The Climate Reality Project
SILICON VALLEY CHAPTER

January 24, 2025

Meredith Fowlie, Chair,
Danny Cullenward, Vice Chair,
and members of the Independent Emissions Market Advisory Committee

Subject: Comments on the draft 2024 IEMAC Annual Report

Dear Dr. Fowlie, Dr. Cullenward, and members of the IEMAC,

Following are my comments on the committee's draft annual report, and some (***highlighted***) suggestions to strengthen several of the chapters. [Google Docs link] My comments cover the following topic categories:

> Market Design to Strengthen California's Climate Policy Portfolio (Dallas Burtraw and Danny Cullenward): The waterbed effect and the Emissions Containment Reserve (ECR)
>
> Cap-and-Trade and Cost Containment in California (Meredith Fowlie and Brian Holt): EV subsidies
>
> Environmental Justice Options in California's Cap-and-Trade Program (Katelyn Roedner Sutter & Meredith Fowlie): Regulation of criteria pollutants
>
> Carbon Management in California's Cap-and-Trade Program (Katelyn Roedner Sutter & Brian Holt): Cement
>
> Carbon Offsets (Danny Cullenward and Dallas Burtraw): Global decarbonization

Thank you for considering my feedback, and I look forward to seeing your final report.

Sincerely,

Ken Johnson
Legislation and Public Policy Committee
Climate Reality Project: Silicon Valley Chapter

Comments on "Market Design to Strengthen California's Climate Policy Portfolio" (Dallas Burtraw and Danny Cullenward)

The waterbed effect

The report highlights the dilemma "that the carbon market does not efficiently amplify and may diminish the performance of sector-specific regulations.":

> *Unfortunately, over a broad range of outcomes, successful regulations do not affect the number of emissions allowances available in the market and hence do not affect the emissions that occur. This phenomenon is known as the "waterbed effect" ... when regulatory policies push emissions down in one place, emissions rise at a covered entity somewhere else in the market.*

This explanation appears to essentially describe how carbon trading is intended to operate. The waterbed effect, like emissions trading, reallocates emission rights to minimize the cost of achieving a predetermined emission target.

I have not heard any IEMAC members other than Dallas Burtraw voice concerns about the waterbed effect, and neither does it appear to be a concern of either CARB or the legislature. For example, last year several NGOs requested CARB's clarification of "whether the SB 596 program [for cement decarbonization] is intended to further reduce statewide GHG emissions." The concern was explained in the NGOs' query letter:

> *If a particular industry sector, such as cement, achieves greater than expected emission reductions, it will require fewer allowances for compliance and the resulting surplus allowances will allow other sectors to emit more. To the extent that emissions in capped sectors are determined by the cap, aggregate emissions will be unaffected by additional emissions reductions in the cement sector. … should the SB 596 regulations operate to achieve significant reductions not only in cement-sector emissions, but also in statewide emissions, beyond what would be achieved by cap-and-trade without SB 596?*

CARB's response was that "Staff do not view the SB 596 requirements as additional to the state's overall GHG reduction targets …," meaning that continued inclusion of cement in cap-and-trade would not affect the number of emissions allowances available in the market and hence would not affect the emissions that occur.

A similar question was subsequently posed to Senator Becker's legislative staff: "Based on California's statutory climate policies …, should the SB 596 regulations operate to

achieve significant reductions not only in cement-sector emissions, but also in statewide emissions, beyond what would be achieved by cap-and-trade without SB 596?" Staff's response paralleled CARB's position:

> *I have to say that we probably didn't really think about it, but it wasn't our intent. It was our intent that SB 596 would help achieve the targets already set, not increase the overall targets.*

Most policy makers seem to view the waterbed effect not as a "bug", but as a "feature." As long as the state is achieving its emissions target, why is the waterbed effect a problem? A similar question arises with regulatory measures to mitigate the waterbed effect, such as the price floor or the IEMAC's proposed Emissions Containment Reserve (ECR). Why is there any need to impose a price floor or ECR as long as the emissions target is being achieved? The answer depends on what the state's legislative policy objective is, whether to minimize the cost of achieving a predetermined emissions target, or to minimize emissions within a predetermined cost limit. Statutory guidance can be found in HSC 38560 ("... achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions …") and HSC 38562.2(c)(1) ("Achieve net zero greenhouse gas emissions as soon as possible …"). ***The IEMAC's policy recommendations relating to the waterbed effect and ECR can be strengthened by citing supporting statutory authority.***

