# Carbon offsets

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## Introduction

California has a large carbon offsets program. As the end of December 2024, the California Air Resources Board (CARB) has issued more than 267 million offset credits across four protocols that credit activities involving forests across the continental United States and parts of Alaska (81%), the destruction of ozone-depleting substances (10%), coal and trona mine methane capture (6%), and livestock manure digesters (3%).[1] Of the 267 million credits issued, almost 35 million were set aside in the forest protocol buffer pool, leaving almost 233 million available for compliance use. As of the end of the fourth compliance period, compliance entities in the Western Climate Initiative surrendered about 209 million California-issued offsets for compliance purposes (and another 1.4 million offsets issued by the Government of Québec), contributing to the bank of approximately 379 million unused allowances.[2]

Under the original provisions of Assembly Bill 32 (Stat. 2006, Chap. 488), the offsets program is subject to several statutory requirements. Carbon offsets must be "real, permanent, quantifiable, verifiable, and enforceable" by CARB;[3] the outcomes CARB credits must also be "in addition to" any outcomes "required by law or regulation" or "that would otherwise occur," which is collectively known as an additionality requirement.[4] CARB's cap-and trade regulations define the word "permanent" to mean at least 100 years; define "additional" as outcomes that "exceed any greenhouse gas reductions or removals that would otherwise occur in a conservative, business-as-usual scenario"; and define "conservative" to mean using assumptions and methodologies "that are more likely than not to underestimate" credited climate benefits.[5]

AB 32 authorized the original cap-and-trade program but did not specify or prohibit any role for carbon offsets. When CARB developed the original cap-and-trade program, it decided to include a carbon offsets program and to put the supply of carbon offsets "above the cap," meaning that the supply of offset credits expanded the supply of compliance instruments in the cap-and-trade program. By regulation CARB limited the

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1 CARB also approved two additional protocols that have not been used and allows California compliance entities to use offsets issued by its counterpart agency in Québec, which has issued an additional 1.7 million offset credits.

2 CARB, Q4 2024 Compliance Instrument Report. The number of offsets used for compliance purposes is taken from the "Retirement" account (column J), while the bank of allowances is calculated by adding the number of allowances held in private entities' "General" and "Compliance" accounts (columns B and C) for vintages 2013 through 2023 (rows 13 through 23).

3 Health and Safety Code § 38562(d)(1).

4 Health and Safety Code § 38562(d)(2).

5 California Code of Regulations, Title 17, § 95802 (see "permanent" "additional" and "conservative").

use of offsets to no more than 8% of a covered entity's compliance obligations. While this limit might seem small numerically, it is similar in size to the reductions CARB initially anticipated from the cap-and-trade program through 2020.[6] Offsets can be banked indefinitely without limits on the total number of offsets an entity can hold at any given time; however, eligibility to use offsets for compliance cannot be transferred or banked.

When the legislature re-authorized the cap-and-trade program in Assembly Bill 398 (Stat. 2017, Chap. 135), it enacted new limits on the use of carbon offsets. AB 398 lowered the limit from 8% to 4% for emissions in calendar years 2021 through 2025, rising back up to 6% in calendar years 2026 through 2030. AB 398 also required that covered entities use no more than half of the 4% or 6% limit from projects that do not deliver "direct environmental benefits" to state air or water quality.[7] There are no regulatory or statutory limits on offset use after 2030.

Actual offset usage was reported as follows:[8]

| **Reporting period** | **Offsets as % of compliance** | **Offsets limit** |
|---|---|---|
| 2013-2014 | 4.39% | 8% |
| 2015-2017 | 6.36% | 8% |
| 2018-2020 | 6.94% | 8% |
| 2021-2023 | 3.10% | 4% |

Beyond their role as a compliance option for regulated emitters and associated effects on compliance costs, offsets also play an important role in directing resources to sectors and stakeholders that are not directly regulated in the cap-and-trade program. One of the most important stakeholder groups that benefit from the current program are Tribes and Alaskan Native communities. Of the more than 267 million offset credits issued by CARB through 2024, we estimate that about 61 million were issued to projects involving Tribes and Alaskan Native communities across the United States. The income from selling these credits to covered emitters can be significant in both financial and non-financial terms. For example, the Yurok Tribe, which is the largest federally recognized tribe in California, has earned more than 3 million credits, the sale of which helped the Yurok Tribe purchase tracts of ancestral land.

