

December 15, 2022

Board members and staff
California Air Resources Board
1001 I Street Sacramento, CA 95814

Submitted electronically

Dear California Air Resources Board,

We are researchers at the University of California, Berkeley, with a common research focus on the intersection of forest management, forest carbon accounting, and the quality of carbon offsets. We are also co-authors on a journal article currently under review that compares all improved forest management (IFM) offset protocols that have generated credits to date with the latest literature on forest carbon accounting methods (Haya et al., under review). Herein, we summarize our findings on the IFM section of California's U.S. Forest Projects offset protocol, which has generated the large majority of credits under this protocol.

We applaud the Air Resources Board (ARB) for considering reviewing and amending its U.S. Forest Projects offsets protocol. Since the current version of the protocol was adopted in 2015, the science of forest carbon accounting has advanced substantially, and with growing experience with the protocol, a number of studies have been published analyzing the protocol's outcomes. These studies show that the protocol needs several important changes to avoid generating credits far in excess of its actual effect on emissions and carbon sequestration. Baselines, leakage, harvested wood product accounting, and durability elements of the current protocol can be brought into better alignment with current science. We focus this comment letter on literature that has been published or is currently under journal review.

Summary of Recommendations for Protocol Amendment

Baselines

- The most important area for reducing over-crediting is changing the way baselines are determined. We recommend setting baselines in one or a combination of the following four ways: (1) current levels; (2) past practice for the particular parcel (not for a broad regional average); (3) dynamically; or (4) based on NPV, for some forest lands in which NPV is predictive. These approaches are more conservative than current methods that have systematically resulted in aggressive harvesting baselines.
- To the extent that common practice continues to be used in baseline estimates, methods for estimating common practice developed by Badgley et al. (2022a) should replace ARB's current methods that allow for baseline gaming.

Leakage & harvested wood product accounting

- One important correction to the ARB protocol is to fix a contradiction in the baseline whereby predicted onsite carbon stocks contradict predicted levels of harvesting and leakage. A straightforward correction is to assume levels of harvesting in the baseline that match any assumed drop in onsite carbon stocks (Haya, 2019; Cabiyo et al., in submission).
- Similarly, protocols could avoid another source of over-crediting by using temporally explicit decay functions, rather than the averages of such functions, to estimate carbon in harvested wood products instead of assuming all carbon removed during harvesting is lost immediately (Cabiyo et al., in submission).
- Instead of 20%, ARB could apply a higher leakage rate better aligned with current, albeit limited, literature available, until new data and methods can be developed to support a more refined approach (Haya, 2019; Haya & Stewart, 2019).

Durability

- ARB could increase its buffer pool deductions to better reflect reversal risks with climate change (Anderegg et al., 2022; Badgley et al., 2022b), especially in light of the recent catastrophic fires that have emitted more carbon in a single year than California's climate policies have saved over the course of several decades (Jerrett et al., 2022).
- For projects in California, incentives created by the offset protocol to maintain and increase carbon stocks are directly contradictory with the goals of the state's Forest Health Grants program that pays forest owners to reduce the risk of wildfire through fuels reduction. ARB could bring its forest offsets protocol into better alignment with the state's broader goals by better incentivizing or requiring management for fire risk in moderate or high fire risk regions (Herbert et al., 2022).

Baselines

The most important area for reducing over-crediting is changing the way baselines are determined. The protocol allows any improved forest management project with initial carbon stocks above regional averages for its forest type (the large majority of projects) to choose a baseline that is above the regional average for the forest type, aligned with legal or other obligations, and financially feasible. The chosen baseline needs to meet these requirements but does not need to reflect the most likely future land management practice.

Logically, this means that forest landowners that already would have managed their lands in ways that hold more carbon per acre than the average can receive offset credits from ARB's offset program for their business-as-usual land management practice. This approach does not protect against adverse selection, whereby participation is skewed towards participants that have less to lose and more to gain by participating (more credits for less effort) rather than participation centering around the average.