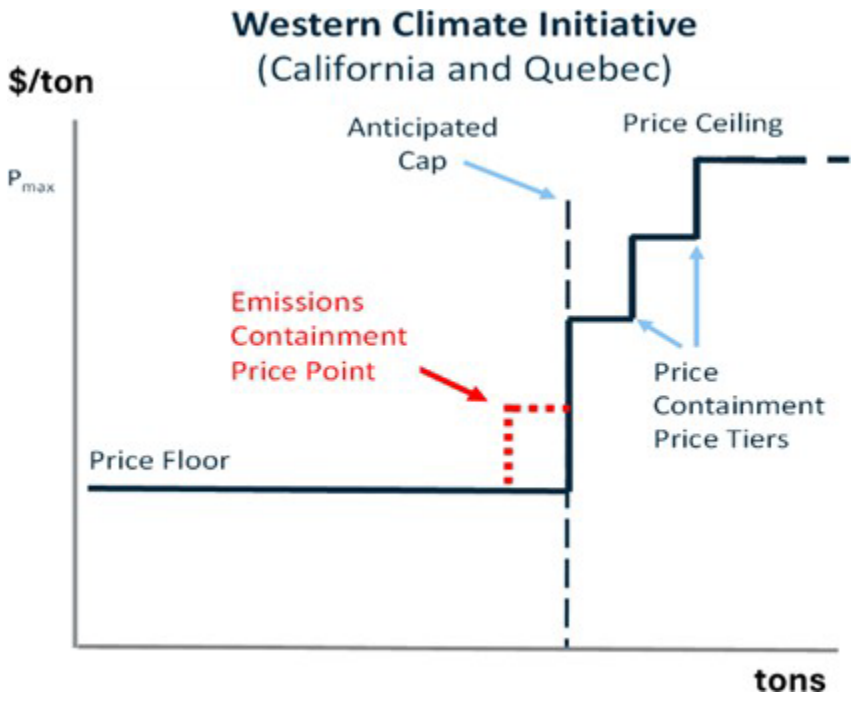
<u>The Emissions Containment Reserve (ECR)</u>

CARB's cap-and-trade regulation currently has a price floor ($24 per allowance in 2024) below which allowances are not sold, a price ceiling ($88) above which an unlimited number of allowances are sold, and two price points ($56 and $72), above which additional allowances are released from the Allowance Price Containment Reserve (APCR). (All price points increase by 5% annually.) The IEMAC recommends that CARB add an additional price point at $40 (midway between the floor and first APCR price point), below which a portion of the available allowances (e.g. 10%) will be withheld from sale. The following Figure 1, copied from the draft report's FIgure 1, illustrates the stepped allowance supply schedule, i.e., the number of allowances available ("tons" at 1 allowance per ton-CO2e, horizontal) at any market auction price ("$/ton", vertical).

An alternative to the ECR would be to simply raise the price floor. The draft report briefly discusses this option, but does not recommend that CARB give it consideration. The report favors an ECR over raising the price floor for the following stated reason: "An advantage of introducing an additional price step as an Emissions Containment

Reserve is that it fills out a price-responsive allowance supply schedule which preserves and enhances the role of the market in price discovery over a wider range of outcomes (Roberts and Spence 1976; Burtraw et al. 2022)."

Figure 1



The Conclusion of Burtraw 2022 elaborates on this point (page 880): “Our strategy, price-responsive supply, determines price and quantity simultaneously by using the policy maker’s best estimate of the marginal damage schedule as the supply function that is used to settle allowance auctions.” “Marginal damage” essentially means the Social Cost of Carbon (SCC), i.e., the monetized climate damage per ton of CO2-equivalent GHG emissions. The SCC is not necessarily constant; it can depend on the emissions level. The “marginal damage schedule” is an estimate of the SCC as a function of emissions.

The concept is explained more fully in the following earlier paper by the same authors as Burtraw 2022:

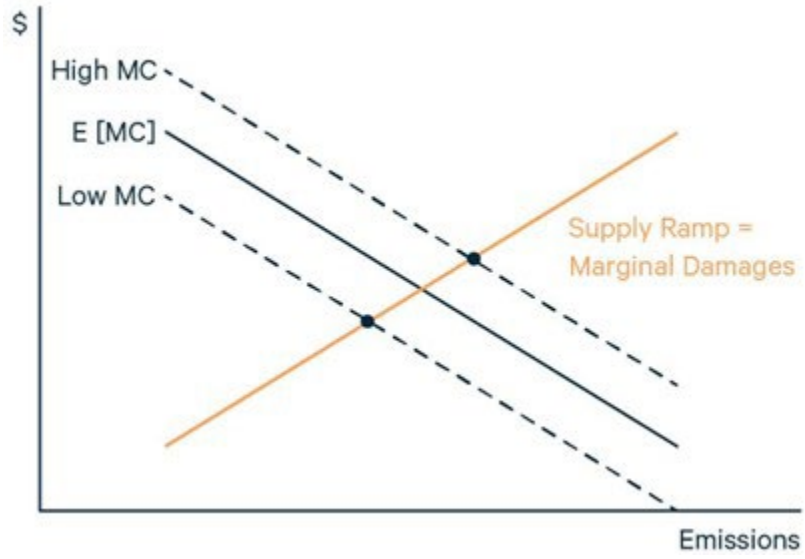
> Burtraw, D., Holt, C., Palmer, K. and Shobe, W., 2020. Quantities with prices: price-responsive allowance supply in environmental markets. *Resources for the Future Working Paper*, pp.20-17. https://media.rff.org/documents/RFF_WP_20-17_Burtraw.pdf

