligation) continues until 2030 and that the price containment points and price ceiling are not reached (thus not releasing the additional allowances reserved for those mechanisms). Through that analysis, ARB concludes that – even with a potential 150 MMT allowances in oversupply, which is a conservative estimate when compared to the conclusions of external groups – that the program would achieve its share of the 2030 target. Corrections to ARB's estimate of covered emissions described above, however, show that the program may not achieve the 236 MMT of cumulative emissions reductions called for in the 2030 Target Scoping Plan. Further, no staff analysis has been done on what impacts the combined use of those price containment mechanisms, banking, projected allowance oversupply, and offset credits could have on the annual target set in SB 32.

Table 1: Correction to ARB's Cumulative Overallocation Analysis, 2021-2030

	Case A (MMT)	**Case B (MMT)**
Covered emissions without Program (ARB projection)	3,054	3,054
Correction to covered emissions estimate (Near Zero projection)	-277	-277
Corrected covered emissions without Program	**2,777**	**2,777**
Post-2020 allowances (without reserve – ARB projection)	2,532	2,532
Unused allowances at end of 2020 (ARB projection)	0	150
Offset credit usage (ARB projection)	96	103
Total compliance instruments (ARB projection)	2,628	2,785
Cumulative reductions from Cap-and-Trade Program	**149**	**-8**

Source: http://www.nearzero.org/wp/2018/05/07/ready-fire-aim-arbs-overallocation-report-misses-its-target/

AB 398, at Health and Safety Code Section 38562(c)(2)(D), requires ARB to "evaluate and address concerns related to over-allocation" of allowances. A number of groups – including Energy Innovation,[5]

[3] California Air Resources Board, "Appendix E: Setting the Program Emissions Cap," available at https://www.arb.ca.gov/regact/2010/capandtrade10/capv3appe.pdf; quote from page E-8
[4] Near Zero, "Ready, fire, aim: ARB's overallocation report misses its target," available at http://www.nearzero.org/wp/2018/05/07/ready-fire-aim-arbs-overallocation-report-misses-its-target/
[5] Energy Innovation, "Oversupply Grows in the Western Climate Initiative Carbon Market: An adjustment for current oversupply is needed to ensure the program will achieve its 2030 target," available at http://energyinnovation.org/wp-content/uploads/2018/02/WCI-oversupply-grows-February-update.pdf

the independent Environmental Commissioner of Ontario,[6] and the Legislative Analyst's Office[7] – have concluded that the issue of allowance oversupply is significant and should be addressed.

While ARB has stated that removing allowances or lowering the cap to account for additional allowances would penalize entities who did more than was necessary to reduce emissions by raising the costs of compliance, other carbon markets adjust the cap in their programs to account for banked allowances. The Regional Greenhouse Gas Initiative (RGGI) covering Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont includes two interim adjustments to the program's cap to account for banked allowances accumulated in the first and second compliance periods.[8] The European Union's emissions trading scheme is also proposing to adjust the number of allowances available at auction in an effort to address market imbalance.[9] Further, while California is on track to reach the 2020 emissions target established per AB 32, reductions so far are largely believed to be attributed to the economic decline that started in 2008 and on decarbonizing efforts in the electricity sector – not necessarily to actions related to compliance with the Cap-and-Trade Program.

DEFINING "DIRECT ENVIRONMENTAL BENEFIT"

There are currently six categories of offsets: Ozone Depleting Substances Projects (ODS), Livestock Projects, U.S. Forest Projects, Urban Forest Projects, Mine Methane Capture Projects (MMC), and Rice Cultivation Projects. All eligible offsets projects must be implemented to the standards of Board-approved protocols with annual reporting and third-party verification. ARB does not set prices for offsets or sell them directly; all offset pricing and trading is done through bilateral contracts between regulated entities.

Table 2: ARB Offsets Credits Issued (as of May 9, 2018)

Project Type	ODS	Livestock	U.S. Forest	Urban Forest	MMC	Rice Cultivation
Compliance	10,349,937	2,916,061	72,240,465	--	2,203,737	--
Early Action	6,336,710	1,695,029	13,276,494	--	2,879,684	--

Source: https://www.arb.ca.gov/cc/capandtrade/offsets/offsets.htm

AB 398, at Health and Safety Code Section 38562(c)(2)(E), requires that no more than half of the offsets used in the post-2020 period come from projects that do not create a direct environmental benefit in California. The statute defined "direct environmental benefits" 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." AB 398 further directed ARB to work with the Compliance Offsets Protocol Task Force to develop approaches to increase offset projects in the state.

In their most recent documents, ARB is proposing that any project in the state automatically qualify as a direct environmental benefit, regardless of whether there is a benefit outside of reductions in greenhouse gases. For projects located outside of the state, ARB staff is proposing to allow project developers to propose their own criteria and standards to justify if a direct environmental benefit exists; ARB staff has

[6] Environmental Commissioner of Ontario, "Ontario's Climate Act: From Plan to Progress," available at https://eco.on.ca/reports/2017-from-plan-to-progress/

[7] Legislative Analyst's Office, "Cap-and-Trade Extension: Issues for Legislative Oversight," available at http://lao.ca.gov/Publications/Report/3719

[8] The Regional Greenhouse Gas Initiative, more information available at https://www.rggi.org/program-overview-and-design/elements

[9] European Union Emissions Trading System, "Market Stability Reserve," more information available at https://ec.europa.eu/clima/policies/ets/reform_en

not proposed any limits to this process and have not ruled out the possibility that an offset project might claim to establish a direct environmental benefit solely based on the greenhouse gas reductions it generates onsite. Offset projects do not generate net greenhouse gas reductions because project-level gains are zeroed out when regulated companies use the associated offset credits to increase their own emissions, resulting in no direct environmental benefit outside of potential air quality or water quality impacts.

Materials posted for the April 26, 2018 workshop showed that ARB staff was considering allowing all offset credits issued before the passage of AB 398 to be considered as direct environmental benefits. This proposal is in response to some stakeholder concerns that investments in credits that they planned to use for compliance after 2020 might not be able to be used to the extent that was anticipated. However, until AB 398 was signed into law ARB did not have authority to carry forward the Cap-and-Trade Program to 2030, so any private investments in offset credits were made without direction from ARB or the Legislature. Previously issued credits that do not earn a direct environmental benefit certification once the regulation is finalized can still be used for compliance purposes in the program, but compliance entities may have to secure additional credits that meet the definition of direct environmental benefit to meet the requirements of AB 398.

DISCUSSION QUESTIONS

ARB plans to bring the 2021-2030 regulation before the Board before the end of the year. This hearing is an opportunity to understand what key questions ARB and stakeholders are working to answer regarding allowance oversupply and "direct environmental benefit," and to discuss potential considerations to inform the regulatory process as it progresses. Since this is an ongoing regulatory process ARB will not be able to commit to any outcomes in the final regulation at this time.

Potential questions for the panel:

a) What evidence exists that the Cap-and-Trade Program has reduced emissions to date? Has ARB studied the impact the "Great Recession of 2008" had on statewide emissions?
b) What is ARB's current thinking on the potential oversupply of allowances in the market? How many allowances are in circulation right now? What external studies has ARB consulted in the staff analysis of this issue? Why does the current cap setting analysis differ from the analyses done in 2010?
c) What are your thoughts on defining "direct environmental benefit" for offsets? How can the state account for the compliance credits issued when determining any additional "benefit" to California communities? How should pre-2021 offsets be processed into this new system?

LAO
LEGISLATIVE ANALYST'S OFFICE

May 24, 2018

Cap-and-Trade Extension: Issues for Legislative Oversight

LEGISLATIVE ANALYST'S OFFICE

Presented to:
Joint Legislative Committee on Climate Change Policies
Hon. Eduardo Garcia, Chair

LAO
LEGISLATIVE ANALYST'S OFFICE

Background

☑ **State Greenhouse Gas (GHG) Goals and Policies**

- The Global Warming Solutions Act of 2006 (Chapter 488 [AB 32, Núñez/Pavley] established a statewide GHG emissions limit of 1990 levels by 2020. Chapter 249 of 2016 (SB 32, Pavley) established a GHG limit of at least 40 percent below 1990 levels by 2030.
- 2017 Scoping Plan Update developed by the California Air Resources Board (CARB) includes a variety of policies to meet 2030 targets, including a 50 percent renewable portfolio standard, a low carbon fuel standard, energy efficiency, and cap-and-trade.

☑ **Chapter 135 of 2017 (AB 398, E. Garcia) Extended Cap-and-Trade From 2020 to 2030.**

- Provides new direction regarding certain cap-and-trade design features, but significant discretion on key implementation decisions left to CARB.

☑ **CARB Held Informal Workshops on AB 398 Implementation in Early 2018.**

- CARB staff presented initial thinking on various AB 398 implementation issues in March and April workshops.
- Formal regulatory proposals and hearings expected to begin later in 2018.

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Background *(Continued)*

Major Differences Between Current CARB Cap-and-Trade Regulation and AB 398[a]

Design Feature	Current Regulation	AB 398 Extension (2021 Through 2030)
Setting Post-2020 Emissions Caps	Establishes the number of allowances issued each year through 2030.	When setting post-2020 caps, directs CARB to evaluate and address concerns related to a large number of banked allowances.
Banking	No expiration date for allowances; limits on the number of allowances an entity can hold at a time.	Directs CARB to adopt banking rules that "discourage speculation, avoid financial windfalls, and consider impact on complying entities and market volatility."
Price Ceiling	"Soft" price ceiling of about $60 per allowance in 2017, increasing gradually in future years.	Directs CARB to establish "hard" price ceiling and consider various factors when setting the level of ceiling.
Price Containment Points	None.	Directs CARB to establish two price containment points (also known as speed bumps) between the price floor and the price ceiling.
Offset Limits	Maximum of 8 percent of a covered entity's emissions.	Maximum of 4 percent in 2021-2025 and 6 percent in 2026-2030, with no more than half from projects that do not provide direct environmental benefits in California.
Industry Assistance	Different IAFs for high- (100 percent), medium- (75 percent) and low- (50 percent) risk industries from 2018 through 2020; not specified from 2021 through 2030.	100 percent IAFs from 2021 through 2030.

[a] Chapter 135 of 2017 (AB 398, E. Garcia).
CARB = California Air Resources Board and IAF = industry assistance factor.

LAO LEGISLATIVE ANALYST'S OFFICE

Summary of Key Issues for Legislative Oversight

Key Issues for Legislative Oversight

- ✓ **Setting Post-2020 Caps and Banking Rules to Ensure State Meets Its GHG Targets**
- ✓ **Setting Hard Price Ceiling at Level That Balances Emissions and Costs**
- ✓ **Setting Level and Size of Two Price Containment Points to Limit Price Spikes**
- ✓ **Implementing New Offset Limits Consistent With Legislative Intent**
- ✓ **Determining Industry Assistance Factors Through 2020**

GHG = greenhouse gas.

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Setting Post-2020 Caps

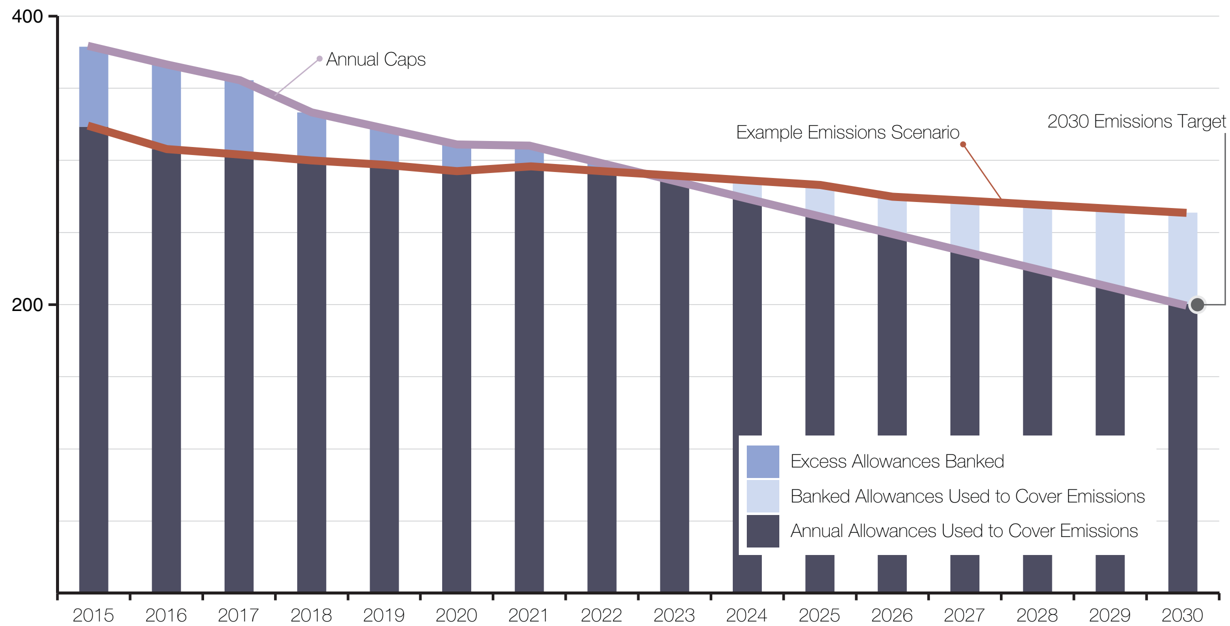
☑ CARB Estimates 150 Million Allowances Could Be Banked Into Post-2020 Program

- Last year, we estimated that 100 million to 300 million California allowances could be banked into the post-2020 program, with the most likely scenario roughly 200 million.
- CARB estimates 150 million California allowances could be carried into the post-2020 program. This amount is based on our office's estimate, plus various downward adjustments for regulatory provisions that we did not incorporate into our prior estimates.
- Most of CARB's adjustments appear reasonable. However, CARB makes no adjustments to account for the lower than estimated emissions in 2016. Based on this new data, our estimate of oversupply increases by a few tens of millions, all else equal.
- Based on these various factors, we continue to think a central estimate of roughly 200 million allowances is reasonable, but the actual amount could be at least several tens of millions higher or lower.

