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**Forest Offsets in the California Carbon Market:
Challenges of a Market Based Climate Solution**

A Thesis Presented

by

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To the Keck Science Department

of

Claremont McKenna, Scripps, and Pitzer Colleges

In Partial Fulfillment of

The Degree of Bachelor of Arts

Senior Thesis in Environmental Analysis

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Abstract

Within California's cap-and-trade program, forest offsets allow landowners to earn carbon credits for protecting forests that sequester carbon and sell these credits to polluters that can then emit one additional ton of carbon. The state's top regulator, the California Air Resources Board (CARB), is tasked with overseeing cap-and-trade and the forest offset system. CARB is currently updating the state's Climate Change Scoping Plan to set California on track to achieve its 2030 climate goal of reducing greenhouse gas emissions to 40% below 1990 levels. CARB is approving forest offsets that overestimate emissions reductions, while allowing companies to continue polluting in disadvantaged communities across the state. The forest offset guidelines contain loopholes that allow project developers to maximize carbon credits by taking advantage of statistical differences between regions, submitting hypothetical heavy logging proposals for forests that were already protected, and contributing low amounts to destruction insurance. Even a perfect forest offset system, devoid of these existing flaws, delivers net neutral benefits to the climate because emissions produced are matched 1:1 with emissions reductions through increased carbon sequestration in forests.

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I. Introduction

Emissions trading policies such as cap-and-trade originated in 1976 when the US Environmental Protection Agency prohibited new business in regions which did not meet air quality standards under the Clean Air Act (Tietenberg, 2016). Policymakers looked to emissions trading to address air quality concerns while furthering economic growth. New companies could purchase emission reduction credits from existing companies in order to enter the marketplace, which kept emissions at the same level while encouraging new business (Cushing et al., 2018). Emissions trading was formalized in the 1997 Kyoto Protocol, which allowed countries to trade emissions quotas according to their legally binding emissions targets (Tietenberg, 2016). The United States did not ratify the Kyoto Protocol, and the first introduction of domestic emissions trading was the Regional Greenhouse Gas Initiative, developed by 10 Northeastern states in 2005 (Klinsky, 2012).

In 2006, the California Legislature passed AB 32, the Global Warming Solutions Act, which set a cap on emissions statewide that decreases over time to secure emissions reductions. The bill requires polluting companies to buy and trade permits to continue emitting carbon, with the cap on total emissions across all companies decreasing 3-3.5% every year (Cushing et al., 2018). Companies have four options to be compliant in this cap-and-trade system: upgrading facilities to be more efficient, emitting less carbon, buying polluting permits from other companies, or buying offset credits. Offsets are specific credits that polluters can purchase that counteract or cancel out carbon emissions through carbon sequestration. Offsets could originally cover up to 8% of the required emissions reductions by canceling out the emitted carbon, but since 2020, companies can only offset 4% of their required reductions (Haya et al., 2020). The original bill was only 13 pages long, leaving much of the cap-and-trade program to be designed

and implemented by the California Air Resources Board (CARB), the state's climate regulator (Bigger, 2016). Cap-and-trade officially began in California on January 1, 2013.

Forest Offsets

Forest offsets are the most commonly used form of offset in California's cap-and-trade program, allowing a landowner to earn one carbon credit for every ton of carbon stored in their trees that is above what other trees in the region store (Pontecorvo and Osaka, 2021).

Landowners can sell these credits to polluters in California with the plan that each ton of carbon emitted as a result of the offset is balanced out by a ton of carbon stored in forests. There are over \$2 billion worth of offsets present in California's cap-and-trade program, though offset credits can be generated by projects anywhere in the continental United States or southern Alaska (Badgley et al., 2021). In addition to maintaining forests that store higher-than-average carbon for their area, project owners can eliminate logging or improve forest management practices in order to earn carbon credits (Gifford, 2018).