Theorem 1 in this paper states the following (on page 15):

> *A price-responsive supply policy can be implemented using an auction … the available price and quantity pairs are determined by the auctioneer's (policymaker's) best estimate of the marginal damage function. The auction selects a price-quantity pair such that the supply of allowances equals the demand and price equals expected marginal damages at the given quantity.*

The following figure excerpted from Burtraw 2020 (Figure 2 on page 16), illustrates the concept:

Figure 2



The upward-sloping "Marginal Damages" curve illustrates the SCC dependence on emissions. (The vertical axis in Figure 2 should be labeled $/ton-CO2e, not $.) At very low emissions, the SCC would be zero or negative. This model is consistent with climate science, e.g., it is believed that CO2 and methane emissions from pre-industrial agriculture prevented the climate from entering a new ice age. The zero-crossing of the Marginal Damages curve is in the vicinity of 280 to 300 ppm atmospheric CO2. Below this level, GHG emissions would be (and have been) beneficial, and above it, marginal damages increase as emissions approach and traverse the threshold at which GHGs could trigger catastrophic and irreversible climate tipping points (e.g., AMOC collapse).

The horizontal axis in FIgure 2 is labeled "Emissions" but should be interpreted as representing GHG levels. The marginal damages depend on cumulative atmospheric GHGs, not emission rates. For example, if global emissions were to suddenly stop,

there would be no immediate change in the SCC (marginal damages) because GHG levels would still be high. GHG levels would need to be reduced, e.g. via negative-emission measures, to bring down the SCC.

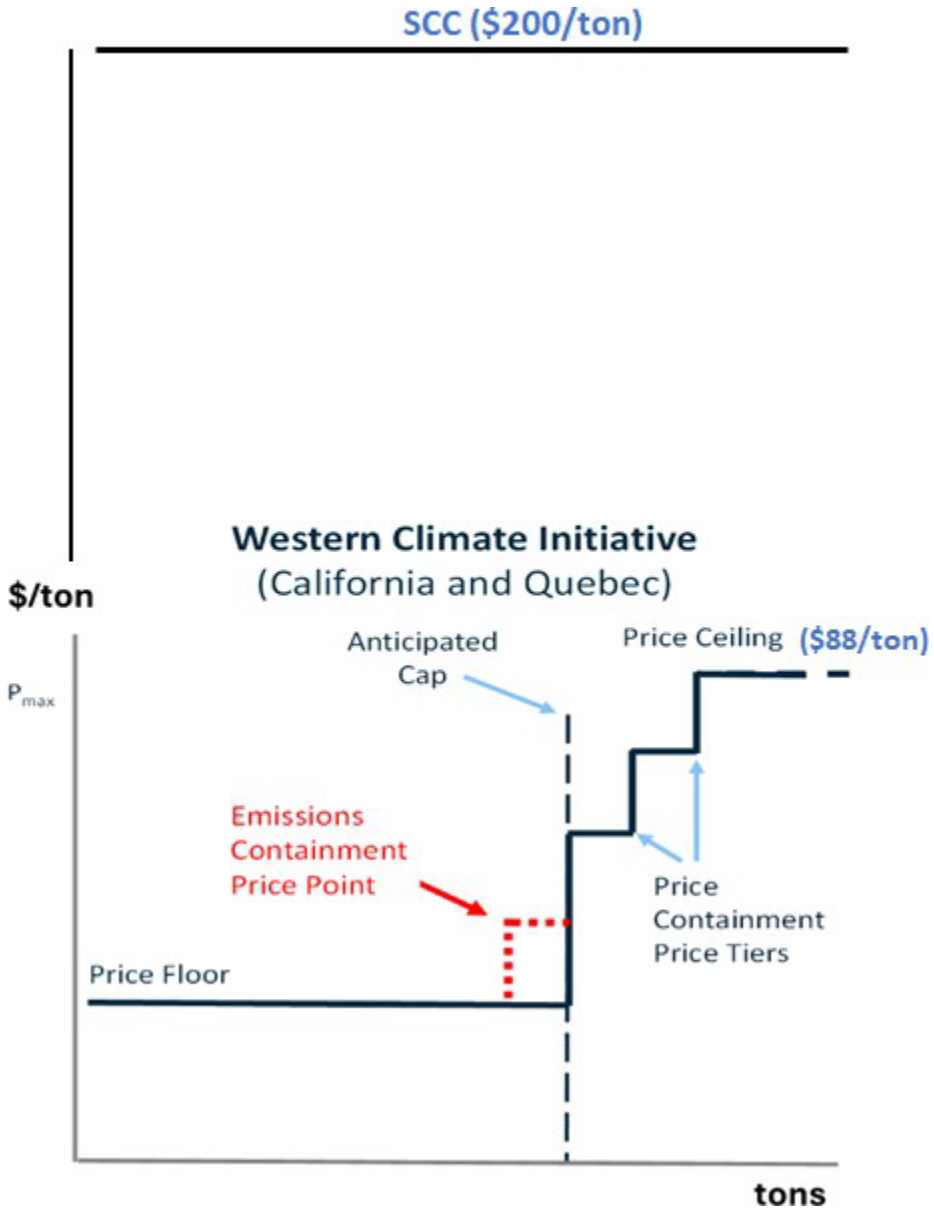
The downward-sloping MC curves in Figure 2 represent alternative forms of the marginal cost of emissions abatement (low, estimated, and high) as a function of GHG levels. The cost of bringing GHGs back to preindustrial levels (on the left side of the figure) would be very high, whereas the abatement cost in a business-as-usual scenario (right side of the figure) would approach zero.