Setting Post-2020 Caps *(Continued)*

Large Number of Banked Allowances Increases Risk of Exceeding GHG Target

Million Metric Tons



GHG = greenhouse gas.

☑ CARB Has Not Described How Program Would Ensure the State Meets Its 2030 GHG Limit

- CARB's 2017 Scoping Plan assumes cap-and-trade will achieve enough emissions reductions—beyond those achieved by other policies—needed to meet the 2030 GHG limit.

- CARB staff estimated how the current program might affect *cumulative* emissions through 2030, but has not provided an analysis on how the program would put the state on track to meet its 2030 *annual* GHG target. We note that there are plausible scenarios where the state could meet the cumulative targets established by CARB, but where emissions are still significantly higher than the Legislature's 2030 annual target.

☑ Consider Directing CARB to Provide Additional Evidence That Current Program Is Consistent With Legislature's 2030 GHG Goals

- The Legislature should consider directing CARB to (1) explain how the current program is likely to put the state on track to meet its annual 2030 limit; (2) evaluate different options for adjustments to address a large number of banked allowances; and (3) establish clear criteria that will be used to make future adjustments, if needed.

- Options to increase the stringency of the program include moving allowances from the regular auctions to: (1) the price ceiling and/or (2) the "speed bumps." These options have a trade-off of putting upward pressure on prices. However, decisions about program caps and allowance supply should be guided primarily by what is needed to meet the state's environmental goals, while concerns about the risks of program costs exceeding acceptable levels should be addressed primarily through setting the price level for the ceiling (discussed below) and speed bumps.

LAO LEGISLATIVE ANALYST'S OFFICE

Setting Level of the Price Ceiling

☑ **CARB Staff Suggests Level of Price Ceiling and First Speed Bump**

- Price ceiling between $82 and $147 (in 2015 Dollars) in 2030.
- Lowest speed bump at $70 or more (in 2015 dollars) in 2021.

☑ **Consider Whether These Price Levels Are Consistent With Legislative Priorities**

- Setting the level of the price ceiling is a policy decision that will depend on how one weighs many different factors, including certainty that targeted emission levels will be achieved and interest in containing costs for businesses and households. Other considerations could include effects on linkages with other jurisdictions and the degree to which different price levels encourage development of new technologies to reduce GHGs in other jurisdictions.
- If the range of price ceilings currently being considered by CARB is inconsistent with how the Legislature weighs these different factors, the Legislature could set the price ceiling in statute or provide additional direction about how to weigh the different factors.

☑ **Consider Price Ceiling When Evaluating Options for Setting Post-2020 Caps**

- It is important to consider that a price ceiling will be part of the post-2020 program when evaluating any potential adjustments related to an oversupply of allowances and setting post-2020 caps (discussed above) because it can help mitigate concerns about risks of high costs.
- The price ceiling is a design feature that is specifically intended to limit price uncertainty and reduce the risk of excessively high program costs.

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Implementing New Limits on Offsets

☑ **Proposed Criteria Used to Determine Offsets That Provide Direct Environmental Benefits (DEBs) in the State Is Unclear**

- AB 398 establishes new limits on the percent of emissions that can be covered by offsets and no more than half of offsets can come from projects that do not provide DEBs in the state. It defines DEBs in the state 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."
- CARB staff is soliciting stakeholder feedback on how to implement the DEBs provision. However, the specific types of projects that would qualify, or criteria that would be used to evaluate the projects, are currently unclear.

☑ **CARB Staff Considering DEBs Interpretation That Appears Inconsistent With Legislative Intent**

- Staff comments at workshops suggest that CARB is considering allowing GHG reductions to qualify as DEBs.
- Since all offset projects are expected to reduce GHGs, such an approach would seem to allow all offsets projects to meet the DEBs requirement. In our view, this approach would be inconsistent with legislative intent to create a distinction between different types of offset projects.

Testimony of Dr. Danny Cullenward
Member, Independent Emissions Market Advisory Committee

Joint Legislative Committee on Climate Change Policies
Hon. Eduardo Garcia (Chair) & Sen. Henry Stern (Vice Chair)

May 24, 2018

Chair Garcia, Vice Chair Stern, and Members of the Joint Committee:

Thank you for the opportunity to testify today about the AB 398 implementation process now underway at the California Air Resources Board (ARB). My remarks today draw on recent reports co-authored with my Near Zero colleagues Michael Mastrandrea and Mason Inman. For more information, I would refer you to our public Research Notes on offsets[1] and overallocation.[2] I will address three important issues:

1. Total limits on carbon offsets.

AB 398 set new limits on the use of carbon offsets, which credit greenhouse gas (GHG) reductions achieved outside of the cap-and-trade program. AB 398 limits offsets usage to 4% of emissions over the period 2021 to 2025, and 6% of emissions over the period 2026 to 2030.[3] However, ARB has proposed interpreting these limits in a way that applies the higher 6% limit to most emissions in 2024 and 2025. This interpretation would authorize up to 8.5 million additional offset credits, relative to a scenario in which ARB interprets AB 398's limits on a calendar-year basis.

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1 Near Zero, Interpreting AB 398's offsets limits (Mar. 15, 2018), http://www.nearzero.org/wp/2018/03/15/interpreting-ab-398s-carbon-offsets-limits/.

2 Near Zero, Ready, fire, aim: ARB's overallocation report misses its target. (May 7, 2018), http://www.nearzero.org/wp/2018/05/07/ready-fire-aim-arbs-overallocation-report-misses-its-target/.

3 Cal. Health & Safety Code §§ 38562(c)(2)(E)(i)(I)-(II).

2. Defining "direct environmental benefits" from carbon offsets.

Under AB 398, no more than half of the offsets used in the post-2020 period may come from projects that do not generate "direct environmental benefits" to California air or water quality.[4] Some have suggested that offset projects could meet this standard by claiming that their project-level GHG reductions constitute "direct environmental benefits." However, offset projects do not produce *any* climate benefits because project-level GHG reductions are zeroed out when regulated companies use offset credits to increase their own GHG emissions by an equivalent amount.

While I appreciate that ARB must make careful decisions about how to define "direct environmental benefits" under AB 398, Board staff have been unwilling to rule out the argument that project-level GHG reductions produce such benefits. If ARB were to accept this argument, the Board would effectively remove AB 398's "direct environmental benefits" requirements because *all* offset projects would qualify, even though *no* offset project produces net climate benefits.

3. **Allowance overallocation.**

AB 398 requires the Board to "[e]valuate and address concerns related to overallocation"[5]—the problem of having too many allowances in the program. As the Legislative Analyst's Office has explained, excess allowances put the state's 2030 climate target at risk because companies that bank today's extra allowances for future use could, in so doing, emit more than total program limits in 2030.[6] Despite multiple reports from credible, independent analysts that identify a significant overallocation problem in California's cap-and-trade program,[7] Board staff have so far dismissed these findings.

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4 *Id.*

5 *Id.* at § 38562(c)(2)(D).

6 Legislative Analyst's Office, Cap-and-Trade Extension: Issues for Legislative Oversight (Dec. 12, 2017), http://lao.ca.gov/Publications/Report/3719.

7 *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), https://eco.on.ca/reports/2017-from-plan-to-progress/; Chris Busch, Oversupply Grows in the Western Climate Initiative Carbon Market, Energy Innovation Report (Dec. 2017), http://energyinnovation.org/wp-content/uploads/2018/02/WCI-oversupply-grows-February-

In April 2018, Board staff published a draft response to AB 398's instruction to evaluate overallocation, presenting calculations that purport to show that overallocation would not affect the program's ability to deliver on California's 2030 climate target. However, the Board's analysis falls short on two critical grounds.

First, the Board's analysis does not examine the effects of overallocation on *annual* emissions in 2030. By instead examining *cumulative* emissions in the 2020s, the Board's analysis is non-responsive to the concern that LAO and others have raised with respect to overallocation.

Second, the Board's analysis makes a fundamental factual error—one that Board staff specifically and appropriately warned against in the original 2010 cap-and-trade rulemaking process. Once corrected for this factual error, the Board's April 2018 analysis indicates that overallocation will cause the cap-and-trade program to fall short of the role ARB identified in the 2017 Scoping Plan.

In my professional opinion, the Board's April 2018 analysis does not provide a reasonable basis for responding to AB 398's instruction to evaluate overallocation. A new and more serious analysis is essential because the Scoping Plan calls for cap-and-trade to deliver nearly 47% of the annual GHG reductions needed in 2030.[8] I urge the Board to review the available evidence and treat the overallocation problem with the care it deserves—just as ARB did in the original 2010 cap-and-trade rulemaking process.

Thank you for your time, and I would be happy to answer any questions.

Danny Cullenward JD, PHD
Research Associate, Near Zero & Carnegie Institution for Science
Member, Independent Emissions Market Advisory Committee
dcullenward@nearzero.org

Note: I am testifying only in my personal capacity today, not on behalf of my employers or associates.

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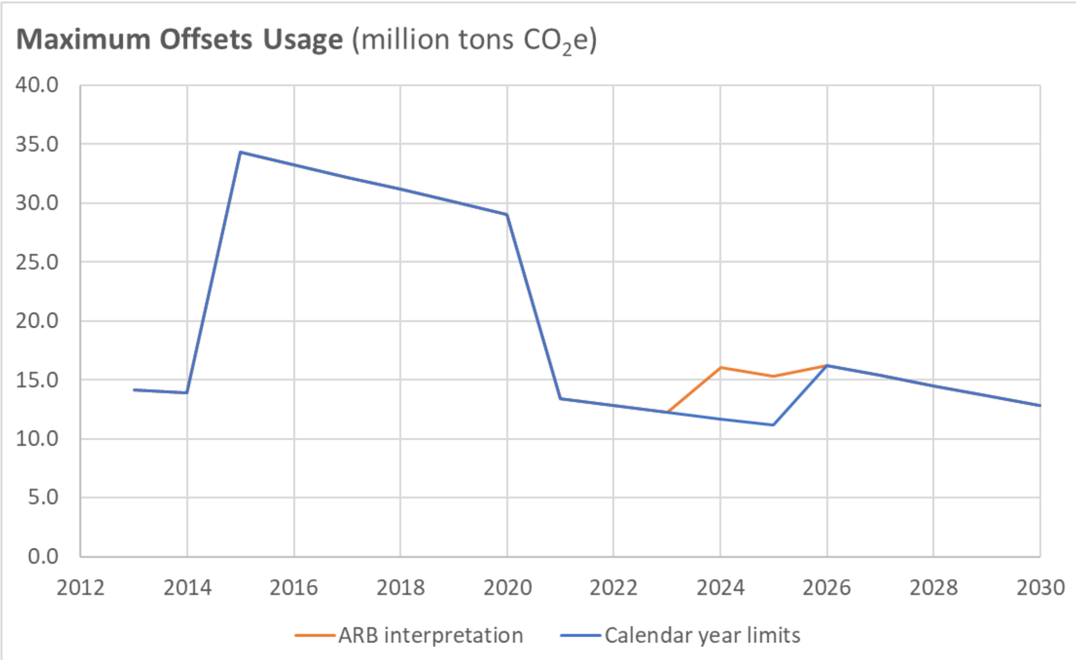
update.pdf; Legislative Analyst's Office, Letter to Hon. Christina Garcia regarding oversupply of allowances in the cap-and-trade program (June 26, 2017), http://www.lao.ca.gov/Publications/Detail/3818.