6 See this explanation from UC Berkeley researcher Dr. Barbara Haya.

7 Health and Safety Code § 38562(c)(2)(E).

8 Data sources: 2013-2020 (IEMAC 2021: 30) and 2021-2023 (CARB's compliance report).

Offset issuance and price data are as follows:[9]

| | | Price (nominal USD per credit) | | | Value of issuance (million nominal USD) | |
|---|---|---|---|---|---|---|
| **Year** | **Issuance (millions)** | **Generic Credit** | **Forest DEB** | **Allowance** | **100% generic credits** | **50% generic, 50% DEB** |
| 2013 | 3.92 | — | — | — | — | — |
| 2014 | 9.82 | $9.65 | — | $11.95 | $94.8 | — |
| 2015 | 17.21 | $10.20 | — | $12.66 | $175.5 | — |
| 2016 | 17.34 | $10.86 | — | $12.76 | $188.3 | — |
| 2017 | 28.28 | $11.89 | — | $14.40 | $336.2 | — |
| 2018 | 46.64 | $13.16 | — | $15.13 | $613.8 | — |
| 2019 | 22.76 | $14.13 | — | $17.07 | $321.6 | — |
| 2020 | 39.36 | $13.71 | — | $16.86 | $539.6 | — |
| 2021 | 15.18 | $14.91 | $16.14 | $25.39 | $226.3 | $235.7 |
| 2022 | 10.41 | $17.74 | $19.91 | $28.50 | $184.7 | $196.0 |
| 2023 | 12.21 | $20.88 | $26.65 | $33.97 | $254.9 | $290.2 |

## Policy design purposes

Carbon offsets have three primary effects:

- **Offsets that are "above the cap" reduce carbon prices.** Carbon offsets currently expand the supply of compliance instruments because they are issued in excess of the program's allowance budgets. Because carbon offset prices have historically been below the auction price of allowances, offset availability lowers the compliance cost for regulated entities. Further, offsets substitute for the most expensive (marginal) mitigation options that determine the market price of allowances, so increasing the market-wide supply of compliance instruments reduces the resulting carbon price, which also lowers compliance costs for covered emitters and reduces revenues collected for the Greenhouse Gas Reduction Fund and California Climate

[9] Issuance is based on CARB's ARBOC issuance table and prices are weighted average prices for U.S. forest ARBOCs and allowances from CARB's annual summary of market transfers report. Issuance data are reported net of buffer pool contributions.

Credits. For example, a recent issue brief from Resources for the Future (Burtraw and Roy 2025) estimates that limiting the eligibility to use offsets to 4% in 2026 would increase the allowance price in that year by $1.28 (2024$).

- **Offsets direct resources to target sectors and stakeholders.** The sale of carbon credits raises funds that support project activities in the sectors and geographies where projects are eligible to earn carbon credits. These sectors are not covered by the emissions cap and often involve activities that are not subject to direct climate regulations, such as activities involving carbon storage in natural and working lands. A significant fraction of the activities credited in these sectors involve Tribes and Alaskan Native communities. While reporting data do not indicate how much of that total value is transferred to project intermediaries, such as credit brokers and project developers, covered entities transfer significant funds to target sectors and participating stakeholders when they purchase offset credits. These are private transfers from greenhouse gas emitters directly to offsets projects, bypassing rather than involving the state's Greenhouse Gas Reduction Fund.
- **Offsets shift where emissions and reductions occur.** Offsets allow for higher emissions from fossil fuel use at regulated sources covered by the cap-and-trade program in exchange for lower emissions or greater carbon storage outside the cap-and-trade program. This can lead to environmental justice harms inside the state (cross-reference EJ chapter) as well as corresponding environmental and equity benefits in project locations, including on Tribal lands. The IEMAC has previously observed that offsets can make it harder to achieve statewide greenhouse gas emissions limits, as they allow higher emissions from covered entities in exchange for climate benefits claimed outside of the cap-and-trade program (IEMAC 2021: 27-35). Because many projects are outside the state and most projects inside the state are not included in the state's AB 32 greenhouse gas inventory, offsets have the practical effect of increasing statewide emissions as those emissions are recorded in the AB 32 inventory. (In-state projects generate benefits that are recorded in a separate natural and working lands inventory, which CARB does not use to track compliance with state emission reduction laws.)