The Conference of the Parties climate convention in Bali in 2007 first introduced forest offsets in global policy discussions in the form of Reducing Emissions from Deforestation and Forest Degradation (REDD) programs (Gifford, 2020). They were introduced as a way for developed countries to compensate developing countries for their forest management and carbon sequestration, canceling out some of their industrial carbon emissions. Nevertheless, concerns grew about the colonial implications of REDD programs in which investment in conservation was based on continued and potentially increased fossil fuel emissions (Fletcher et al., 2016). REDD was re-invented to remove the contentious international development components,

resulting in a cap-and-trade program similar to California's which relies on internal forest projects for the generation of carbon credits.

Forest offset projects involve quantifying, calculating, and translating forest carbon storage into a defined number of carbon credits that polluters can buy via the carbon market. The system of forest offsets must delicately balance ensuring real emissions cuts and creating a viable carbon market that can fund forest conservation and carbon sequestration (Song & Temple, 2021a). One challenge is that measuring ecosystem growth and carbon sequestration is a subjective and varied calculation that is frequently over or underestimated (Gifford, 2020). There is no easy template for how to design the core components of a cap-and-trade program, and calculations of carbon storage that go above and beyond the status quo of historical forest conservation are nearly impossible to measure objectively. Specific regulatory decisions by CARB influence how many carbon credits a forest offset project will receive and can frequently lead to either over or underestimation of carbon storage, which has real climate implications for Californians.

History of Environmental Justice in California

Over 5.4 million Californians currently live within a mile of an oil or gas well, and about 4 million of them are people of color (Srebotnjak & Rotkin-Ellman, 2014). Oil drilling operations in California are concentrated in Los Angeles and Kern Counties, and these communities face adverse health impacts as a result of the elevated levels of air pollution. Of those who live within a mile of a well, 1.8 million live in communities that face a disproportionate amount of the state's air pollution, and 92% of these heavily impacted Californians are people of color (Srebotnjak and Rotkin-Ellman, 2014). Fracking and oil

production is closely linked to negative health outcomes, such as cardiovascular diseases, asthma, and cancer. In Kern County, where more than half of the residents are people of color, lung cancer is the leading cause of death, and infant mortality and heart disease death rates are higher than the state average (Gonzalez et al., 2022).

In the Yurok Tribe in Northern California, over 80% of community members live below the poverty line (Kormann, 2018). After years of legal battles over land and water rights, the tribe gained federal recognition in 1986 and the government granted them 5,000 acres of land—1% of their historical land (Beck, 2021). The Yurok Tribe, along with seven other Indigenous entities, participate in California’s offset program to invest in their communities and purchase land back with the earnings from selling carbon credits (Kormann, 2018).

In 2012, Governor Jerry Brown signed SB 535, directing 25% of revenue from cap-and-trade to projects that will benefit disadvantaged communities (Bigger, 2016). CalEnviroScreen is a mapping tool that measures 21 environmental and socioeconomic indicators to produce pollution scores for each census tract in the state, allowing specific communities to be identified as disadvantaged and in need of climate investments (Cushing et al., 2018). AB 1550 in 2016 went even further, requiring that 25% of revenue from cap-and-trade must be directed to projects located in these disadvantaged communities (Bigger, 2016). These investments reflect the growing call for environmental justice communities to gain some value from a program that continues pollution in their neighborhoods. In recent years, increased funding led to the creation of the Low-Income Weatherization Program, the Transformative Climate Communities Program, and utility debt relief, which each provide crucial recovery and resilience aid to disadvantaged communities throughout California (Bigger, 2016).

California Air Resources Board

The California Air Resources Board (CARB) was established in 1967 as a department within the California Environmental Protection Agency to maintain healthy air quality and help the state comply with air pollution regulations. CARB developed cap-and-trade and its regulatory components based on a long process, weighing science and policy considerations to create a cap-and-trade program that meaningfully contributed to California's emissions reduction goals and created an economic value for conserving forests. CARB has created a Climate Change Scoping Plan every five years since 2008 in order to assess the progress of maximizing feasible and cost-effective emissions reductions to reach the state's 2030 climate goals (Zabin, 2020).