The allowance supply ("available price and quantity pairs" in Theorem 1) is determined by the marginal damages curve. In other words, the carbon price at any emissions level is set equal to the SCC ("... price equals expected marginal damages at the given quantity"). This allowance allocation method is a "mixed" policy instrument in the sense that it is neither a fixed emissions cap nor a fixed emissions price.

Market actors would pay allowance prices up to, but not more than, their marginal emissions abatement cost, choosing rather to invest in abatement if carbon prices are more expensive. At market equilibrium, abatement costs are equal to the carbon price and emissions are at the intersection of the MC and Marginal Damages curves (i.e., somewhere between the two dots in Figure 2). At this point, "the supply of allowances equals the demand and price equals expected marginal damages at the given quantity" as stated in Theorem 1.

The stepped form of the IEMAC's proposed price-responsive allowance supply in Figure 1 is intended to coarsely follow the upward-sloping Marginal Damages curve (SCC) of Figure 2 (cf. Burtraw 2020, Figure 5, Panel A on page 25). However, the actual SCC, i.e., the "best estimate of the marginal damage function" as estimated by EPA, is about $200/ton and exhibits no such slope. Figure 3 below replicates Figure 1, with the EPA's SCC illustrated. The SCC is substantially constant because the horizontal scale in Figure 3 is greatly reduced relative to Figure 2. In Figure 2, the horizontal scale covers the excess atmospheric GHGs resulting from industrialization (950 gigatons since 1850), whereas Figure 3 only spans California's annual allowance allocation (140 million tons in 2024, amounting to only 0.015% of total anthropogenic GHGs in circulation). The SCC slope would be imperceptible on that scale.

Figure 3



Without an upward-sloping marginal damages curve, the multi-tiered allowance supply proposed by the IEMAC lacks any policy basis. As noted in Burtraw 2022, page 856, "... if marginal pollution damages are constant, then there is no benefit to a mixed policy instrument." Moreover, the allowance supply is not determined to match the SCC, although the price ceiling was initially set in 2018 to match the IWG's SCC at the time. The IWG's SCC was much less than the EPA's current SCC estimate, but CARB realized that its SCC assumption could be overly conservative. As stated in the 2018 Initial Statement of Reasons for the Cap-and-Trade Regulation (page 39),

> *… Staff believes, however, that while new research indicates the SC-CO_2 may be much higher, even closer to $220, setting a price ceiling based on this research would be excessive relative to prices needed to achieve the 2030 target, and may be so high that it may lead to leakage and adverse impacts to the economy and households. Staff is proposing a price ceiling of $61 in 2021 (real 2018 dollars), which would escalate over time. This value captures the SC-CO_2 as established by IWG, but recognizes that value does not represent the "full" social cost of carbon.*

There is clear statutory guidance on setting the price ceiling in AB 398 (HSC 38562(c)(2)(A)), but there is no comparable guidance on setting the price floor, and there is no express statutory requirement for a price floor although AB 398 does mandate a multi-tier allowance schedule. The JLCCCP should consider whether cap-and-trade reauthorization should fill in these statutory gaps, and the IEMAC could assist the JLCCCP by articulating the policy rationale for a price floor and proposing decision criteria for setting the floor level.

The IEMAC's proposed "price-responsive allowance supply," including the ECR, is clearly not determined "by using the policy maker's best estimate of the marginal damage schedule as the supply function" according to the policy prescription in Burtraw 2022. The IEMAC's preference for an ECR over simply raising the price floor may be motivated more by perceived political viability than by considerations of economic efficiency, but decisions about political viability should be made by elected politicians, not by economists. The IEMAC's role should be to present the JLCCCP and CARB the full range of economic policy options, without prejudicial bias of political judgement, and the IEMAC should explain the policy considerations for or against each alternative. The IEMAC can reasonably identify its preferred or recommended policy alternative based on considerations of political viability, provided that the political rationale is expressly articulated. ***The IEMAC should not cloak political judgments in the guise of theory-based economic precepts.***

***

Comments on "Cap-and-Trade and Cost Containment in California" (Meredith Fowlie and Brian Holt)

My comments on this chapter pertain primarily to EV subsidies, the topic of section iv in the Appendix. Two key points from this discussion could be briefly addressed in the IEMAC report: ***(1) The lack of robust benefit-cost accounting methodologies, and of resource allocation based benefit-cost prioritization, is seriously impeding***

cost-efficient transportation programs. (2) EV conversion of ICE vehicles is an unappreciated decarbonization strategy that could have a relatively high benefit-cost rating and could expedite electrification of road transport.