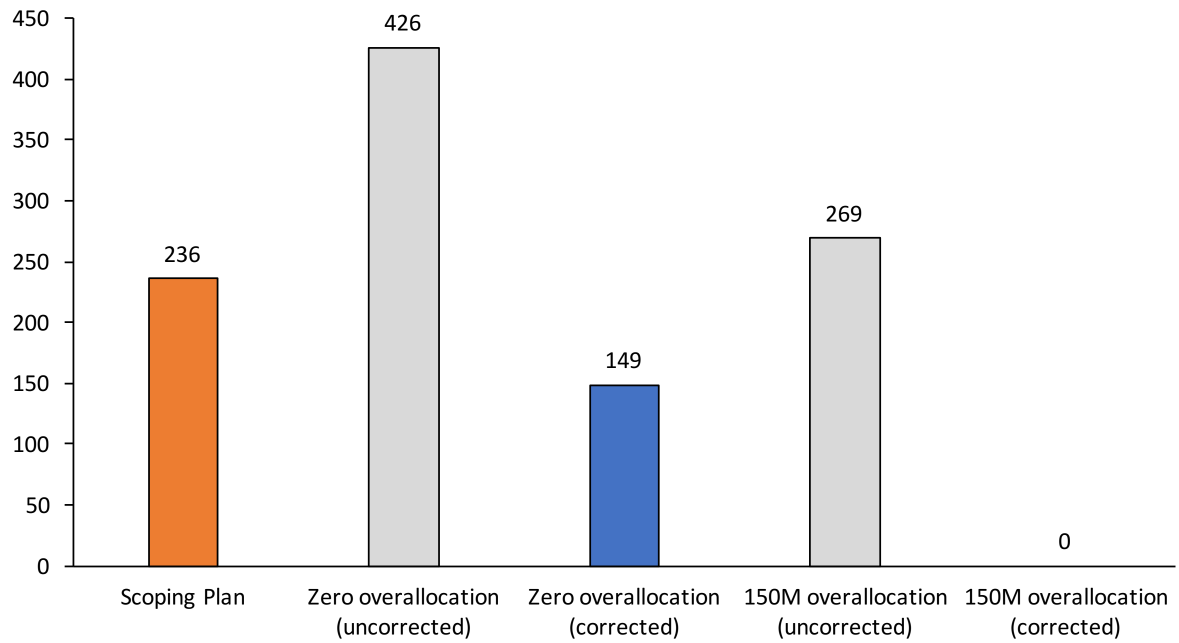
8 ARB, California's 2017 Climate Change Scoping Plan (Nov. 2017) at 26 (see Table 2), https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf

Topic #1: Total Offsets limits



	2023	2024	2025	2026	2027
Calendar Year Limits	4%	4%	4%	6%	6%
ARB Interpretation	4%	5.4%	5.4%	6%	6%

Topic #3: Overallocation / oversupply



Projected reductions from cap-and-trade, 2021 through 2030 (MMtCO_2e)

ARB's uncorrected April 2018 analysis suggests that whether or not there are 150M overallocated pre-2021 allowances, the cap-and-trade program will deliver at least as many reductions as called for in the 2017 Scoping Plan on a cumulative basis over the period 2021 through 2030. Once corrected for ARB's error, however, the Board's analysis indicates that the status quo market design is expected to fall short of the 2017 Scoping Plan's requirement—with or without 150M overallocated allowances.

Note that ARB's analysis does not address whether or not emissions in 2030 will achieve the state's 2030 climate target; instead, it focuses only on *cumulative* reductions over the period 2021 through 2030. The primary concern with overallocation is that excess allowances will cause *annual* emissions in 2030 to exceed the state target. As a result, ARB's analysis does not address the primary concern with overallocation.

May 30, 2018

The Honorable Eduardo Garcia
Chair, Joint Legislative Committee on Climate Change Policies
State Capitol, Room 4140
Sacramento, CA 95814

The Honorable Henry Stern
Vice Chair, Joint Legislative Committee on Climate Change Policies
State Capitol, Room 3070
Sacramento, CA 95814

Dear Chair Garcia and Vice Chair Stern,

I write to address issues discussed in last week's hearing before the Joint Legislative Committee on Climate Change Policies. As noted in the hearing's Committee Report,[1] my organization, Near Zero, released a public research note[2] that criticized the Air Resources Board's April 2018 analysis of market overallocation.[3] Near Zero's work shows that the Board's calculations contain a significant error. Once corrected, the Board's analysis indicates that allowance overallocation will cause the cap-and-trade program to fall short of the emission reductions ARB called for from the program in the 2017 Scoping Plan.

At last week's hearing, ARB Deputy Executive Officer Edie Chang testified that the Board has evaluated Near Zero's criticism and concluded that the Board made no error in its April 2018 analysis. In fact, however, her testimony did not dispute the error Near Zero identified. Rather than address the clear and transparent criticism Near Zero produced, Ms. Chang offered a series of non-

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1 JLCCCP Background Document: Informational Hearing on Cap and Trade (May 24, 2018), http://climatechangepolicies.legislature.ca.gov/previous-hearings.

2 Mason Inman, Michael Mastrandrea, and Danny Cullenward. Ready, fire, aim: ARB's overallocation report misses its target. Near Zero Research Note (May 7, 2018), http://www.near-zero.org/wp/2018/05/07/ready-fire-aim-arbs-overallocation-report-misses-its-target/.

3 ARB, Supporting Material for Assessment of Post-2020 Caps (Apr. 2018), https://www.arb.ca.gov/cc/capandtrade/meetings/20180426/carb_post2020caps.pdf.

sequiturs that do not affect Near Zero's conclusion that ARB's April 2018 report does not provide a reasoned basis for satisfying AB 398's instruction to "evaluate and address concerns related to overallocation."[4]

Ms. Chang testified:

> I want to note that the Committee Report cites a paper that claims there is an error in our staff analysis. We've reviewed the paper and evaluated that claim. Our conclusion is that there is no error in our analysis. Simply put, the paper doesn't realize that we made an adjustment, and it makes that adjustment again. Now, the specific issue is that the paper claims that our analysis doesn't adjust the caps to account for the portions of covered sectors that are not covered [by the cap-and-trade program]—for example, fugitive emissions from the industrial sector. So this isn't true. Our caps in the post-2020 program are set based only on the portion of the inventory that is covered by the program, just like the caps in the pre-2020 program.[5]

Contrary to Ms. Chang's testimony, Near Zero's criticism did not address the method by which ARB set its post-2020 program caps. Rather, Near Zero's analysis demonstrated that ARB erroneously projected greenhouse gas emissions covered by program caps and thereby inflated the emission reductions the Board attributed to the program in its April 2018 staff analysis.

Specifically, Near Zero documented how the Board erroneously projected greenhouse gas emissions on the basis of sector-wide emissions, as opposed to facility-level emissions actually covered under the cap-and-trade program—a distinction the Board properly emphasized as essential to avoiding overallocation in its original 2010 cap-and-trade rulemaking process.[6]

Instead of responding to Near Zero's criticism, Ms. Chang addressed a separate issue. She testified that the post-2020 program caps were set on the basis of facility-level emissions data, rather than sector-wide emissions. But this simply does not speak to the Board's serious analytical error. Again, Near Zero showed that the Board's report erroneously projected post-2020 *emissions*, not post-2020 *program caps*.

The difference can be illustrated by reviewing Table 3 in Near Zero's report, which is referenced in Table 1 in the Committee Report and reproduced in this letter below. Near Zero showed

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4 Cal. Health & Safety Code § 38562(c)(2)(D) (as added by AB 398).

5 Transcribed from video of the JLCCCP hearing on published by The California Channel, http://calchannel.granicus.com/MediaPlayer.php?view_id=7&clip_id=5543 (clip begins at 17:25 minutes).

6 ARB, ISOR Part 1, Volume III, Appendix E: Setting the Program Emissions Cap (Oct. 28, 2010) at E-7 to E-8, https://www.arb.ca.gov/regact/2010/capandtrade10/capv3appe.pdf.

that ARB erroneously inflated its projection of covered emissions by projecting sector-wide emissions, rather than the smaller subset of facility-level emissions that are actually subject to the cap-and-trade program. The erroneous calculation is shown on line #1.

Once corrected (line #2) using the same method ARB adopted in its original 2010 cap-and-trade rulemaking—which specifically warned against making this very error—projected emissions subject to the cap-and-trade program are significantly lower (line #3). In turn, this lowers the emission reductions ARB attributes to the cap-and-trade program (line #8) well below the 236 $MMtCO_2e$ reduction called for in the 2017 Scoping Plan.[7]

Table 1: Correction to ARB's cumulative overallocation analysis, 2021-2030 ($MMtCO_2e$)

#	Series	Case A (No overallocation)	Case B (150 M overallocation)
1	Erroneous covered emissions w/o cap-and-trade program (demand)	3,054	3,054
2	Correction to covered emissions (Near Zero calculation)	-277	-277
3	Corrected covered emissions (demand) (#1 + #2)	2,777	2,777
4	Post-2020 allowances (w/o Post-2020 Reserve)	2,532	2,532
5	Unused allowances at end of 2020	0	150
6	Offset credits	96	103
7	Total compliance instruments (supply) (#4 + #5 + #6)	2,628	2,785
8	Cumulative reductions from cap-and-trade (#3 – #7)	149	0 (*)

In response, Ms. Chang testified that ARB's post-2020 program caps were set using facility-level emissions data, referring to the number of post-2020 allowances in the program (line #4). This statement has no bearing on the error Near Zero identified. Near Zero made no adjustment

[7] ARB, California's 2017 Climate Change Scoping Plan (Nov. 2017) at 28, https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm.

whatsoever to the number of allowances available in the post-2020 market period. The only correction Near Zero made was to adjust the Board's erroneous emissions projections (line #2).

Notably, Ms. Chang did not refute Near Zero's claim by testifying, for example, that ARB's projected emissions (line #1) are actually based on facility-level data. Nor did she specifically address whether or not the Board agrees that its emissions projections were made in error. Instead, Ms. Chang misconstrued Near Zero's clear criticism, providing a non-sequitur response that fails to address the problem Near Zero identified.

It bears repeating that the thrust of Ms. Chang's remarks—that ARB properly accounted for the difference between sector-wide emissions and facility-level emissions actually subject to the cap-and-trade program—is explicitly contradicted by the Board's own report. The April 2018 overallocation report specifically states that it projects emissions on a sector-wide basis:

> Covered Emissions w/out Cap-and-Trade Program refers to the estimates of the GHG emissions **in the Cap-and-Trade covered sectors** while reflecting the impact of the complimentary policies only and not including any changes in GHG emissions due to the impact of a Cap-and-Trade Program. **This number may also include some limited fugitive emissions not covered by the Cap-and-Trade Program.** [Emphasis added.][8]

Indeed, no other outcome is plausible because the PATHWAYS model that generated this projection only analyzes sector-wide emissions, not facility-level emissions. As ARB recognized in its official description of the 2017 Scoping Plan scenario, the PATHWAYS model does not analyze the cap-and-trade program at all:

> The PATHWAYS scenario does not model the impacts of cap-and-trade, but this policy is assumed to deliver GHG emissions reductions through a declining cap to help meet the 2030 GHG target.[9]

If Board staff believe the emissions projections in their April 2018 overallocation report are appropriately based on facility-level emissions data, rather than erroneously on sector-wide emissions, they should explain why their report says the exact opposite.

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8 ARB, *supra* note 3 at 11 (see Table 3, note ###).

9 ARB, California's 2017 Climate Change Scoping Plan, Appendix D: PATHWAYS (Nov. 2017) at 1, https://www.arb.ca.gov/cc/scopingplan/2030sp_appd_pathways_final.pdf.

As I reflect on this exchange, I am equally troubled and saddened by the Board's discussion of overallocation in the AB 398 process. California policymakers—both at the Board and in the Legislature—face significant policy decisions that should be informed by clear, objective data and high-quality analysis. But until all parties can agree on a shared set of basic facts, it will be difficult to balance the many competing objectives that are reasonably part of state climate policy discussions. In these difficult times for climate policy, we in California can and should meet a higher standard.

The experience of other leading climate policy systems may offer a path forward. All major carbon markets have experienced overallocation conditions in the wake of the great recession, including the northeastern states' Regional Greenhouse Gas Initiative (RGGI) and the European Union's Emissions Trading System (EU ETS). California is no exception. But unlike California, RGGI and the EU ETS have implemented policy reforms designed to dynamically adjust program stringency in response to the actual bank of allowances held by private entities. Beyond showing that reform is possible, these particular interventions illustrate how overallocation adjustments can be managed dynamically on the basis of objective market data—and thus, that policymakers do not need to agree on a precise *ex ante* estimate of market overallocation in order to take effective action.

I remain convinced that ARB's April 2018 overallocation report is fundamentally flawed and therefore fails to meet AB 398's requirement to evaluate and address overallocation. This in no way prejudges any new efforts the Board makes to improve its analysis, which I hope are forthcoming. I am personally agnostic as to how ARB ensures that the cap-and-trade program delivers on the 2017 Scoping Plan and the 2030 climate target. As a professional matter, however, I remain committed to ensuring that the analysis supporting ARB's policy decisions is consistent with state law, including the requirements outlined in AB 32, SB 32, AB 197, and AB 398. I look forward to working with you and the Board on these important matters.

Sincerely,

Danny Cullenward JD, PHD
Member, Independent Emissions Market Advisory Committee

cc: Ms. Edie Chang, Deputy Executive Officer, Air Resources Board
Prof. Ann Carlson, Member, Independent Emissions Market Advisory Committee
Dr. Ross Brown, Legislative Analyst's Office

October 27, 2017

Ms. Rajinder Sahota
Assistant Division Chief, Industrial Strategies Division
California Air Resources Board

Dear Ms. Sahota,

Thank you for the opportunity to comment on the October 2017 scoping plan and cap-and-trade staff workshop presentations.[1] We appreciate ARB's efforts to finalize the 2030 Scoping Plan and continue California's climate policy leadership.

We write today with comments on the relationship between the 2030 Scoping Plan and the AB 398 implementation process. As everyone is aware, AB 398 requires a number of substantive changes to the post-2020 cap-and-trade market design ARB adopted in August 2017;[2] however, the timing of these changes presents analytical challenges that we believe warrant additional consideration. At the October 2017 workshop on the cap-and-trade program, ARB staff indicated the Board hopes to approve final AB

1 ARB, 2017 Scoping Plan Update: The Proposed Strategy for Achieving California's 2030 Greenhouse Gas Target. Public workshop (Oct. 12, 2017); ARB, Cap-and-Trade Regulation Workshop (Oct. 12, 2017).