CARB established the Offset Protocol Task Force in 2019 to provide guidance on how to ensure new offset protocols for cap-and-trade would provide direct environmental benefits to the state and prioritize disadvantaged communities, Indigenous tribes, and rural communities (Halper, 2021). On February 24, 2021, the environmental justice and environmental advocacy members of the task force resigned, criticizing CARB for improperly handling conflicts of interest for the majority of task force members who have financial interest in an expanded and deregulated offset program (Tangri & Nowicki, 2021). They cited longstanding leniency to demands from industry representatives and lobbyists, which successfully pressured CARB to allow 8% of emissions reductions to come from offsets, up from the proposal of 4%, in the original design of cap-and-trade (Bigger, 2016). Tangri and Nowicki argued that the program needed to be reduced and refocused to address the needs of the state's most impacted communities, yet the task force recommended an expansion of the role of offsets, including removing existing safeguards (Tangri & Nowicki, 2021).

By the end of 2022, CARB will complete a new five year scoping plan. The state's current climate goal is to reduce greenhouse gas emissions to 40% below 1990 levels by 2030, and CARB estimates that cap-and-trade should represent more than a third of those reductions (Anderson, Field and Mach, 2017). In January 2022, Assembly Speaker Anthony Rendon expressed concern that cap-and-trade will not be able to provide the emissions reductions required for California's 2030 climate goal, stating that California is not on track to meet that goal (Olney, 2022). California's Secretary for Environmental Protection Jared Blumenfeld, who oversees the scoping plan alongside CARB Chair Liane Randolph, said that the scoping plan will specifically examine how much California's strategy to meet its climate goals can rely on cap-and-trade (Becker, 2021).

Forest offsets and carbon markets can be powerful tools for decreasing carbon emissions on a drawn out time-scale if they accurately represent net emissions reductions. California's cap-and-trade program's current reliance on forest offsets is derailing California's progress towards meeting its climate goals. At best, the inclusion of forest offsets helps companies transition into a low-carbon economy that relies on significantly reduced emissions. In California, the flaws in the system of offsets include systematic over-counting of carbon credits, the exploitation of loopholes by landowners, out-dated insurance calculations, and continued environmental injustice. These offset flaws have created a program that will prevent California from meeting its greenhouse gas reduction goals by 2030.

II. Systematic Over-Counting of Carbon Credits Due to Regional Averages

For the forest offsets program to help California meet its emissions reduction goals, all carbon credits granted to projects must represent real carbon sequestration that directly matches the amount of carbon that will be released when companies buy the credits. The current trend of over-crediting forest offset projects threatens the guarantee that emissions released by polluters are matched by emissions stored in forests.

The determination of carbon credits for a project in California's offset program is based upon regional averages of carbon storage in forests. The data come from the U.S. Forest Service. Forest offset projects are granted credits when the area's carbon storage is greater than the regional average of carbon storage (Gifford, 2018). Landowners calculate a baseline scenario for a project to represent the carbon storage in their trees. This determination is based on the type of trees and the fact that they are preserved rather than logged. Project proposals include a predicted business-as-usual logging scenario, which calculates stored carbon based on what would have been destroyed without the project. Often, landowners submit logging scenarios that are close to the regional average in order to maximize carbon credits they can earn by pledging to prevent logging. Over 90% of projects in the forest offset program identify logging scenarios that are within 5% of the regional average, the legal minimum scenario they can submit (Badgley et al., 2021). It is unlikely that each project would be logged this much, which means that many of the credits granted to projects based on these logging scenarios do not represent real emissions reductions.

In an analysis of 102 million carbon credits from forest offsets, which is 65% of the forest offset credits in California's cap-and-trade program, 29% of credits were over-credited

(Badgley et al., 2021). These 30 million tons of carbon worth \$410 million did not represent meaningful offsets to real carbon emissions.

Taking Advantage of Regional Borders

Researchers identified a pattern of projects along the borders of regions in California, which each have distinct regional averages of carbon storage. Forests near both sides of a regional border often have similar amounts of stored carbon. But the two regions have different regional averages, so forest land on each side could produce different amounts of carbon credits solely based on which side of the border it lies.