EV subsidies are an important topic, considering that Transportation accounts for 39% of California's emissions inventory. And it is a timely topic in view of Trump's order to end EV subsidies and Governor Newsom's pledge to resurrect CVRP if Trump pulls the plug on the federal EV tax credit.

The IEMAC should direct its policy guidance on this topic to the Governor as well as CARB and the JLCCCP. We need smart and efficient transportation policy guided by sound economics, not knee-jerk political reactions that counter federal inaction with wasteful and inefficient state action.

A couple years ago an acquaintance of mine bought a new Tesla Model 3 with assistance from both the $2000 California CVRP rebate and the $7500 federal tax credit. I asked him whether his purchase decision had been at all influenced by the CVRP rebate, and his response was an emphatic "No, absolutely not." He couldn't say for sure whether his purchase decision would have been different without the federal tax incentive, but he was unequivocal that the CVRP incentive had no influence on his choice.

The Allcott paper cited in the IEMAC report finds that the federal credit has been costing the government $32,000 for each additional EV sold because most incentive recipients would have bought an EV even without the credit. As EVs approach price parity with ICE vehicles, incentives will have even less influence on vehicle choice. California probably cannot afford to match the federal $7500 incentive, and while restoring the smaller $2000 CVRP incentive would cost less, the benefit/cost numerator would likely be near-zero due to the weak incentive.

Rather than reviving CVRP, the state's resources might be better spent on accelerating buildout of its EV charging infrastructure so that car buyers who want and can afford a new EV will not be deterred by range anxiety. Also, California has several active transportation incentive programs in operation (CC4A, DCAP, HVIP). The draft IEMAC report briefly discusses the federal EV tax credit, but makes no mention of charging infrastructure or of these other state programs.

CARB's 2024 GGRF Annual Report (Appendix A) reports the following project cost data (cumulative, over the full project life): $1014.5/MTCO2e for CC4A, $322.7/MTCO2e for HVIP, and $368.0/MTCO2e for CVRP. However, these estimates are not meaningful

because of deficiencies in CARB's accounting methodology, which have been criticized by the LAO in a 2018 report (p. 14-15), and by the State Auditor in a 2020 report (Chapter 1). Incentive programs cannot operate efficiently without robust benefit-cost accounting and without a mechanism for allocating resources based on benefit-cost prioritization. This is required not only for prioritizing individual incentives, but also for high-level resource prioritization between major programs. For example, would accelerated electrification of transportation vehicles be marginally more cost-effective than low-carbon fuels? That question cannot be answered (or the answer might be misleading) with CARB's current accounting methodology.

The methodology is illustrated in CARB's Funding Plan for Clean Transportation Incentives, in the FY 2023-24 Funding Plan (not 2024-25), Appendix A, for several programs such as CC4A and HVIP. One deficiency of the methodology is that GHG benefits of clean vehicles are counted only over the vehicle's ownership requirement (2.5 years at 13,600-mile annual VMT for CC4A, and 3 years at 31,000-mile annual VMT for HVIP). There is no clear policy rationale for this limitation because after an EV is sold, it will enter the used EV market and will be available to other buyers who might not be able to afford a new EV. Allcott counts emission savings over a 150,000-mile vehicle lifespan (which is probably an underestimate because newer EVs and batteries can last much longer). By not applying lifecycle emissions accounting, CARB understates the GHG benefit of clean vehicle incentives by an order of magnitude.

On the other hand, CARB overstates the GHG benefit of its incentive programs by ignoring the impact of incentives on consumer choice. CARB has collaborated with the Center for Sustainable Energy (CSE) on studying "rebate essentiality," which measures the extent to which vehicle rebate incentives affect consumer choice. (Allcott calls this "subsidy additionality".) However, CARB does not account for rebate essentiality in its accounting methodology.

A fundamental principle of regulatory incentives is that they will more likely affect consumer choice if they are targeted at consumers who are in greatest need of the incentive. CVRP offered increased rebates of $7500 for income-qualified applicants (compared to the standard $2000 rebate). The combination of the income limit and the higher incentive increased the likelihood that the recipient's decision to buy a new EV was influenced by the rebate. However, this did not necessarily translate into greater program effectiveness because of a mitigating factor that is neglected in CSE's rebate essentiality metric: If the buyer's alternative to buying a new EV would have been to buy a used car rather than a new ICE vehicle, then the subsidy might have perversely incentivized increased emissions by inducing the manufacture and sale of a new vehicle without affecting the counterfactual number of ICE vehicles on the road. (A

macroeconomic analysis would be required to estimate the impact of a marginal, subsidized new vehicle sale on used-car scrappage and export rates.)