2 ARB Resolution 17-21 (Aug. 4, 2017).

398 cap-and-trade regulations in mid-2019.[3] In contrast, AB 398 directs ARB to finalize the 2030 Scoping Plan by January 1, 2018.[4]

Because AB 398 requires ARB to finish the 2030 Scoping Plan by the end of 2017, ARB will need to select its preferred portfolio of policy measures for reaching the state's 2030 climate target more than a year before the Board completes its post-2020 cap-and-trade market design process. As a result, the 2030 Scoping Plan could identify a role for the cap-and-trade program, but any such quantitative role might not reflect the final market design ARB later adopts in implementing AB 398.

We appreciate that ARB's statutory deadlines preclude any other outcome with respect to timing. Nevertheless, we call on ARB to commit to integrating its AB 398 implementation regulations with the 2030 Scoping Plan environmental analysis. Specifically, ARB should commit to directly and quantitatively evaluating how its AB 398 regulations will deliver the annual emission reductions expected from the cap-and-trade market in the final 2030 Scoping Plan, consistent with the SB 32 target for 2030. We elaborate on these points below.

- **A larger role for cap-and-trade.** In its draft 2030 Scoping Plan, ARB decided to analyze the emission reduction requirements from 2021-30 on a cumulative basis, estimating that policy measures would have to reduce emissions by 680 million tons CO_2e over this period relative to a business-as-usual scenario in order to meet the 2030 target.[5] ARB projected that in its preferred scenario, cap-and-trade would need to deliver 191 million tons CO_2e (about 28%) of that total reduction.[6] In its

[3] ARB staff cap-and-trade presentation, *supra* note 1 at slide 34.

[4] Cal. Health & Safety Code § 38592.5(a)(1).

[5] ARB, The 2017 Climate Change Scoping Plan Update: The Proposed Strategy for Achieving California's 2030 Greenhouse Gas Target (Jan. 2017) at 37, 42. As we and our colleagues have previously emphasized, we believe that a single point forecast of business-as-usual emissions—whether annual or cumulative—cannot be accurate and should be accompanied by sensitivity analysis to create a robust strategy. *See*, *e.g.*, Comment letter from Mason Inman, Michael D. Mastrandrea, Danny Cullenward, and Michael Wara to ARB (Apr. 10, 2017), *available at* http://www.nearzero.org/wp/reports/.

[6] *Id.* at 41-42.

October 2017 workshop slides, ARB calls for an even larger role for cap-and-trade, which ARB now projects will need to reduce 294 million tons CO_2e (about 43%) of the total in order to reach the target.[7] As this new outlook indicates, a well-designed cap-and-trade program is essential to delivering on California's climate goals.

- **Cumulative vs. annual accounting.** As discussed above, ARB's analysis in the 2030 Scoping Plan process emphasizes *cumulative* emission reduction requirements over the period 2021-30; however, the draft scoping plan and workshop slides also present estimates for *annual* reductions from policy measures in 2030.[8] For example, the workshop slides suggest that after accounting for the effects of non-cap-and-trade policies, cap-and-trade will still need to deliver between 34 and 76 million tons of additional reductions in the year 2030 alone, depending on how those other policies perform.[9] Annual estimates of policy impacts on emissions are essential, because SB 32 sets an annual target of reducing statewide emissions to 40% below 1990 levels by the year 2030.[10]

  As we and our colleagues have previously emphasized, ARB needs to show how its 2030 Scoping Plan delivers on the SB 32 annual target for the year 2030, not an estimated reduction in cumulative emissions relative to a modeled baseline.[11] While cumulative emission reduction estimates can provide a helpful, high-level metric for comparing the role of individual policies, no cumulative analysis can replace a direct analysis of annual emissions showing that ARB's selected policy measures will deliver on ARB's legal requirement to achieve the SB 32

[7] ARB staff scoping plan presentation, *supra* note 1 at slide 16.

[8] ARB draft 2030 Scoping Plan, *supra* note 5 at 43 (see Table II-3); ARB staff presentation, *supra* note 1 at slide 17.

[9] ARB staff scoping plan presentation, *supra* note 1 at slide 17.

[10] Cal. Health & Safety Code § 38566.

[11] See, e.g., comment letter from Mason Inman et al., *supra* note 5; comment letter from Michael Wara and Danny Cullenward to ARB (Dec. 16, 2016); comment letter from Michael Wara and Danny Cullenward to ARB (Nov. 21, 2016). All comment letters available at http://www.nearzero.org/wp/reports/.

annual target in the year 2030. ARB's inclusion of annual emission reduction requirements for the cap-and-trade program in the draft Scoping Plan is helpful but not sufficient, because the program is at core a cumulative emissions reduction instrument; translating the cumulative reduction requirements ARB identifies for the program into annual reductions will depend on the details of AB 398 implementation.

Further analysis showing how the 2030 annual target will be achieved is especially important given the large role ARB expects cap-and-trade to play. Like any cap-and-trade program, California's program allows regulated emitters to shift the timing of their emissions through various measures such as banking of allowances,[12] access to some 80 million extra allowances at price containment points in the post-2020 market period,[13] the use of over-allocated allowances from the pre-2020 period in the post-2020 period,[14] and unlimited allowances made available at a hard price ceiling.[15] As a result, the specific market design ARB adopts pursuant to AB 398 will have important effects on the timing of emission reductions from sources regulated under the cap-and-trade program. In turn, the timing of emission reductions will determine whether or not the cap-and-trade program is capable of closing the gap between ARB's selected complementary policies and the SB 32 annual target in 2030.

- **ARB should commit to analyzing how its final AB 398 regulations deliver on SB 32's 2030 annual target, making use of the PATHWAYS model results from the 2030 Scoping Plan.** Because ARB will not be able to incorporate the final cap-and-trade program market design into the 2030 Scoping Plan and because the final cap-and-trade market design has critical implications for the timing of annual emission reductions through 2030, ARB should commit to integrating its environmental analysis across these two regulatory processes.

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

13 *Id.* at § 38562(c)(2)(B).

14 *Id.* at § 38562(c)(2)(D).

15 *Id.* at § 38562(c)(2)(A).

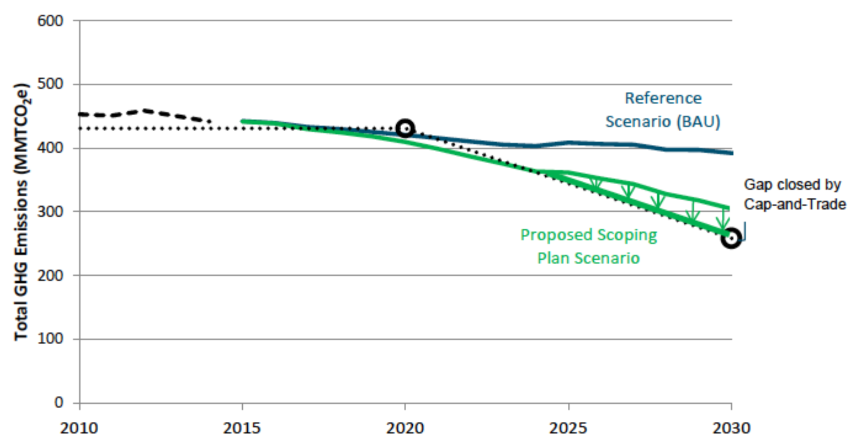
Specifically, we recommend that ARB explicitly analyze the annual reductions it expects from its final AB 398 market design regulations and compare these reductions with the PATHWAYS projections developed for the final 2030 Scoping Plan. Connecting these two analytical processes is critical because PATHWAYS does not model the emission reductions from cap-and-trade or other market-based measures.[16] Rather, ARB infers the emission reductions needed from cap-and-trade based on the gap between (1) the annual PATHWAYS projections for the contribution of non-market-based measures and (2) an annual emissions scenario that is consistent with the SB 32 annual target for 2030.

For example, in the figure below, the cumulative gap between PATHWAYS and ARB's preferred scenario is indicated by the area described by the arrows between the solid green line and the dotted Proposed Scoping Plan Scenario line; the annual gap is the difference between these two lines in 2030.[17] ARB assumes cap-and-trade will close these gaps.

16 Draft 2030 Scoping Plan, *supra* note 5, Table III-3 at 65-66 (citing California Air Resources Board, Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation, Staff Report: Initial Statement of Reasons, Appendix C: Revised Standardized Regulatory Impact Assessment (SRIA) (Aug. 2, 2017) at 11 ("PATHWAYS scenarios do not include the Cap-and-Trade Program, therefore, these scenarios provide information on reductions that may be achieved through other measures and the remaining emissions reductions that may be required to be achieved through the post-2020 Program."), *available at* https://www.arb.ca.gov/regact/2016/capandtrade16/appc.pdf).

17 Draft 2030 Scoping Plan, *supra* note 5, Figure II-3 at 42. We note that this figure is from the January 2017 draft Scoping Plan and that the numbers released in the October 2017 workshop indicate that the complementary policies will play a reduced role relative to this figure.

Figure II-3. Proposed Scoping Plan Scenario GHG Reductions



In the final 2030 Scoping Plan, we anticipate that ARB will identify emission reductions in 2030 from various measures, including the cap-and-trade program. We also anticipate that the final 2030 Scoping Plan will quantify emission reductions from non-market-based measures using PATHWAYS model projections. However, it is impossible to say what the actual annual emission reductions from the cap-and-trade program will be until the market design is finalized, because the choices ARB will make in implementing AB 398 will control how the cumulative reductions delivered by the program are distributed on an annual basis.

To resolve this issue, we recommend that ARB directly and quantitatively evaluate how its cap-and-trade regulations under AB 398 will reduce emissions in 2030, above and beyond reductions from non-market-based measures identified in the final 2030 Scoping Plan and quantified using PATHWAYS. If ARB commits to providing such an analysis in the AB 398 rulemaking process, it would then be defensible to argue that the 2030 Scoping Plan need not identify the specific cap-and-trade market design that complies with SB 32's annual emissions target, because that design will be properly analyzed in the AB 398 implementation process using consistent analytical methods.

Fundamentally, we believe a commitment by ARB to integrate the environmental analyses in the 2030 Scoping Plan and AB 398 implementation processes would provide a rigorous and well-reasoned basis for argument that the final 2030 Scoping Plan will enable the state to achieve the SB 32 annual target.

Thank you for your consideration. Again, we appreciate the opportunity to comment and look forward to working with ARB staff and other stakeholders going forward.

Sincerely,

Michael Mastrandrea, Ph.D.
Director, Near Zero
Senior Research Associate, Carnegie Institution for Science
mikemas@nearzero.org

Mason Inman
Research Associate, Near Zero
minman@nearzero.org

March 16, 2018

Dear ARB Board Members and staff,

Thank you for the opportunity to comment on the materials provided for ARB's March 2018 workshop on the implementation of AB 398's cap-and-trade program reforms. Our comments today focus on two issues: ARB's overall market design proposal and staff's proposed interpretation of AB 398 offsets limits. We will keep our comments brief and refer staff to more extensive analysis contained in two attached Near Zero Research Notes.[1]

1. **Pursuant to AB 398, ARB still needs to evaluate market oversupply conditions and allowance banking regulations.**

   AB 398 requires ARB to "[e]valuate and address concerns related to overallocation"[2] in the cap-and-trade program and "[e]stablish allowance banking rules that discourage speculation, avoid financial windfalls, and consider the impact on complying entities and volatility in the market."[3] The Board's March 2018 workshop materials include some discussion of these requirements, but do not evaluate either issue. Staff has requested further stakeholder input on these topics.

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1 Danny Cullenward, Mason Inman, and Michael Mastrandrea (2018a), Implementing AB 398: ARB's initial post-2020 market design and "allowance pool" concepts. Near Zero Research Note (Mar. 16, 2018) (attached here as Attachment 1); Danny Cullenward, Mason Inman, and Michael Mastrandrea (2018b), Interpreting AB 398's offset limits. Near Zero Research Note (Mar. 15, 2018) (Attachment 2 here).

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

3 *Id.* at § 38562(c)(2)(H).

Troublingly, ARB staff have indicated that they view the current oversupply of allowances in the market as a sign of its success, not a result of relative program laxity.[4] Staff present no evidence to support this view.

Without mentioning any of the various independent studies and reports that have concluded the market is experiencing a significant oversupply condition—including analysis from the Legislative Analyst's Office,[5] the Environmental Commissioner of Ontario,[6] Energy Innovation,[7] Near Zero,[8] and the Carbon Market Compliance Association,[9] to name only a few—Board staff suggest that the "relationship between GHG reductions and carbon price requires a more thoughtful and in-depth evaluation – not simply [an analysis of] supply vs. demand."[10] If the Board believes that there are methodological deficiencies with these existing conclusions, it should make more specific criticisms and identify a better approach. We identify the elements of an oversupply calculation the Board should

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4 ARB, Amendments to the Cap-and-Trade Regulation Workshop (March 2, 2018), slides 22-24.

5 Legislative Analyst's Office (2017), Cap-and-Trade Extension: Issues for Legislative Oversight (Dec. 12, 2017), http://lao.ca.gov/Publications/Report/3719.

6 Environmental Commissioner of Ontario (2018), Ontario's Climate Act: From Plan to Progress, Appendix G: Technical Aspects of Oversupply in the WCI Market, https://eco.on.ca/reports/2017-from-plan-to-progress/.

7 Chris Busch (2017), Oversupply grows in the Western Climate Initiative carbon market: An adjustment for current oversupply is needed to ensure the program will achieve its 2030 target. Energy Innovation LLC Report.

8 Danny Cullenward, Mason Inman, and Michael Mastrandrea (2017), California's climate emissions are falling, but cap-and-trade is not the cause. Near Zero Research Note, http://www.nearzero.org/wp/reports/.