One example occurs in Northern California. There is a coastal region, with a regional average of 205 tons of carbon per acre, and an inland region, with a regional average of 122 tons of carbon per acre (Figure 1) (Song & Temple, 2021a). Yellow dots—signifying projects near the border that are prone to over-crediting—make up a majority of the projects within this region (Figure 1). The projects are in the inland region, but close to the border of the coastal region, because they can earn far more credits for the same tree species due to a lower regional average of carbon storage in the inland region. In one instance, a project would earn \$0 in the coastal region, but instead it earned over \$8 million just miles away in the inland region (Song & Temple, 2021a). This \$8 million represents carbon credits that polluters can purchase and use, but it does not represent robust emissions reductions to match the corresponding emission output.

Within the inland region, borders between the three subregions can also cause variations in carbon crediting. Projects are clustered within the darkest green subregion because it contains the trees with the most carbon storage, but the regional average for the region is based upon the

average of all three subregions (Badgley et al., 2021). These projects are eligible for more upfront credits solely as a result of belonging to the same region as lower-carbon storage areas.

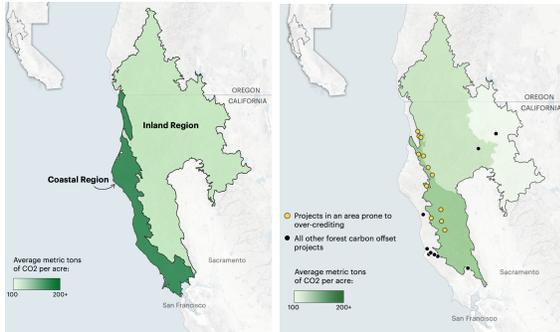


Figure 1. Maps of the Coastal and Inland regions, measuring the regional averages of carbon storage, including forest offset projects analyzed by CarbonPlan researchers (Song & Temple, 2021a).

Another case of placing projects strategically near borders to maximize carbon credits, despite no additional carbon reductions, takes place in projects managed by the Yurok Tribe and offsets developer New Forests in Northern California. The tribe owns several offset projects on their reservation of 65,000 acres surrounding the Klamath River (Kormann, 2018). Most of the tribe’s land falls within the coastal region, but their reservation crosses the border between the coastal and inland regions (Figure 2). Nevertheless, 99% of the tribe’s first forest offset project falls within the inland region, where it is eligible for more credits despite nearly identical vegetation, according to the tribe’s former forestry director (Song & Temple, 2021a).



Figure 2. Map of the Yurok Reservation in Northern California, including the location of the lands they enrolled to receive forest offsets (Song & Temple, 2021a).

Offsets Saved in Allowances

A problem with the widespread over-crediting of forest offsets is the ability of carbon-emitting companies to save carbon offset credits as allowances. Companies currently have 322 million carbon credits saved as allowances. Experts from the Independent Emissions Market Advisory Committee warn that these credits could undercut the cap-and-trade program's ability to reduce emissions (Cullenward et al., 2019). While the program's total emissions cap continues to fall year after year, companies could use banked allowances to limit their obligation to decrease direct emissions (Green, 2017).

California is updating its Climate Change Scoping Plan, and the performance of offsets within the cap-and-trade program is a major topic of discussion. Ross Brown, the Principal Fiscal & Policy Analyst for the Environmental division of the California Legislative Analyst's Office, warns that "it's possible that when you get out into the later years up to 2030, that large bank of allowances could be used to comply with the program. And as a result, the state might not be close to its ambitious emission targets out to 2030" (Becker, 2021). By 2030, the state must reduce emissions by at least 40% below 1990 levels, which will require cutting emissions by about 4% each year (Haya et al., 2020). In contrast, California reached its 2020 emissions target in 2016, but was only reducing emissions by about 1% each year (Becker, 2021).

III. Additionality in Offset Crediting - Loopholes for Landowners

The current loopholes in forest offset protocol allow landowners to submit projects to receive forest offsets that do not represent an increase in the amount of carbon being stored in the included trees. Projects are located around the country, making it harder for state regulators to oversee projects that might take advantage of a lack of data or that their trees are already conserved before earning credits. Similar to over-crediting, if these projects do not represent real emissions reductions, they harm California's progress towards reducing statewide emissions.