California's Clean Cars 4 All (CC4A) program provides incentives of up to $14,000 for low-income consumers to scrap their old ICE vehicle and replace it with a clean alternative, typically a used EV. CARB's accounting methodology calculates emissions reductions for CC4A based on the difference between the retired and replacement vehicles' emissions. However, the replacement vehicle's emissions are irrelevant because a used vehicle's emissions are unaffected by the change of ownership. The CC4A incentive enables the recipient to outbid other buyers in the used-EV market, making fewer used EVs available to other buyers.

The primary GHG benefit of CC4A comes from the scrappage requirement. The benefit is insignificant if the retirement vehicle is already at or near the end of its useful lifespan. But scrapping relatively newer vehicles at a scale sufficient to materially affect statewide emissions would be very expensive. Moreover, the vehicle market shortage resulting from premature vehicle scrappage could result in commensurately less scrappage of older, highly-polluting vehicles, as repair and continued use of those vehicles could be more economical than scrappage and replacement. The benefit of early scrappage could thus be offset by leakage.

CARB's 2022 Scoping Plan considered a straw-man policy alternative, "Alternative 1: Carbon Neutral by 2035," which was rejected due in part to the "Highest direct costs due to early retirement of nearly all vehicles … by 2035." However, the high cost of early retirement can be avoided by using EV conversions, i.e., replacing an ICE vehicle's combustion engine and drivetrain with EV components. Carbon neutrality by 2035 might be an unrealistic target, but EV conversions provide an alternative strategy for expedited decarbonization of road transport that could be marginally less costly than the next-best alternative, low-carbon fuels.

Unlike new-EV incentives, which achieve emissions reductions by displacing new ICE vehicle sales, EV conversions reduce emissions by effectively removing existing ICE vehicles from circulation. The high cost of new vehicles and their associated manufacturing emissions are avoided. Scrappage costs are incurred only for the ICE engine and drivetrain, and are offset by reduced operating costs and extended vehicle lifespan. In contrast to whole-vehicle scrappage incentives, EV conversion incentives do not reduce the number of vehicles in circulation, so there would be no leakage resulting from induced vehicle scarcity. Furthermore, "rebate essentiality" (subsidy additionality) would be a non-issue if ICE engine scrappage is required as a condition of subsidized EV conversion.

CARB has opposed legislative efforts to provide regulatory support for EV conversion of passenger cars, in part because of potential safety concerns, and also because of staff's perception (based on outdated, anecdotal information) that EV conversions are uneconomical. The safety concerns can be resolved. France recently instituted safety regulations requiring that EV conversion safety be "of the same standard as a new electric vehicle." Regarding economic practicality, the following report evaluates the potential of EV conversions in a European context, and its conclusions may be broadly applicable to the U.S. market as well:

> "Ending the ICE age – Can e-retrofit help Europe phase out fossil fuel cars?" (Electrify 2023)

CARB has also opposed EV conversions for the following stated reason:

> *Funding conversions is at odds with the Governor's ZEV Executive Order N-79-20 to support ZEV sales for new light-duty vehicles by diverting limited funding away from new ZEVs to instead fund conversions of conventional vehicles. Since CARB is a part of the Governor's Administration we support his policies.* [6/4/2024 email from CARB's Legislative Director, Dr. David Garcia, to Ken Johnson]

The cited EO N-79-20 says the following:

> *It shall be a goal of the State that 100 percent of in-state sales of new passenger cars and trucks will be zero-emission by 2035. It shall be a further goal of the State that 100 percent of medium- and heavy-duty vehicles in the State be zero-emission by 2045 for all operations where feasible and by 2035 for drayage trucks. It shall be further a goal of the State to transition to 100 percent zero-emission off-road vehicles and equipment by 2035 where feasible.*

This order needs to be updated to reflect changes in California's transportation policy. With or without conversion incentives, the existing CC4A program is "at odds with" the Governor's Order by funding used-EV incentives. Moreover, California has abandoned its zero-emission trucks rule in anticipation of federal opposition from the Trump administration.

Although CARB does not support EV conversion of passenger cars, it does accept and promote EV conversion of buses and trucks in HVIP. Supported conversion vehicle types include a School Bus, Van, and two Trucks (Evolectric and SEA Electric). The

benefit-cost rating of EV-conversion buses and trucks would be high, but HVIP allocates awards on a first-come-first-served basis, so a high benefit-cost rating for EV conversions would give them no preferential advantage. Economically efficient award prioritization would be based on benefit-cost scoring that accounts for the following factors:

- Cost: For buses and trucks, EV conversions cost about half as much as new EVs, and the cost ratio might be further reduced with standardization, economies of scale, and continued evolution of EV component technologies.
- Scrappage: HVIP has no scrappage requirement, but with an EV conversion the old ICE engine would normally be scrapped.
- Manufacturing emissions: EV conversion avoids the emissions associated with manufacture of a new vehicle body and chassis.
- Economic need and consumer choice: EV conversions would best serve the needs of buyers who are least able to afford a new EV, and whose buying choices are most likely to be influenced by subsidization.