9 Comment letter from Andre Templeman (CMCA) to Richard Corey (ARB) (Sept. 15, 2016) (estimating oversupply at up to 300M allowances), available in ARB, Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanism: Final Statement of Reasons (Aug. 2017), 499-500, https://www.arb.ca.gov/regact/2016/capandtrade16/ctfinsor.pdf.

10 ARB workshop presentation, supra note 4, slide 23.

consider and would be glad to provide additional information to assist ARB staff.[11]

Although ARB staff officially dispute the view that today's oversupply condition puts the program's environmental performance at risk, we note that the Board's proposed allowance pool concept would transfer some of the excess allowances in the post-2020 program budgets to the new price containment points and/or the price ceiling.[12] The total number of allowances that would be transferred under ARB's proposal is 75.1 million allowances. While removing this quantity of allowances from the auction supply curve could help address market oversupply conditions, the total transfers represent only 28% of Chris Busch's central estimate of market oversupply in 2020 (270 ±70 million allowances).[13] They are therefore insufficient to address the extent of market oversupply documented by credible, independent studies.

We are preparing our own estimate of the number of compliance instruments banked at the end of 2017, beyond entities' expected compliance obligations. We believe our analysis will show strong evidence that substantial banking has already occurred. As soon as this analysis is complete, we will send it to ARB and also release it publicly. Because ARB has made several public statements arguing that market participants are not banking significant amounts of allowances beyond their need for emissions already incurred,[14] we strongly encourage ARB to perform its own analysis and publish the results, methods, and underlying data.

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11 Cullenward et al. (2018a), supra note 1 at Appendix 2 (see Attachment 1 to this letter).

12 ARB, Preliminary Concepts: Price Containment Points, Price Ceiling, and Allowance Pools (Feb. 2018).

13 Busch (2017), supra note 7.

14 See, e.g., ARB, Responses to Questions, for Joint Oversight Hearing of the Senate Environmental Quality Committee and Senate Budget and Fiscal Review Subcommittee No. 2 on Resources, Environmental Protection, Energy and Transportation (Jan. 17, 2018). http://senv.senate.ca.gov/sites/senv.senate.ca.gov/files/arb_responses.pdf.

2. **Rather than dispute the cause of market oversupply, ARB should consider how to develop a post-2020 market design that manages a transition from today's low prices to the higher prices that are likely needed to achieve California's 2030 target.**

   Today's market prices are low because the supply of compliance instruments significantly exceeds near-term demand. Eventually, oversupply conditions will diminish and, absent a recession or major technological breakthroughs, carbon prices will likely rise—potentially to significantly higher levels. However, ARB staff have proposed a market design that does not include mechanisms to actively manage a gradual transition. By relying on market oversupply conditions to keep near-term prices low, the Board's proposal defers serious action, risks rendering the program ineffective at reducing emissions in the short term, and creates a political liability for the next administration to manage.

   We urge the Board to consider an alternative approach wherein oversupply conditions are carefully managed via program cap adjustments, banking rules that discount the value of banked allowances, and/or other creative approaches developed collaboratively with stakeholders. Instead of relying on oversupply to manage prices—a strategy that will eventually stop working as caps decline in the years to come—the Board might consider setting price containment points at lower levels and implementing a graduated price ceiling that starts at a lower initial price and increases more rapidly over time. We note that these alternative cost containment strategies are warranted only if ARB simultaneously resolves market oversupply conditions; if combined with no action on oversupply, they would only weaken the status quo market design.

3. **ARB needs to indicate how its proposed post-2020 offset limits are consistent with the legislative intent in AB 398.**

   ARB has proposed interpreting AB 398's post-2020 offset limits in a way that substantially increases the number of allowable offset credits in the years 2024 and 2025. Rather than apply the AB 398 offset limits on a calendar year basis—in which case 2024 and 2025 emissions would be subject to the lower 4% limit—ARB has proposed applying the higher 2026 calendar year limits (6%) to the bulk of compliance obligations associated with emissions in calendar years in 2024 and 2025.[15]

We calculate that this interpretation would increase the number of permissible offset credits by approximately 8.5 million, relative to a scenario in which the AB 398 limits applied on a literal calendar year basis and assuming covered entities' emissions are equal to program year allowance budgets plus maximum allowable offsets in each scenario.[16]

ARB has not justified its interpretation as being consistent with the statutory text in AB 398, which appears to apply to calendar year limits. ARB should explain how its proposed interpretation is consistent with the legislative intent behind AB 398.

4. **ARB should exclude consideration of greenhouse gas emissions from its proposed bottom-up determination of an offset project's "direct environmental benefits."**

In addition to setting overall limits on offsets usage, AB 398 also requires that no more than half of total post-2020 offsets limits come from projects that do not provide a "direct environmental benefit" ("DEB") to California air or water quality.[17] ARB has proposed a bifurcated approach to determining a DEB wherein certain bright-line conditions would automatically qualify an offset project as providing a

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15 ARB workshop presentation, supra note 4, slide 25.

16 Cullenward et al. (2018b), supra note 1 (see Attachment 2 to this letter).

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

DEB while allowing all other projects the opportunity to make an individualized case as to whether or not they provide a DEB.[18]

We agree that a bifurcated approach to determining a DEB could, if executed carefully and consistently, fairly balance the need for program flexibility with AB 398's statutory requirements. However, if the Board elects this approach, it is critically important that ARB identify arguments that cannot be used to demonstrate a DEB.

Specifically, ARB should clarify that offset projects may not argue that their gross avoided or reduced GHGs generate a DEB. Offset projects produce no net GHG reductions because for every avoided or reduced GHG emissions, ARB awards an equal number of offset credits that will eventually be used by covered entities to increase their own GHG emissions by the same amount the offset project reduces or avoids. Thus, there is no basis whatsoever for an offsets project to claim a DEB on the basis of its gross GHG reductions.[19] Accordingly, ARB should explicitly foreclose this argument in whatever process the Board ultimately adopts for determining whether or not an offsets project provides a direct environmental benefit to state air or water quality.

5. **ARB needs to show how its proposed market design is consistent with the role the Board identified for cap-and-trade in the final 2017 Scoping Plan.**

Finally, we reiterate the need for ARB to show how the market design it selects in the AB 398 implementation process is consistent with the large role the Board identified for the cap-and-trade program in its final 2017 Scoping Plan. The cap-and-trade program was identified as the single largest contributor to California's climate goals, representing 38% of the required cumulative emission reductions over

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18 ARB, Preliminary Discussion Draft of Potential Changes to the Regulation for the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms (Feb. 2018), at 17-19.

19 Cullenward et al. (2018b), supra note 1 (see Attachment 2 to this letter).

the period 2021-2030[20] and almost 47% of the annual reductions projected for the year 2030.[21] Whatever choices ARB makes in implementing its discretionary authority under AB 398 should be consistent with the role ARB identified for the cap-and-trade program.[22]

We appreciate that the design choices facing ARB require difficult policy judgments and complicated technical analysis. Nevertheless, we urge ARB to be transparent in its process and to address the fundamental challenges present in the current market. If we can provide analytical support to the ARB in the future, please feel free to contact us.

Sincerely,

Danny Cullenward JD, PHD

Mason Inman

Michael D. Mastrandrea PHD

Disclaimer: Dr. Cullenward is a member of the California Independent Emissions Market Advisory Committee; however, this letter does not represent the official views of the IEMAC.

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20 ARB, 28.

21 *Id.* at 26.

22 We expressed this view in the Scoping Plan process. *See* Comment letter from Michael Mastrandrea and Mason Inman (Near Zero) to Rajinder Sahota (ARB) (Oct. 27, 2017), http://www.nearzero.org/wp/2017/10/27/cap-and-trade-2030/.

Attachment 1:

Danny Cullenward, Mason Inman, and Michael Mastrandrea (2018a), Implementing AB 398: ARB's initial post-2020 market design and "allowance pool" concepts. Near Zero Research Note (Mar. 16, 2018).

Attachment 2:

Danny Cullenward, Mason Inman, and Michael Mastrandrea (2018b), Interpreting AB 398's offset limits. Near Zero Research Note (Mar. 15, 2018).

May 10, 2018

Dear ARB Board Members and staff,

Thank you for the opportunity to comment on the materials provided for ARB's April 2018 workshop on the implementation of AB 398's cap-and-trade program reforms. Our comments today focus on two issues: the inadequacy of ARB's Post-2020 Caps Report[1] and remaining uncertainties associated with staff's proposed interpretation of AB 398's offsets limits. We refer staff to more extensive analysis on the Post-2020 Caps Report in an attached Near Zero Research Note[2] and, on offsets, to our previous comment letter and its attachments.[3]

1. **ARB's analysis of allowance overallocation does not provide a reasoned basis for addressing AB 398's requirements. ARB should conduct rigorous new analysis and evaluate the market reforms enacted in the RGGI and the EU ETS programs to address market overallocation.**

   AB 398 requires ARB to "[e]valuate and address concerns related to overallocation" in the cap-and-trade program.[4] In turn, ARB released its first formal evaluation of allowance overallocation in the April 2018 Post-2020 Caps Report. As we show in the attached Research Note,

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1 ARB, Supporting Material for Assessment of Post-2020 Caps (Apr. 2018) (hereinafter, the "Post-2020 Caps Report"), https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm.

2 See attachment 1 to this comment letter.

3 See attachment 2 to this comment letter.

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

however, the Post-2020 Caps Report does not provide a reasoned basis for addressing AB 398's requirements because it falls short on two critical grounds.

First, despite the clear concern that excess allowances from the program's pre-2021 period could enable covered emissions to exceed program caps and undermine the state's ability to meet its legally binding emission limit in 2030, the Report does not analyze the impact of overallocation on 2030 emissions. As a result, it does not speak to the key concern identified by numerous independent analysts[5] and therefore does not satisfy AB 398's requirements.

Second, our attached Research Note shows that the Report contains a major factual error. Once this error is corrected using the method ARB staff employed in the original 2010 cap-setting rulemaking, the Report's analysis suggests that overallocation will cause emissions to exceed the 2030 limit. Rather than justify ARB's proposal not to take any action to address allowance overallocation, the Report's corrected analysis indicates that overallocation is a serious problem that puts California's emissions limit at risk.

ARB should acknowledge the error in its Report, review the extensive set of studies conducted by independent analysts, and undertake a more substantive assessment of allowance overallocation and its risks. A new analysis should include a careful evaluation of the extent to which the economic recession exogenously reduced emissions below program caps because emission reductions caused by lower-than-anticipated economic growth are not attributable to "early action" undertaken by market participants.

We emphasize that there are a variety of solutions available to ARB, as evidenced by the reforms other prominent cap-and-trade programs have implemented in recent years. Both the northeastern states' RGGI program and the EU ETS have made adjustments to reduce

5 See attachment 1 to this letter.

excess allowance supplies that have built up in part because of the effects of the recession.

These policy systems not only show that it is possible to analyze overallocation and make adjustments to future program caps, but also provide examples of how objective metrics that track actual allowance banking can be used to dynamically manage a program's stringency. For example, the EU ETS automatically increases or decreases future allowance supplies depending on the extent of allowance banking that regulators observe in the market; RGGI uses a related approach to introduce or remove allowances from the program cap in response to market prices.

When it comes to developing solutions to allowance overallocation, ARB has at least two broad options. One approach would be to review the existing and high-quality independent studies that make prospective estimates of allowance overallocation to inform an adjustment to the California program's stringency. Alternatively—or in parallel—the Board could develop objective banking metrics and design dynamic program adjustments to implement changes that are based on actual market outcomes as they arise, just as RGGI and the EU ETS have done.

We urge the Board to take seriously the concern that overallocation could put the state's 2030 climate target at risk and conduct a more thorough evaluation of the issue in order to satisfy AB 398's requirements.

2. ARB still needs to address concerns related to staff's proposed interpretation of AB 398's offsets reforms.

As we and others articulated in comment letters responding to ARB's March 2018 workshop, ARB's proposed interpretation of AB 398's offsets requirements raises a number of important concerns. Board staff neither addressed these comments in their summary of March 2018 comments nor provided any new information on these issues in the April 2018 workshop. We re-iterate here the concerns we expressed in our March 2018 comment letter and call on ARB to address these issues.

a. ARB needs to indicate how its proposed post-2020 offset limits are consistent with AB 398's requirements.

ARB's proposed interpretation of AB 398's total limits on post-2020 carbon offsets increases the total number of offset credits that can be used in 2024 and 2025 relative to a literal reading of the statute. In its March 2018 workshop materials, ARB did not offer any justification for this more expansive interpretation. ARB staff should explain how the proposed interpretation is consistent with the plain text of AB 398 as well as the statute's legislative intent.

b. ARB should exclude consideration of greenhouse gas emissions from its proposed bottom-up determination of an offset project's "direct environmental benefits."

AB 398 limits the eligibility of offset credits that do not generate a "direct environmental benefit" to air or water quality in California. Board staff have proposed evaluating this requirement on a project-by-project basis, but have so far been unwilling to clarify whether they are open to allowing offset projects to claim a direct environmental benefit on the basis of their project-level greenhouse gas reductions.

The preliminary discussion draft suggests that "a GHG reduction anywhere is a benefit everywhere."[6] This is true, but only where there are net GHG reductions. Offset projects do not generate net GHG reductions because project-level reductions generate offset credits, which in turn increase emissions under the cap-and-trade program by an equivalent amount. As a result, offset projects generate no climate benefits, and therefore it would be irrational to conclude they generate

[6] ARB, Preliminary Discussion Draft regulatory text (Feb. 2018) at 17.

a "direct environmental benefit" on the basis of their project-level greenhouse gas emission reductions.