Recent literature has found empirical evidence that non-additional crediting is widespread. First, almost all projects use baselines at or within several percentage points of minimum allowed baselines

(Badgley et al., 2022a). This shows that most project developers are choosing baselines that maximize crediting. Further, since the average project starts with levels of carbon per acre around 43% above the chosen baselines (Haya et al., under review), project developers are receiving credits for their past land management practice that has allowed for the accumulation of forest carbon to well above regional averages.

In a sobering critique of ARB's current methods of baseline-setting and credit generation, Coffield et al. (2022) used remote sensing to study the effects of offset projects in Northern California on carbon accumulation, and found no discernable carbon benefit as a result of the offset projects. Rates of accumulation on offset project lands were not significantly different from past rates on the same lands, nor were they different from rates on similar control areas. They found no evidence that offset projects are at risk of being harvested to the baseline. A larger study analyzing all ARB IFM projects across the United States has similar findings (Stapp et al., under review). This study found that IFM projects in the ARB protocol had lower historical disturbance than regional averages and that participating landowners did not significantly reduce disturbance three and five years after project initiation relative to similar lands. With complementary results, Badgley et al. (2022a) found evidence of adverse selection whereby the lands participating in the protocol are skewed towards forests with carbon stocks that are naturally higher than the average for their assessment area.

Baselines are inherently uncertain because they reflect land management practice in a counterfactual scenario that never happened. Since ARB offset credits are tradeable with direct reductions by regulated facilities within the state, ARB requires offset protocols to estimate project impacts conservatively, defined as more likely to under-credit than to over-credit.¹ Baseline uncertainty can potentially be reduced and conservativeness increased by developing baselines on historical practice, initial carbon stocks, similar lands with "dynamic" baselines, and NPV for landowners where NPV is reasonably predictive with some restrictions. Methods would be developed, possibly drawing on several of these methods, to conservatively predict land management decisions for different land ownership classes. Most importantly, baselines should avoid being far below initial or recent past practice to contain the risk of non-additional crediting through adverse selection.

To the extent that the protocol continues to use the idea of common practice, Badgley et al. (2022a) develops a revised common sense method for defining common practice to reduce the risk of gaming by project developers. This article found that just the way that ARB defines common practice alone has led to over-crediting of 29% (29% of credits generated are in excess of what would have been generated had ARB used a more refined method of estimating common practice).

Leakage

One important correction to the ARB protocol is to fix a contradiction in the baseline scenario that has led to significant over-crediting. Currently, in the first year of a project, the landowner receives

¹ California Code of Regulations, title 17, § 95802.

credits against a constructed baseline scenario in which they would have rapidly harvested down to baseline levels, but credits are deducted for carbon in harvested wood products and leakage as if the landowner will gradually harvest down to the baseline over 100 years. A straightforward correction is to assume harvesting in the baseline that matches any assumed drop in onsite carbon stocks (Haya, 2019; Cabiyo et al., in submission). In order to avoid discouraging projects that extend rotations by reducing harvesting for short periods, leakage deductions could be applied over several years, and positive leakage could be accounted for cumulatively rather than annually when harvesting is larger in the project than in the baseline scenario.

Similarly, protocols could avoid over-crediting by directly modeling decay functions, rather than taking averages of decay, to estimate carbon in HWPs instead of assuming all carbon that is lost during the assessment period is lost immediately (Cabiyo et al., in submission).

On the leakage rate used, the protocol has opted to apply a low 20% leakage rate, which is generally inconsistent with the limited literature available (Haya, 2019; Haya & Stewart, 2019). This approach strays from the conservativeness principle which requires methodological choices more likely to under-credit than to over-credit when there is uncertainty.

Correcting the baseline timing issue, and applying a 40%, 60%, or 80% leakage rate, respectively would reduce the number of credits by 51%, 67%, or 82% across the ARB IFM portfolio (Haya, 2019). In addition to fixing the timing issues, to be accurate and conservative, ARB could apply a higher leakage rate until new data and methods can be developed to support a more refined approach.