***

Comments on "Environmental Justice Options in California's Cap-and-Trade Program" (Katelyn Roedner Sutter & Meredith Fowlie)

The draft report notes that "While EJ advocates are deeply concerned about global climate change, their objections to California's GHG cap-and-trade program generally stem from the impact of this program- or lack thereof - on local air pollutants such as sulfur dioxide and nitrogen oxides." The report discusses several EJAC-proposed reforms, but these do not directly address the core issue that cap-and-trade is inapplicable to criteria pollutants. Cap-and-trade is foundationally based on the premise that the impact of regulated emissions has no dependence on where or when the emissions occur, whereas the opposite is true of criteria pollutants. The EJAC proposals appear to be "band-aid fixes" that try to adapt cap-and-trade to do something it is not designed to do.

The IEMAC should consider whether cap-and-trade should be complemented with regulations to directly regulate criteria pollutants, or whether existing air quality laws and regulations can be more effectively applied to criteria pollutants.

Effective regulation must be based on robust benefit-cost accounting, which appears to be lacking in CARB's regulatory processes. Case in point: CARB-administered AQIP projects for mobile pollution sources are required by statute (HSC 44274(b)) to "provide preference in awarding funding to projects with higher benefit-cost scores," where

"'Benefit-cost score' means the reasonably expected or potential criteria pollutant emission reductions achieved per dollar awarded by the board for the project" (HSC 44270.3(b)(1)). CARB may give "additional preference" based on other criteria, such as "climate change benefits," which are enumerated in HSC 44274(b)(1)...(6), but the mandated "benefit-cost score" applies specifically to criteria pollutants.

One such AQIP program is HVIP, which provides vouchers for clean truck and bus purchases. HVIP awards are prioritized on a first-come-first-serve basis, contrary to statutory requirement of HSC 44274(b). (The class of "projects" that HSC 44274(b) applies to expressly includes vouchers under HSC 44270.3(b)(2).) However, CARB calculates emissions data from which a benefit-cost score could be determined for the purpose of project prioritization. The emissions quantification methodology is illustrated in CARB's Funding Plan for Clean Transportation Incentives, in the FY 2023-24 Funding Plan (not 2024-25), Appendix A, for an $80 million appropriation in 2023 to finance zero-emission drayage trucks under HVIP (page A-25 et seq). Emission factors are calculated for GHGs, NOx, PM2.5, and ROG. These factors could be monetized using the EPA's Social Cost of Carbon for GHGs (about $200/ton-CO2e) and monetization factors for criteria pollutants (e.g., $60,200/ton-NOx for Internal Combustion Engines), and the monetized benefits could be added to determine a combined benefit-cost score.

The above-cited document also illustrates CARB's benefit-cost calculation methodology for two particular AQIP programs: Innovative Small e-Fleets and Clean Off-Road Equipment (page A-36 et seq). The FY 2022-23 Funding Plan, Appendix A, outlines the methodology for the Truck Loan Assistance Program (page A-53 et seq). The "benefit-cost score" defined in these documents is based on a point-rating heuristic that differs from, and is not proportional to, the "benefit-cost score" defined by statute ("pollutant emission reductions achieved per dollar awarded," HSC 44270.3(b)(1)). Historical background on the development of this methodology can be found in the FY 2014-15 Funding Plan.

One complication in defining a benefit-cost score for criteria pollutants is that a uniform $/ton monetization factor cannot account for differences in health impacts depending on where and when emissions occur. For example, the factor will be proportional to local population density, and could depend on time-dependent factors such as thermal inversion. High per-capita health impacts resulting from concentrated emission sources would not be reflected in a $/ton monetization factor if the numerator and denominator both scale in proportion to emissions density. (A high density of pollution sources would result in relatively high, localized pollution levels and high per-capita health impacts, but mitigation costs would also be relatively high.) The economic benefits of pollution-generating activities are uniformly distributed economywide, whereas the

health costs are not, and the disproportionate health burden of communities affected by high pollution levels should be accounted for in the benefit-cost accounting.

It might not be feasible to account for location and time dependencies of benefits in prioritizing individual vehicle incentives, but they could be accounted for in rating broad investment categories such as the HVIP program as a whole or the Drayage Truck incentive program within HVIP. Drayage trucks generally traverse well-defined routes between seaports and railyards, and vehicles such as delivery trucks are statistically concentrated in population centers. Furthermore, location- and time-dependent monetization factors could be used for individual, stationary-source emitters such as industrial combustion facilities.

California's pollution regulations for both stationary and mobile sources are intertwined with federal policy and are subject to federal preemption, and they could be vulnerable to sabotage by the Trump administration. California might be able to sidestep federal obstruction by shifting from standards-based regulations to incentives. For example, a vehicle emission standard could be converted to a feebate incentive policy, which would retain much of the same program design and would appear to regulated entities to be much like a tradable standard, except that emission prices rather than emission quantities would be regulated. A feebate-type policy could similarly be applied to stationary-source industrial polluters as described in the following paper:

> Wolff, G.H., 2000. When will business want environmental taxes? Redefining Progress, San Francisco.