## Evidence about the program's performance

A growing number of academic studies have questioned whether California's carbon offsets program is achieving its intended climate mitigation objectives (Haya et al. 2020), particularly when it comes to the forest carbon protocols that generate 81% of offset credits. Major concerns include:

- **Non-additionality.** Some studies compare carbon storage and timber harvest rates across forests that enrolled in the carbon offsets program and similarly situated

lands that did not, finding that credited carbon outcomes have "generally not been additional to what might otherwise have occurred" (Coffield et al. 2022) and that the researchers' analysis "failed to demonstrate additionality" due to relatively similar disturbance rates between enrolled and control group forests (Stapp et al. 2023).

- **Project baselines.** Other studies critique the statistical methods by which CARB's forest offset protocols credit avoided timber harvests in projects' baseline scenarios, finding that "nearly a third" of offset credits analyzed "do not reflect real climate benefits and are, instead, the consequence of methodological shortcomings" (Badgley et al. 2022a) and that several projects "did not preserve or increase carbon stocks above what was typical, suggesting that no carbon offsets should have been issued" (Randazzo et al. 2023).

- **Non-permanence.** CARB defined the statutory requirement to credit "permanent" outcomes as being satisfied if carbon dioxide is stored outside the atmosphere for at least 100 years and developed a "buffer pool" insurance program to cover forest carbon lost to wildfires, drought, disease, and other impacts over this timeline. There are two related concerns. First is that 100 years is not truly "permanent" or comparable to the atmospheric lifetime of fossil fuel emissions, which lasts for tens of thousands of years (Archer et al. 2009, Badgley et al. 2022b, Joos et al. 2013). Second is that the risk of reversal on a 100-year timeframe is underestimated. Several studies have criticized the buffer pool for assuming that these risks are constant across the United States and will not get worse with climate change (Anderegg et al. 2020); for being too small, as the number of offsets set aside to compensate for wildfire-related losses was consumed in less than 10 years (Badgley et al. 2022b) and total wildfire losses through 2024 are projected to consume 39% of the total buffer pool (Badgley 2024); and for failing to account for growing climate-related forest carbon storage reversal risks (Wu et al. 2023).

- **Leakage.** CARB's protocol assumes that avoiding timber harvests in project lands leads to only 20% of that activity to be displaced and "leak" to other timber-producing areas, but the academic literature suggests that substantially higher leakage rates may occur in practice (Haya et al. 2023). CARB's forest offset protocol also provides substantial upfront crediting for avoiding timber harvests over 100 years (Badgley et al. 2022a), but does not deduct leakage emissions in a synchronous and consistent manner (Haya et al. 2023).

CARB's October 2024 market notice indicates that CARB is considering changes to the mine methane and ozone depleting substances protocols. CARB is not planning to consider any changes to the forest offsets program in its upcoming rulemaking process, though CARB has indicated that it intends to revisit the protocol's buffer pool design for non-permanence after completion of a study with the U.S. Forest Service.

## Alternative policy options and considerations

Policymakers may wish to consider two alternative approaches to carbon offsets:

- **Put offsets "under" the cap.** One reform would be to reduce allowance supplies based on the number of offset credits issued, which is sometimes called putting offsets "under" the cap. This approach was adopted by Washington state in its cap-and-trade program. If adopted in California, it would have two effects. An offset credit would be used by a firm for compliance if it cost less than an allowance (which would lower compliance costs); however, the reduction in total compliance instruments would also raise the market-wide allowance price (which would increase compliance costs). The ultimate effect on Greenhouse Gas Reduction Fund revenues could be positive because of the higher allowance price. An advantage of this approach is that it would help address concerns that offset credits do not reflect real, additional, or permanent climate benefits by reducing allowance supplies in parallel to credit issuance. To the extent that offsets do not achieve their stated goals, then the reduction in allowance supplies can help ensure that the overall effect is to reduce net greenhouse gas emissions. This approach would also continue to channel investments to sectors not regulated directly under the cap-and-trade program. On the other hand, this approach would decrease allowance supplies and therefore increase allowance prices. It would also result in a smaller increase in Greenhouse Gas Reduction Fund revenues relative to replacing offsets with a procurement fund because both reforms would increase allowance prices by a similar amount, but the procurement fund would not reduce allowance supplies. Similarly, putting offsets under the cap could potentially produce fewer climate benefits than a procurement fund model, though only if an alternative procurement program supports climate mitigation outcomes that are more effective than current offset practices.
- **Replace offsets with projects or credits procured with dedicated cap-and-trade funding.** Policymakers could phase out all or some portion of the current offsets program and replace it with dedicated funding from the Greenhouse Gas Reduction Fund. Potential advantages of this approach include increased revenues for the Greenhouse Gas Reduction Fund, the ability to select target sectors and support state policies like the Natural and Working Lands strategy (rather than let the market choose project outcomes), and the ability to choose projects and programs based on any mix of climate, biodiversity, equity, and geographic preferences policymakers like, including Tribal priorities (rather than letting the market choose project outcomes). Potential disadvantages of this approach include uncertainty about the availability of future Greenhouse Gas Reduction Fund revenues, competition with other priorities for limited program revenues (including environmental justice priorities), challenges related to sunsetting the existing offsets program (such as how existing projects, credit owners, and compliance emitters would be affected during a

transition), and the increase in allowance prices that would be expected to follow from a reduction in compliance instrument supplies (which should be similar to the increase in prices expected from putting offsets "under" the cap).

If policymakers wish to retain a carbon offsets program, they might consider three additional considerations:

- **Change offset compliance use limits.** The original 8% limit on offset use through 2020 was set by regulation. AB 398 specified lower limits of 4% from 2021 through 2025 and 6% from 2026 through 2030, with no more than half of total offsets coming from projects that do not deliver direct environmental benefits to state air or water quality. No limits have yet been set by the Legislature or CARB for post-2030 offset use. The legislature could revise existing limits and/or set different limits after 2030. While the IEMAC agreed that it would be useful for the legislature to provide statutory instruction on the post-2030 use of offsets, if any, committee members were divided as to whether the legislature should consider changes to the existing limits through 2030. One advantage of considering changes to the current limits is that changes could help establish the viability of alternative funding models. For example, the legislature could keep the 4% limit in effect through 2025 in place through 2030, which would reduce the eligibility of offset use beginning in 2026. This change would be expected to produce higher allowance prices relative to the status quo and therefore greater Greenhouse Gas Reduction Fund revenues, which could be directed to investments in natural and working lands (or other applications) to replace the funding that would have otherwise been channeled through the higher 6% limit on offsets. On the other hand, changing offset limits previously set by statute could disrupt current market expectations and unfairly prejudice market actors, such as offset project developers including Tribes, who made decisions based on the provisions of the previous extension bill. The committee observes that because AB 398 did not address the post-2030 operation of the cap-and-trade program, it would not be reasonable to assert reliance on the continuity or reform of current program design features after 2030.

- **Establish a tribal-specific offset compliance option.** Washington state's cap-and-trade program provides an example that could inform California's approach to offsets. Washington allows compliance entities to surrender offsets equal to up to 8% of their compliance obligations, but provides that no more than 5% can come from projects not involving federally recognized tribes while allowing for an additional 3% from projects that do involve federally recognized tribes.[10] This is similar to California's approach to direct environmental benefits to state air or water quality under AB 398. For example, from 2026 through 2030, compliance entities in

[10] The IEMAC notes that many tribal communities in California are not federally recognized.

California can surrender offsets equal to up to 6% of their compliance obligations, with up to 3% from projects that do not generate direct environmental benefits and an additional 3% from projects that do deliver environmental benefits. The IEMAC notes that if this approach were adapted to provide a tribal-specific offset compliance option in California, it would prioritize the participation of tribal parties in the offsets program but would not address any concerns related to the effectiveness of offset projects.