If Board staff accept the argument that "a GHG reduction anywhere is a benefit everywhere," then all offset projects would qualify on the basis of purported climate benefits, despite the fact that none of these projects produce net climate benefits. This interpretation is inconsistent with the plain language and intent of AB 398. Because all offset projects would qualify under this expanded definition, it would also erase AB 398's entire direct environmental benefits requirement, contrary to the standard judicial canons of statutory construction.

We appreciate that Board staff are trying to develop an efficient approach to evaluating whether existing and future carbon offset projects produce a direct environmental benefit and appreciate the administrative challenge this entails. Nevertheless, the Board can and should clarify that offset projects cannot demonstrate a direct environmental benefit on the basis of their project-level greenhouse gas reductions—no matter where they are located. This clarification would not limit the Board's ability to develop a fair and efficient implementation process.

Thank you for the opportunity to comment and please feel free to contact us if we can provide any additional information.

Sincerely,

Danny Cullenward JD, PHD

Mason Inman

Michael D. Mastrandrea PHD

Disclaimer: Dr. Cullenward is a member of the California Independent Emissions Market Advisory Committee; however, this letter does not represent the official views of the IEMAC.

Attachment 1:

Mason Inman, Danny Cullenward, and Michael Mastrandrea, Ready, fire, aim: ARB's overallocation report misses its target. Near Zero Research Note (May 7, 2018).

Attachment 2:

Near Zero comment letter to ARB re: March 2018 cap-and-trade workshop (Mar. 16, 2018).

July 5, 2018

Dear ARB Board Members and staff,

Thank you for the opportunity to comment on the materials provided for ARB's June 2018 Workshop on the implementation of AB 398's cap-and-trade program reforms.[1] Our comments today focus on AB 398's requirement that the Board "evaluate and address concerns related to overallocation."[2]

Before we discuss this issue, however, we first want to recognize that the workshop materials provide significant new information on two critical issues related to carbon offsets. First, the presentation and preliminary discussion draft indicate staff now interpret AB 398's definition of "direct environmental benefits" as environmental benefits that go beyond project-level greenhouse gas reductions.[3] Second, staff clarify that they interpret AB 398's total limits on offsets as applying to the calendar year in which emissions take place, rather than the year in which compliance obligations for those emissions are calculated.[4] As we had earlier expressed concern that other interpretations would be inconsistent with legislative intent,[5] we

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1 ARB, Workshop to Continue Informal Discussion on Potential Amendments to the Cap-and-Trade Regulation, Staff Presentation (June 21, 2018) (hereinafter "Staff Presentation"), https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm.

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

3 Staff Presentation at slide 26; ARB, Preliminary Discussion Draft of Potential Changes to the Regulation for the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms (June 2018) at 17, https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm.

4 *Id*. at 27.

5 Near Zero comment letter to ARB (Mar. 16, 2018); Danny Cullenward, Mason Inman, and Michael Mastrandrea, Interpreting AB 398's carbon offsets limits, Near Zero Research Note (Mar. 15, 2018),

sincerely thank ARB staff for clarifying their views on these important matters.

Although we are grateful that ARB staff have clarified their interpretation of AB 398's limits on carbon offsets, we remain deeply concerned about the Board's lack of substantive discussion on allowance overallocation. Our strong preference is to avoid further disputes over basic facts and establish a constructive working relationship with Board staff. We are agnostic about which solutions policymakers choose to adopt, so long as they are effective, and appreciate the many constraints affecting climate policy today. Nevertheless, the explanations staff have offered with respect to allowance overallocation are factually incorrect and, to many outsiders, confusing. We offer a detailed response here in order to correct the record, with the sincere hope that we can work together going forward to ensure the cap-and-trade program achieves the substantial role the Board has chosen for it in meeting California's climate goals.

From an environmental perspective, managing the cap-and-trade program's excess supply of allowances is arguably the most important question affecting the design of ARB's post-2020 market. Yet the Board's discussion of this issue has continually failed to take into account the growing evidence—both in the Board's own data[6] and in multiple reports from credible, independent experts[7]—that excess allowances from the market's pre-2021 period are likely to be banked into the market's post-2020 period, causing low market prices that are insufficient to induce serious climate

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http://www.nearzero.org/wp/2018/03/15/interpreting-ab-398s-carbon-offsets-limits/.

6 ARB, Mandatory GHG Reporting – Reported Emissions, https://ww2.arb.ca.gov/mrr-data.

7 *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), https://eco.on.ca/reports/2017-from-plan-to-progress/; Chris Busch, Oversupply Grows in the Western Climate Initiative Carbon Market, Energy Innovation Report (Dec. 2017), http://energyinnovation.org/wp-content/uploads/2018/02/WCI-oversupply-grows-February-update.pdf; Legislative Analyst's Office, Cap-and-Trade Extension: Issues for Legislative Oversight (Dec. 2017), http://lao.ca.gov/Publications/Report/3719.

mitigation and enabling emissions that are significantly higher than nominal program caps. Should these outcomes manifest, California will likely fail to keep statewide emissions below the mandated limit for 2030. We once again call on ARB to treat this issue with the seriousness it deserves.

Not only should ARB address allowance overallocation as a matter of good policymaking, but the Board is also obligated to provide a serious analysis under state law. AB 398 requires ARB to "evaluate and address concerns related to overallocation."[8] For months, however, staff have dismissed these concerns without analysis or reference to the long list of relevant, independent studies.

The Board's first and only formal discussion of the issue is contained in its April 2018 Post-2020 Caps Report.[9] ARB's Report concluded that even if 150 million allowances are banked into the post-2020 market period, the cap-and-trade program would still generate at least as many reductions as called for in the 2017 Scoping Plan.[10] Rather than review the literature on allowance overallocation or offer its own calculations, staff cited only one independent report and argued why they believe overallocation will be lower than the report's central estimate.[11] Most problematic, the Post-2020 Caps Report contains a serious methodological error, which we documented in a May 2018 Research Note and an associated comment letter in response to the May 2018 cap-and-trade workshop.[12] Staff dispute our findings.[13]

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

9 ARB, Supporting Material for Assessment of Post-2020 Caps (Apr. 2018) (hereinafter "Post-2020 Caps Report"), https://www.arb.ca.gov/cc/capandtrade/meetings/meetings.htm.

10 *Id*. at 14.

11 *Id*. at 7-9 (citing LAO, *supra* note 7).

12 Mason Inman, Michael Mastrandrea, and Danny Cullenward, Ready, fire, aim: ARB's overallocation report misses its target. Near Zero Research Note (May 7, 2018), http://www.nearzero.org/wp/2018/05/07/ready-fire-aim-arbs-overallocation-report-misses-its-target/; Near Zero comment letter to ARB (May 10, 2018).

13 Staff Presentation at slides 21-24.

We emphasize that the environmental integrity of the post-2020 program caps is essential to achieving California's climate goals. At a time when the federal government is backsliding on climate policy and science-based regulation, it is essential for California's environmental policies to demonstrate not only a path forward, but also a philosophy of putting data and analysis front and center.

1. ARB admits the error Near Zero identified in the Post-2020 Caps Report and fails to respond to our criticism.

Board staff now dispute our findings, despite admitting during the June Workshop to the specific error we identified. To review, ARB's Post-2020 Caps Report calculates the reductions attributable to the cap-and-trade program in the period 2021 through 2030 by taking the difference between projected greenhouse gas emissions and the number of compliance instruments:

Projected Emissions (A) – Compliance Instruments (B) = Reductions (C)

Or, more simply:

$A - B = C$

Near Zero's report shows that ARB erroneously inflated its Projected Emissions (A), and thereby inflated the Reductions (C) attributable to the cap-and-trade program. Specifically, ARB projected emissions from four economic sectors in their entirety, rather than the smaller set of facility-level emissions from individual emitters within those sectors that are regulated by the cap-and-trade program. (For those who prefer a visual illustration of the error, see Figures 1 and 2 at the end of this letter.)

While ARB's error might seem technically complex, it is entirely straightforward as a matter of fact. The Post-2020 Caps Report makes clear that it projects sector-wide emissions, rather than facility-level emissions actually subject to the cap-and-trade program.[14] Near Zero also confirmed the Post-2020 Caps Report's methods by replicating its calculations from primary sources.[15]

Notably, ARB Assistant Division Chief Rajinder Sahota confirmed the methodological error at ARB's June Workshop. One of us (Dr. Cullenward) sent in a written question by email:

> ARB staff's April 2018 report states on page 11 that there will be 3,054 million tons of emissions over the period 2021-2030. This number is used to calculate the reductions from the cap-and-trade program in the staff report. Does this number represent projected emissions from covered sectors as modeled by PATHWAYS, or does it represent projected emissions from the more narrow category of covered emissions that are subject to the cap-and-trade program?[16]

Ms. Sahota responded:

> It represents the covered sectors, which includes those emissions that are covered by cap-and-trade and a limited amount of fugitive emissions that are not covered by cap-and-trade. When compared against the caps, the caps have already been adjusted for the fact that not all of those emissions are covered by cap-and-trade.[17]

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14 Post-2020 Caps Report at 11 (see Table 3, note ### (citing output from the Scoping Plan's PATHWAYS model, which projects only sector-level emissions)).

15 Inman et al., *supra* note 12 at 12-13. A spreadsheet with our full calculations is available at Near Zero's website.

16 Email from Dr. Danny Cullenward to ARB (June 21, 2018).

17 Ms. Sahota's remarks are transcribed in their entirety from an audio recording we made of the June 2018 workshop. There is no public recording or transcript of this hearing, although we will happily make available our recording to anyone who requests it. We understand that ARB's primary auditorium is under renovation and therefore that the Board's usual A/V capabilities are diminished temporarily. Nevertheless, we urge the Board to ensure that recordings of these public meetings are preserved in order to facilitate a common understanding of the process.

In fact, the difference between "covered sector" emissions and "covered emissions" is large, not "limited." The projections ARB used are about 10% higher than corresponding projections for actual facility-level emissions, a distinction that leads to a cumulative increase of about 277 million tons of CO_2e over the period 2021 through 2030[18]—more than the 236 million tons of emission reductions the 2017 Scoping Plan calls for from the cap-and-trade program over the same period.[19] When adjusted for this error, ARB's calculations show that banking 150 million excess allowances from the pre-2021 period would lead the program caps to be non-binding through 2030, causing the program to fall well short of the role ARB identified in the Scoping Plan.[20]

Despite acknowledging the Board's error, Ms. Sahota asserted that it does not matter because the Board has accurately set the number of Compliance Instruments (B). This is entirely non-responsive to Near Zero's criticism. Our work did not allege or imply that ARB erroneously reported the market's post-2020 supply of compliance instruments; rather, we used their exact numbers and confirmed their calculations from primary sources in preparing our own report. The only error we identified was ARB's inflated numbers for Projected Emissions (A).

Again, ARB's error inflates the calculated Reductions (C) attributable to cap-and-trade. Once those Reductions (C) are adjusted to account for the error in Projected Emissions (A), the reductions expected from cap-and-trade fall well below the levels required under the 2017 Scoping Plan[21]—without making any changes to the number of Compliance Instruments (B) in ARB's current regulations.

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18 Inman et al., *supra* note 12 at 12-13.

19 ARB, California's 2017 Climate Change Scoping Plan (Nov. 2017) (hereinafter "2017 Scoping Plan") at 26, 28.

20 Inman et al., *supra* note 12 at 13-14.

21 *Id.* at 14.

Thus, even if we take as true all of the things staff now say about the post-2020 program caps, ARB has acknowledged that its response to AB 398's requirement to analyze overallocation is factually incorrect.

2. ARB's claims about the integrity of the status quo program are arbitrary and unsupported by rigorous analysis.

In response to Near Zero's criticism of the Post-2020 Caps Report, ARB staff make three arguments to justify the status quo approach they are considering—(1) that the program caps already account for emissions falling below program caps, (2) that the current program design achieves a 77.5% ratio between key program-year caps and statewide emission limits, and (3) that the current program supports a rising carbon price sufficient to keep total emissions below the 2030 emissions limit.[22]

Even if these arguments were true, we emphasize that they do not change the serious error Near Zero identified in ARB's calculations. Therefore, these arguments do nothing to change the fact that ARB's response to AB 398's instructions to analyze overallocation is factually inaccurate. As it happens, however, each of these arguments also is invalid and/or untrue. We respond to each below.

a. ARB's post-2020 caps were not set using methods that ensure program stringency and consistency with the state's 2030 emissions limit.

ARB's first argument is that Near Zero's criticism requires the Board to make an adjustment to program caps that is unnecessary because the post-2020 program caps currently in the Board's regulations were set using the very methods Near Zero asserts are necessary to ensure program stringency. Specifically, the Staff Presentation asserts that the post-2020 program caps have already been sufficiently adjusted to reflect the fact that covered

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22 Staff Presentation at slides 16-24.

emissions are expected to be lower than the program cap in 2020.[23] This assertion is both procedurally and substantively deficient.

As an initial matter, it is important to note that the current post-2020 program caps were established in a rulemaking process that concluded after AB 398 extended ARB's authority to continue the cap-and-trade program, but without taking into account any of the requirements of AB 398.[24] Furthermore, the current post-2020 program caps were set prior to finalizing the 2017 Scoping Plan and may well be inconsistent with the role ARB identified for the program in the final 2017 Scoping Plan.[25]

In other words, the current post-2020 program caps were set in a process that did not require analysis of allowance overallocation nor consistency with the final 2017 Scoping Plan. Any such analysis—which is required under AB 398 and for consistency with the environmental analysis justifying the 2017 Scoping Plan—would need to be demonstrated in the current regulatory process. ARB has offered no such analysis to date.