This type of policy would be similar to an emissions tax, except that a regulated entity would only pay a fee (at a regulated emission price) on the portion of its emissions in excess of what its emissions would be at the industry-average emissions intensity. If the entity has better-than-average emissions intensity, its "fee" would be negative (a rebate). The feebate emissions price could be much higher than what would be politically and economically feasible with an emissions tax. Pollution pricing could be simultaneously applied to multiple pollutants, including GHGs, using location- and time-dependent emission prices for criteria pollutants.

***

Comments on "Carbon Management in California's Cap-and-Trade Program" (Katelyn Roedner Sutter & Brian Holt)

CARB's 2022 Scoping Plan is based on the expectation that GHG emissions can be reduced to 85% below the 1990 level by 2045, and that CDR will be required to offset the remaining 15%. The 85% fraction originated from the cap-and-trade sector coverage established in the original 2008 Scoping Plan, based on the existing technology landscape at the time. ***The legislature and CARB should review the assumptions underlying the 85% GHG reduction goal to determine whether alternative evolving technologies such as sustainable cement could help close the 15% net-zero gap more cost-effectively than CDR and potentially more quickly, and to inform contingency plans for accommodating such technologies.***

One such technology option was reported in the October 20, 2022 SB-596 Workshop for CARB's "Net-Zero Emissions Strategy for the Cement Sector". In one of the invited presentations by cement industry representatives, Oakland-based Brimstone discussed their negative-carbon cement production process and asserted that "We have a path to sequester up to 1 ton of CO2 per ton of cement," and that they could do so "Cost parity or better." (Conventional cement production emits 0.8 ton-CO2 per ton-cement.)

This development raises several questions that could impact the state's climate policy planning. How might Brimstone's process and other advances in cement and in other industries impact the estimated achievable GHG reduction in 2045, and could they make it possible to achieve net-zero emissions sooner than 2045 in accordance with the AB-1279 directive to achieve net-zero emissions "as soon as possible"? How would a process such as Brimstone's, which could perform carbon sequestration either in conjunction with cement production or in stand-alone CDR mode, be classified under cap-and-trade? Should regulatory efforts such as SB 596 be expedited to accommodate technologies that are at an advanced development stage and will soon be in commercial production? (Brimstone is currently selecting a site for a commercial-scale demonstration plant, which DOE is funding. Meanwhile, CARB's SB-596 program has stalled; there has been no activity since the last workshop in October, 2023.)

The following paper discusses policy issues and options relating to cement, which are within the IEMAC's purview:

> Johnson, K.C., 2025. California's Senate Bill 596: Spearheading the global transition to sustainable cement. *Next Sustainability*, 6, p.100106. https://doi.org/10.1016/j.nxsust.2025.100106

This paper proposes a cement decarbonization strategy with the following aims:

- Effectuate the SB-596 mandate to "achieve net-zero emissions of greenhouse gases associated with cement used within the state as soon as possible" within limits of cost affordability.
- Pursue policies and collaborations to facilitate and expedite global cement decarbonization at a scale that can significantly impact climate change, and leverage the global investment potential of sustainable cement to facilitate early-stage development and commercialization in California and other first-mover jurisdictions.
- Employ stable and predictable carbon pricing incentives to give economic value to cement decarbonization and to attract long-term investment in sustainable cement.
- Apply carbon pricing revenue to finance decarbonization of the regulated cement sector and to mitigate regulatory costs.

***

Comments on "Carbon Offsets" (Danny Cullenward and Dallas Burtraw)

A question that is not addressed in the IEMAC report, but which should be considered in the context of cap-and-trade reauthorization, is what role offsets are intended to play in the AB-1279 policy to "Achieve net zero greenhouse gas emissions as soon as possible, but no later than 2045, and to achieve and maintain net negative greenhouse gas emissions thereafter." Is it the legislative intent that this policy is to be pursued as part of a coordinated effort to achieve net-zero or net-negative global greenhouse gas emissions in accordance with IPCC guidance on requirements for climate sustainability? Or would California be able to achieve its goal by purchasing over-the-cap offsets from other jurisdictions that do not regulate GHGs, or that have relatively looser regulations without net-zero targets? Or alternatively, would California attain net-negative statewide emissions so that it can sell offsets and allowances to other jurisdictions with net-positive emissions, allowing those jurisdictions to count California's negative emissions against their own emission targets?

If the legislature's intent is to support efforts to decarbonize the global economy as soon as possible, rather than merely decarbonizing the state economy as cheaply as possible, it can do so by helping to fund such efforts in addition to, not in lieu of, reducing in-state emissions. ***The IEMAC's proposed policy alternative to "Replace offsets with projects or credits procured with dedicated cap-and-trade funding" would support efforts to expedite global decarbonization.***