Durability

Because annual acreage of forest fires in the United States is projected to quadruple by the end of the century even under a moderate emissions scenario (Anderegg et al., 2022), current buffer pool allocations may prove insufficient on the basis of wildfire risk alone. If recent wildfire trends continue in the United States, the entirety of the buffer pool for existing ARB projects will be consumed well before its intended lifetime is up (Badgley et al., 2022b). Buffer pool deductions should be updated to reflect evolving understanding of reversal risks with climate change.

For projects in California, incentives created by the offset protocol to maintain and increase carbon stocks are directly contradictory with the goals of the state's Forest Health Grants program that pays forest owners to reduce the risk of wildfire through fuels reduction. ARB's forest offset protocol could create perverse incentives for landowners to maximize carbon today rather than manage for stable carbon. ARB could bring its forest offsets protocol into better alignment with the state's broader forest goals by better incentivizing or requiring management for fire risk in moderate or high fire risk regions, or by otherwise supporting fuels treatments on or surrounding IFM offset projects (Herbert et al., 2022).

We would be happy to answer questions or discuss these recommendations.

Most sincerely,

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References currently under review or in submission

(Once each is published, these articles will be available on the [Berkeley Carbon Trading Project publications website](#).)

Cabiyo, B., Sanchez, D. L., Potts, M. D., & Haya, B. K. (in submission). Inconsistent temporal accounting in California's carbon offsets protocol.

Abstract: Averages taken over time are commonly used to simplify carbon accounting but can introduce significant temporal errors. Here, we analyze two simplifications in the way California's precedent-setting forest carbon offset protocol accounts for wood products, resulting in the generation of credits for climate benefits expected to occur decades later. We find that these simplifications have resulted in the miscrediting of 42.2Mt CO₂e—nearly half of the credits we analyzed—worth US\$578M at recent market rates.

Haya, B. K., Evans, S., Brown, L., Bukoski, J., Cabiyo, B., Jacobson, R., Kerr, A., Potts, M.D., Sanchez, D.L. (under review). Comprehensive Review of Carbon Quantification by Improved Forest Management Offset Protocols. *Frontiers in Forests and Global Change*

Abstract: Improved forest management (IFM) has the potential to remove and store large quantities of carbon from the atmosphere. Around the world, 235 IFM offset projects have produced 14% of offset credits by voluntary offset registries to date, channeling substantial climate mitigation funds into forest management projects. This paper summarizes the state of the scientific literature for key carbon offset quality criteria – additionality, baselines, leakage, durability, and forest carbon accounting – and discusses how well currently used IFM protocols align with this literature. Our analysis identifies

important areas where the protocols deviate from scientific understanding related to baselines, leakage, risk of reversal, and the accounting of carbon in forests and harvested wood products, risking significant over-estimation of carbon offset credits. We recommend specific improvements to the protocols that would likely result in more accurate estimates of program impact, and identify areas in need of more research. Most importantly, more conservative baselines can substantially reduce, but not resolve, over-crediting risk from multiple factors.

Stapp, J., Nolte, C., Potts, M.D., Baumann, M., Haya, B.K., Butsic, V. (under review). Early indications of effectiveness in California's forest offset program. *Nature Communications Earth & Environment*

Abstract: Carbon offsets are widely promoted as a strategy to lower the cost of emission reductions, but recent findings suggest that offsets may not reduce emissions by the amount claimed. In a compliance market, offsets increase net emissions if they do not reflect real emission reductions beyond the baseline scenario. Few studies have examined the additionality of forest carbon offsets within California's U.S. Forest Projects compliance offset protocol, one of the largest forest offset programs in the world. Here we examine additionality in California's offset protocol. Since 2012, most of California's offset credits (84%) have been awarded to improved forest management (IFM) projects. Using a novel database of IFM project characteristics, locations, and remotely sensed forest disturbance data indicative of forest management activity, we find that IFM projects have been primarily allocated to forests with high carbon stocks (127% higher than regional averages) and low historical disturbance (28% less disturbance than regional averages since 1985). Quasi-experimental analysis suggests limited additionality, as forest offset projects creation did not significantly lower forest disturbance rates 3 and 5 years after project implementation relative to similar non-project lands. These results indicate that California's forest offset protocol may contribute to an increasingly large carbon debt.