On the substance of staff's claims, the Board has not offered an analysis of allowance overallocation and/or banking outside of its erroneous Post-2020 Caps Report. Asserting that the 2016 cap-setting process addresses these

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[23] *Id*. at slide 19.

[24] Danny Cullenward, Did the Air Resources Board just approve an illegal regulation while transferring hundreds of millions of dollars to the oil industry? (Aug. 2, 2017), https://www.ghgpolicy.org/blog/resolution-17-21.

[25] Near Zero comment letter to ARB (Oct. 27, 2017) (calling for ARB to ensure that the AB 398 implementation regulations match the final Scoping Plan's requirements), http://www.nearzero.org/wp/2017/10/27/cap-and-trade-2030/. When ARB finalized the post-2020 program caps that are currently in effect in its July 2017 regulations, ARB was anticipating that the cap-and-trade program would only need to deliver 191 $MMtCO_2e$ reductions over the period 2021 through 2030. ARB, The 2017 Climate Change Scoping Plan Update: The Proposed Strategy for Achieving California's 2030 Greenhouse Gas Target (Jan. 2017) at 41-42. But in the final 2017 Scoping Plan, ARB identified a need for 236 MMtCO2e over the same period. ARB, 2017 Scoping Plan at 26-28. *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 8-9 (explaining the significant differences between the draft January 2017 and final November 2017 Scoping Plan), http://senv.senate.ca.gov/sites/senv.senate.ca.gov/files/arb_responses.pdf.

issues is insufficient and implausible on its face, as demonstrated by a brief review of the quantities involved.

The currently applicable post-2020 program caps include a set-aside of 52.4M allowances that were removed from the program caps and transferred to the Allowance Price Containment Reserve (APCR).[26] We note that ARB has not decided yet what to do with these allowances, which could potentially be made available at low prices and therefore still contribute to allowance overallocation in the market.[27] For the purposes of discussing ARB's claims, however, we will treat these allowances as "removed" from the normal auction supply and therefore a step towards reducing allowance overallocation.

Whatever ARB decides to do with these allowances, they constitute a very small number relative to the scale of allowance overallocation. The size of ARB's purported solution for cumulative allowance overallocation (52.4M allowances) is smaller than the extent of *annual* overallocation in 2016, the most recent year for which data are available (58.3M allowances).[28] Even if ARB expands the post-2020 APCR set-aside by an additional 22.7M, as staff are currently contemplating, the total set-aside (75.1M allowances)[29] would still be smaller than the number of allowances AB 398 transfers from the pre-2021 APCR to two post-2020 "price containment points" (81.2M

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26 Cal. Code Regs., tit. 17, § 95871 (Table 8-2).

27 Danny Cullenward, Mason Inman, and Michael Mastrandrea, Implementing AB 398: ARB's initial post-2020 market design and "allowance pool" concepts, Near Zero Research Note (Mar. 16, 2018) at 7-8.

28 Danny Cullenward, Mason Inman, and Michael Mastrandrea, California's climate emissions are falling, but cap-and-trade isn't the cause, Near Zero Research Note (Nov. 17, 2018); *see also* ARB, Mandatory GHG Reporting – Reported Emissions, 2016 MRR Data https://ww2.arb.ca.gov/mrr-data. We note that this calculation looks only at the difference between facility-level covered emissions and the total annual program cap in 2016.

29 Cullenward et al., *supra* note 27 at 7.

allowances), making these excess allowances available at what will likely be lower prices.[30]

Most relevant, even the higher number ARB is currently contemplating (75.1M allowances) is much smaller than credible independent estimates of *cumulative* allowance overallocation through the end of 2020 from Energy Innovation (270M ±70M allowances),[31] the Legislative Analyst's Office (over 200M allowances),[32] and also the number ARB considered in its Post-2020 Caps Report (150M allowances).[33]

ARB has not properly justified its selection of APCR set-asides in relation to independent estimates of allowance oversupply; in fact, the size of the current APCR set-aside is even smaller than a single year's worth of overallocation, let alone credible projections of the cumulative bank of excess allowances into the post-2020 market period. Nor has the Board determined whether these allowances will be accessible at low prices, in which case their purported "removal" from the normal auction supply could be ineffective in addressing excess allowance supplies.

Thus, the assertion that the current post-2020 program caps were set using a method that addresses allowance overallocation is still unsubstantiated. We once again urge the Board to include all of the "pools" of allowances in the pre-2021 and post-2020 periods in a thorough analysis of allowance overallocation.[34]

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[30] Cal. Health & Safety Code § 38562(c)(2)(B); Cullenward et al., *supra* note 27 at 7.

[31] Busch, *supra* note 7.

[32] LAO, *supra* note 7.

[33] Post-2020 Caps Report at 13-14.

[34] Cullenward et al., *supra* note 27 at 11.

b. ARB's choice to set the 2030 program-year cap at 77.5% of the statewide emissions limit is arbitrary and does not address serious issues related to allowance banking or overallocation.

Staff appear to believe that the ratio between annual program caps and annual statewide emissions limits offers an appropriate metric for establishing the role of cap-and-trade in state climate policy.[35] By definition, however, an annual metric fails to account for cumulative issues such as banking and overallocation, which reflect how allowances will be saved up and used across multiple program years.

What staff offer is not a rule for ensuring program stringency, but a tautology. ARB correctly notes that in the original 2010 cap-setting regulation, the program caps were set to decline until such time as they reach 334.2 $MMtCO_2e$ in 2020.[36] This annual program cap is indeed 77.5% of the statewide emissions limit for 2020.[37] But it should come as no surprise that the ratio between the annual program cap ARB established for 2030 and the 2030 emissions limit is also 77.5% because ARB simply extended the current program without adjusting total program caps to address allowance overallocation.

As ARB acknowledges, the post-2020 program caps in the Board's current regulations were set by taking the program cap in 2020 (334.2M allowances) and reducing it on a linear basis each year such that the program caps decline to a 2030 program cap that is 40% below the 2020 program cap.[38] Because ARB used a program cap decline that matches the percentage decline between the 2020 and 2030 statewide emissions limits, it is a

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35 Staff Presentation at slide 19.

36 *Id*. at slide 17; *see also* Cal. Code Regs., tit. 17, § 95841 (Table 6-1).

37 AB 32 set the 2020 climate target at 1990 emissions levels, which ARB determined to be 431 $MMtCO_2e$ using 100-year Global Warming Potentials from the IPCC's Fourth Assessment Report. ARB, California 1990 Greenhouse Gas Emissions Level and 2020 Limit, https://www.arb.ca.gov/cc/inventory/1990level/1990level.htm.

38 Staff Presentation at slide 19; Cal. Code Regs., tit. 17, § 95841 (Table 6-2).

mathematical truism that the ratios between annual program caps and emission limits are the same in both 2020 and 2030.

As another stakeholder suggested at the June Workshop, the 77.5% ratio would better be described as the outcome of an earlier policymaking deliberation for limiting emissions through 2020, rather than an input that should control the strategy for achieving the 2030 emissions limit. To that we would add that the original 2010 cap-setting process appropriately reflected facility-level emission projections, which ARB has still not employed in the AB 398 implementation process. Simply put, there is no logical or empirical basis for using the 77.5% ratio as a metric for resolving allowance overallocation.

c. **ARB's focus on the cap-and-trade program's "steadily increasing price signal" conflicts with the program's role as a gap-closing policy instrument in the Scoping Plan, where it is described as guaranteeing that statewide emissions fall to the 2030 limit.**

Finally, we note a troubling inconsistency between the way staff are now describing the cap-and-trade program's role in the informal regulatory process and its formal role in the 2017 Scoping Plan. If staff believe the 2017 Scoping Plan's analysis of the cap-and-trade program is no longer valid, we encourage them to clarify that matter so that we are all operating on a common understanding of the program's role going forward.

Staff now suggest that "[p]ost-2020 caps constrain emissions to support [a] steadily increasing carbon price signal"[39]—in other words, that the purpose of declining caps is to support a rising carbon price. But that description reverses the Board's position in the 2017 Scoping Plan and incorrectly conflates a policy tool (carbon pricing) with the end goal of the policy (reduced emissions).

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[39] Staff Presentation at slide 24.

The 2017 Scoping Plan assumes that cap-and-trade will "fill the gap" between projected emission reductions resulting from the state's regulatory programs and any reductions that are needed to keep emissions below the 2030 limit. The program functions as a quantity mechanism, ensuring that emissions fall in line with program goals.[40] Notably, ARB did not evaluate what carbon prices would be necessary to achieve its 2030 climate goal; the only mention of what carbon prices would be needed to keep emissions below mandated limits comes with the caveat that its assumptions "should not be used as a forecast of emission responses to allowance prices."[41]

If ARB now believes that the purpose of the cap-and-trade program is to produce a reliable and steadily increasing carbon price, rather than to implement binding emission limits that are consistent with the state's climate goals, staff should clearly indicate this new view. In that case, we would ask staff to provide analysis that demonstrates what carbon prices are consistent with the reductions called for in the 2017 Scoping Plan. Staff should also explain why, in comparing cap-and-trade and carbon taxes, the Board has consistently objected to carbon taxes as being too uncertain to deliver specific emission reduction goals. For example, the Board recently testified that:

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40 *See, e.g.,* ARB, 2017 Scoping Plan 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 SEQ Questions, *supra* note 25 at 2-3 (describing the cap-and-trade program as a program that will achieve certain reductions with prices determined by the market).

41 ARB, 2017 Scoping Plan, Appendix E: Economic Analysis (Nov. 2017) at 65.

> As many economists and experts have previously noted, it is very difficult to identify the exact price for carbon that will result in an exact quantity of emissions reductions. This is one of the biggest challenges with a carbon tax—you don't know where to appropriately set the tax so as not to miss the target or achieve the target at a higher cost than necessary—and this is one of the biggest advantages of a Cap-and-Trade Program—we do not need an exact price and we can allow the market to find the lowest-cost reductions first.[42]

Our view is that there are important tradeoffs between certainty in price outcomes and certainty in emission outcomes when choosing between a quantity-based program (a cap-and-trade program), a price-based program (a tax), or a hybrid instrument (a cap-and-trade program with a price ceiling and price floor). We are agnostic as to how California employs carbon pricing policy to support its climate goals, but will continue to evaluate whether appropriate analysis supports the tradeoffs policymakers select along these important dimensions.

Dating back to the original 2008 Scoping Plan, ARB has consistently rejected price-based policies and stated a preference for quantity-based policies to keep emissions below quantity-based limits. The Board's unwillingness to demonstrate in the current regulatory process that its post-2020 program caps are capable of keeping statewide emissions below the 2030 limit in the presence of excess allowances carried forward from the pre-2021 period—even before addressing the question of how to implement AB 398's price ceiling—is especially problematic given the lack of corresponding analysis on price-induced mitigation in the 2017 Scoping Plan.

As others have recommended, if the Board is concerned about high market prices, then the appropriate solution is to set the price ceiling at whatever level policymakers consider an acceptable balance between program costs and stringency. Maintaining an excess supply of allowances in order to

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42 ARB, Responses to SEQ Questions, *supra* note 25 at 6.

reduce program costs will only serve to undermine both the program's environmental benefits and the Board's reliance on cap-and-trade as a quantity-based instrument that delivers real reductions on the basis of a firm emissions budget.

3. ARB's response to Near Zero's report repeats the same non-answer ARB staff provided in testimony to the Legislature.

Finally, we believe it is important to emphasize that this exchange is no different from one that occurred at a May 2018 oversight hearing before the Joint Legislative Committee on Climate Change Policies.

The Joint Committee's staff report reviewed ARB's Post-2020 Caps Report and Near Zero's Research Note, citing the error Near Zero identified and raising questions about the Board's calculations.[43] Prior to the hearing, the Committee's chairman and lead author of AB 398, Assembly Member Eduardo Garcia, echoed these concerns in remarks to a reporter:

> "Our numbers don't pencil out to be the same numbers they propose," Garcia said. "We will go back and reexamine the numbers they are projecting. We have some questions about how they got there."[44]

One of us (Dr. Cullenward) testified at the hearing in his capacity as a member of the Independent Emissions Market Advisory Committee, repeating the concerns Near Zero had previously identified.[45] ARB Deputy Executive Officer Edie Chang provided a response from the Board's

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43 Joint Legislative Committee on Climate Change Policies, Informational Hearing on Cap-and-Trade (May 24, 2018), http://climatechangepolicies.legislature.ca.gov/sites/climatechangepolicies.legislature.ca.gov/files/Background%20Sheet_5.24.2018.pdf.

44 Julie Cart, Checking the math on cap-and-trade, some experts say it's not adding up. *CALmatters* (May 22, 2018), https://calmatters.org/articles/checking-the-math-on-cap-and-trade-some-experts-say-its-not-adding-up/.