- **Implement regular and consistent updates to offset protocols.** Several studies cited above have raised concerns about additionality, baseline, and over-crediting of offset credits, especially in the forestry offset program. Unfortunately, the forestry protocol adopted by CARB has not been updated since 2015 to reflect research findings and recommended improvements to crediting methodologies. Researchers who identify shortcomings in the current protocols also recommend regular methodological updates to respond to critical findings (Anderson-Teixeira & Belair 2022). The legislature could direct CARB to immediately update the offset protocols, and specifically the forestry protocol, and could further direct the agency to update protocols on a prescribed regular basis (i.e., every 3 or 5 years). While this would not alleviate environmental justice concerns about the displacement of direct emission reductions, it could increase other climate, social, and biodiversity benefits of the program relative to the status quo.

Whether policymakers retain the current system or consider structural reforms, it would be important to address several considerations:

- **Cost containment.** The availability of carbon offsets that are “above” the cap leads to lower allowance market prices. If offsets were put “under” the cap or replaced with a procurement-based alternative funded by the Greenhouse Gas Reduction Fund, they would stop contributing to lower market prices.
- **Effect on the Greenhouse Gas Reduction Fund.** Reducing offset availability or placing offsets “under” the cap would reduce the number of compliance instruments and increase the allowance price. An issue brief from Resources for the Future (Burtraw and Roy 2025) estimates that limiting offset supply “above” the cap to 4% beginning in 2031 would increase the allowance price by just under one dollar, relative to a scenario in which the 6% limit that applies in 2026-30 would also apply after 2030. Because the market responds to cumulative allowance supply a price effect would be felt immediately, and this reform would increase cumulative GGRF revenues by $225 million (2024$) over the five-year period (2026-2030).
- **Effect on statewide emissions.** Because offsets allow for higher emissions in the AB 32 statewide greenhouse gas inventory in exchange for emission reductions that

are not currently included in the AB 32 inventory (such as forests) or that manifest outside the state, their use results in higher emissions in the AB 32 inventory. While this accounting convention does not recognize climate benefits that can be achieved in other sectors or outside of California, statutory emission limits for 2020, 2030, and 2045 are defined in terms of "statewide" emissions and CARB has consistently used the AB 32 inventory as the basis for compliance with these requirements.

- **Tribal considerations.** Many of the projects supported by California's existing forest carbon offset program are operated or owned by Tribes. If the offsets program were replaced with dedicated cap-and-trade funding, it would be important to ensure that there is a transition plan that addresses the commitments made to existing parties, including Tribal parties. Policymakers may wish to consider whether additional program design considerations could support Tribal cooperation in an expenditure-based program, such as requirements to direct a minimum percentage of funds to projects or programs involving Tribal partners to ensure that the overall level of financial investment in Tribal activities is maintained or increased relative to the status quo.
- **Environmental justice considerations.** Policymakers may also wish to consider how the presence or absence of carbon offsets affects the distribution of pollution and environmental co-benefits. Because offsets do not reduce emissions directly from sources, they may be contributing to higher environmental harms than would be the case in the absence of carbon offsets, particularly in communities that are already over-burdened with air pollution. At the same time, carbon offset projects can create environmental co-benefits in the places where they are located. Eliminating or phasing out offsets would affect both the harms and benefits associated with the use of offsets today.
- **Market disruptions.** If policymakers decide to replace or significantly reduce offset use, they may wish to consider how to implement their preferred direction in a manner that minimizes potential disruptions to the offset market going forward. For example, market actors might have made investments or other commitments on the basis of the statutory eligibility criteria in AB 398 that extend through 2030. Making changes to program operations before 2030 would be more disruptive than making changes to post-2030 program operations, which have not yet been established. An incremental approach that revisited the anticipated step-up in offset eligibility from 4% to 6% in 2026 could provide an opportunity to develop new procedures to ensure continued investments in natural working lands while leaving intact the existing program and leave unaffected existing contracts under the 4% cap, but such an approach could impact program stakeholders who made decisions on the basis of the existing statutory limits.

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