45 Testimony of Dr. Danny Cullenward before Joint Legislative Committee on Climate Change Policies (May 24, 2018), https://www.ghgpolicy.org/s/2018-05-24-Cullenward-testimony.pdf.

perspective. As to the error Near Zero identified in ARB's Post-2020 Caps Report, Ms. Chang testified:

> I want to note that the Committee Report cites a paper that claims there is an error in our staff analysis. We've reviewed the paper and evaluated that claim. Our conclusion is that there is no error in our analysis. Simply put, the paper doesn't realize that we made an adjustment, and it makes that adjustment again. Now, the specific issue is that the paper claims that our analysis doesn't adjust the caps to account for the portions of covered sectors that are not covered [by the cap-and-trade program]—for example, fugitive emissions from the industrial sector. So this isn't true. Our caps in the post-2020 program are set based only on the portion of the inventory that is covered by the program, just like the caps in the pre-2020 program.[46]

In response to Ms. Chang's testimony, one of us (Dr. Cullenward) sent a follow-up letter to the Joint Committee containing the same analysis as in Section 1, above, and provided a copy to Ms. Chang.[47] Although the June 2018 ARB Staff Presentation provides more detail on ARB's view of the integrity of its post-2020 program caps, it is exactly as non-responsive as Ms. Chang's testimony with respect to the error Near Zero identified in ARB's work.

We take no pleasure in pointing out ARB's underlying mistake nor in identifying a pattern of non-responsive behavior. In fact, we would be very glad to leave this episode behind us and work with ARB on a serious analysis of allowance overallocation and program reforms.

Furthermore, we appreciate that all projections of allowance overallocation are uncertain, and therefore we can understand why the Board might be

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46 Transcribed from video of the hearing published by The California Channel, http://calchannel.granicus.com/MediaPlayer.php?view_id=7&clip_id=5543 (clip begins at 17:25 minutes).

47 Letter from Dr. Danny Cullenward to the Joint Legislative Committee on Climate Change Policies (May 30, 2018), https://www.ghgpolicy.org/s/2018-05-30-Cullenward-letter-to-JLCCCP.pdf.

cautious about making an intervention before the full extent of excess allowance banking is known. At the same time, it would be a mistake to wrongly insist, as the Board has now repeatedly asserted, that current program caps provide sufficient stringency in light of the gap between program caps and actual facility-level emissions to date. Drawing on recent reforms in cap-and-trade programs in the Northeastern U.S. and in Europe, we are confident that California could make dynamic program cap adjustments on the basis of empirical banking metrics that track the bank of excess allowances currently in the market—a bank that is large, growing, and if credible independent analysts are correct, could very well put California's climate goals at risk unless properly managed in the near future.

ARB is at an important crossroads. As one of the leading climate regulators in the world, the Board has built up enormous goodwill for its persistent efforts to decarbonize a growing economy—efforts that are all the more important at this challenging time in the United States. We also respect how the Board's legacy in tackling California's notorious local air pollution problems rests on a history of scientific integrity, policy ingenuity, and political leadership. There is no shame in having a cap-and-trade program with excess allowances; all of the other major programs in the world have confronted the same challenge. For example, the Northeastern States' RGGI program and the European Union's ETS have both implemented reforms to address the problem of excess allowances, but ARB has so far been unwilling to even run the numbers. We call on the Board to live up to its high standards and address the pressing issue of allowance overallocation with the seriousness it deserves.

Thank you for the opportunity to comment and please feel free to contact us if we can provide any additional information.

Sincerely,

Danny Cullenward JD, PHD

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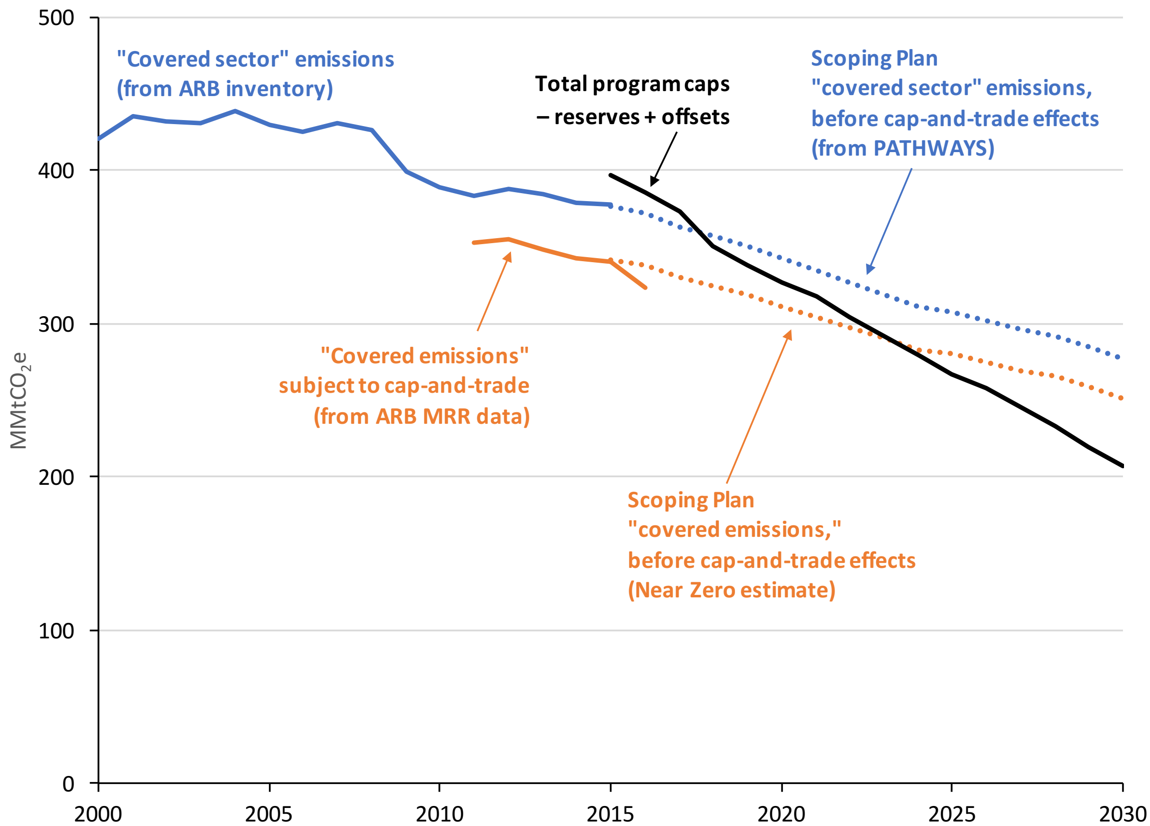
Michael D. Mastrandrea PHD

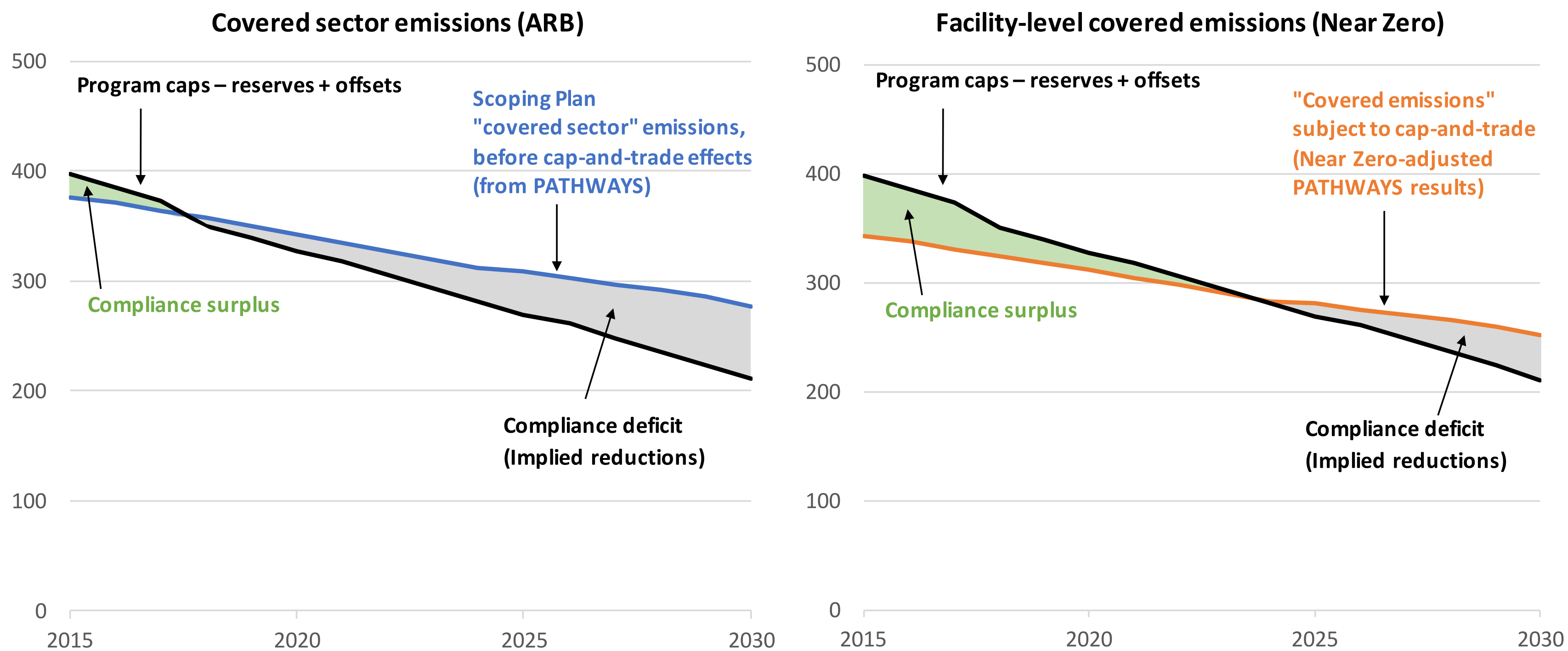
Figure 1: ARB's projection of "covered sector" emissions compared with historical covered emissions and Near Zero's projection of "covered emissions."



ARB's Post-2020 Caps Report incorrectly used projections of "covered sector" emissions from the PATHWAYS model, which includes about 10% more emissions each year than the facility-level "covered emissions" that are actually subject to the cap-and-trade program. Here, we show actual data in solid lines and projected data in dotted lines; the projections are color-coded with blue lines representing ARB's erroneous choice of "covered emissions" and orange lines representing the smaller set of facility-level "covered emissions." The black line indicates the annual program caps for 2015-2030, from which we remove allowances sent to the program's reserve accounts (APCR and Voluntary Renewable Electricity) and add a supply of offsets (5% for 2015-20, 3% for 2021-25, 4.5% for 2026-30). The offset supply for 2015-2020 is based on historical compliance usage, and the assumptions for 2021-2030 match ARB's assumptions in its Post-2020 Caps Report.

ARB incorrectly calculates the reductions from the cap-and-trade program as the difference between the dotted blue line and the black line. In contrast, ARB's method should have calculated program reductions as the difference between the dotted orange line and the black line. In years where the black line is above projected emissions, a surplus of allowances is available; where the black line is below projected emissions, the program has an allowance deficit, requiring emitters to reduce their emissions or use banked allowances for program compliance (see Figure 2).

Figure 2: Comparison of annual cap-and-trade program supply-demand balance (million metric tons of CO_2e).



Both panels show the annual compliance instrument surplus (green) and deficits (grey), which are determined by the difference between projected emissions and the supply of compliance instruments from the cap-and-trade program. The panel on the left shows the effect of ARB's inflated emission projections for "covered sector" emissions from the Scoping Plan scenario, which projects sector-wide emissions without any cap-and-trade program effects. With artificially high projected emissions, the program appears to run a substantial cumulative allowance deficit (grey), which ARB interprets as the program reducing emissions in line with the program caps. In contrast, the panel on the right shows the expected outcome when ARB's inflated emission projection is corrected. Rather than run a substantial allowance deficit, the program is expected to maintain a substantial annual surplus into the early to mid-2020s, and a cumulative surplus through 2030. If these surplus allowances are banked and used to maintain emissions at a level that exceeds program caps in the later 2020s, this would put the 2030 emissions limit at risk.

2018 ANNUAL REPORT OF THE INDEPENDENT EMISSIONS MARKET ADVISORY COMMITTEE

October 22, 2018

Dallas Burtraw, Committee Chair, Darius Gaskins Senior Fellow - Resources for the Future

Ann Carlson, Committee Vice Chair, Shirley Shapiro Professor of Environmental Law, Faculty Co-Director - Emmett Institute on Climate Change and the Environment, University of California, Los Angeles School of Law

Danny Cullenward, Policy Director - Near Zero, Research Associate - Carnegie Institution for Science, Lecturer - Stanford Law School

Quentin Foster, Director, California Climate - Environmental Defense Fund

Meredith Fowlie, Class of 1935 Distinguished Chair in Energy - University of California, Berkeley, Department of Agricultural & Resource Economics

Observer: Ross Brown, Principal Fiscal and Policy Analyst - Legislative Analyst's Office, California

Convener: California Environmental Protection Agency – Secretary J. Matthew Rodriquez, Deputy Secretary Ashley Conrad-Saydah, Bill Dean, Rebecca Favila, Michelle Sinclair, Deputy Secretary and Legal Counsel Chris Tiedemann, Sheryl Watson

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Appendix

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 policies[1].

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 2045[2], 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 environemntal 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 polices 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 NOx 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 (Gattaciecca 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 tCO_2e 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:

Emissions leakage = $GHG_{out} \times \Delta Q_{out}$

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.

$\Delta \mathbf{Q}_{\mathbf{out}}$ (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 Standard[6] 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] *I*d. 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 tCO_2e 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 CO_2e ($MMtCO_2e$) 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 $MMtCO_2e$; in 2030 it is 200.5 $MMtCO_2e$.

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 (± 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
Authors: Quentin Foster and Dallas Burtraw

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 of 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