The concept of additionality deals with the effects of carbon offsets. It measures whether the incentive of the carbon market creates *additional* emissions reductions by protecting forests. The baseline scenario for any given project is intended to show what would happen to a forest if the forest project were not initiated, and thus the maintenance of carbon storage is additional as a result of the forest offset project's approval. But in measuring this additionality to award carbon credits to projects, carbon accounting is a deeply subjective and uneven technical process that can be open to interpretation (Gifford, 2020). Problems with the location and type of landowner for specific forest offset projects have called into question the precision with which California's cap-and-trade program can accurately provide measured emissions reductions.

In March 2012, Our Children's Earth Foundation and the Citizens' Climate Lobby sued the California Air Resources Board, questioning its process for evaluating additionality of offsets within California's cap-and-trade program (Kaswan, 2014). The San Francisco Superior Court emphasized the importance of ensuring accurate additionality, noting that non-additional offsets would "undercut the cap-and-trade program because they substitute illusory reductions, those that would have occurred anyway, for real reductions that the capped sources should have undertaken" (Kaswan, 2014). As CARB and many researchers point out, it is hard to quantify

additionality and measure whether a forest could be logged to any certain level within the next 100 years. The Superior Court determined that its role was not to prefer one method for calculating additionality, deferring to CARB's expertise and thorough process (Kaswan, 2014). The Court of Appeal upheld this ruling (*Our Children's Earth Foundation v. California Air Resources Board, Climate Action Reserve*, 2015). CARB has used this ruling, and the subsequent upholding of it by the California Court of Appeal, as reason to disregard criticisms of their process for evaluating additionality in forest offset projects (Halper, 2021). Nevertheless, projects based outside of California and those proposed by conservation groups raise questions about the calculation of additional offsets, and whether such projects pose problems to the success of cap-and-trade at reaching its planned emissions reductions.

Projects Outside of California

Currently, forest offsets projects exist in 22 states in California's cap-and-trade program (Figure 3), with the largest source being Alaska with \$500 million worth of carbon credits sold to date (Halper, 2021). Environmental activists have criticized the large number of offsets far away in southern Alaska and the Northeast, because hypothetical emissions reductions there will not make a direct difference to those living with fossil fuel refineries in their neighborhoods. Cap-and-trade is a program that aims to reduce global emissions, but Californians are paying the cost of in-state pollution without receiving the benefits from out-of-state forest conservation.



Figure 3. Map of analyzed carbon credits across the United States and southern Alaska based on public data for California's forest offset program (Badgley et al., 2021)

Outside of California, it is harder for state regulators to rely on the integrity of federal and state data necessary to calculate carbon storage and measure emissions reductions in offset projects. These challenges make it easier for landowners to exploit loopholes in the system and gain carbon credits that do not reflect emissions reductions. One project of concern is located in New Mexico, managed by the Mescalero Apache Tribe and offsets developer Forest Carbon Partners. The project earned 3.7 million credits worth over \$50 million as a result of the absence of U.S. Forest Service Data that calculated the area's regional average of carbon storage as zero (Song & Temple, 2021a). This error was originally discovered and acknowledged by CARB in 2014, yet in 2015 the developer could file the project consisting of 220,000 acres that earned carbon credits based on the existing regional average (Song & Temple, 2021a). Just two weeks after the project was filed, CARB updated the regional average of the area, which would have eliminated nearly every carbon credit earned by the project (Song & Temple, 2021a). Despite these facts, CARB reaffirmed that it believes these carbon credits earned by the out-of-state landowners represent real, quantifiable carbon emissions reductions, despite the credits being rewarded primarily due to a lack of data in New Mexico (California Air Resources Board, 2021).

One recent proposal by CARB could limit the number of out-of-state projects available for the cap-and-trade program. Since 2021, CARB requires that half of all offsets projects provide direct environmental benefits to California (Cushing et al., 2018). While this limit could potentially address concerns that the environmental benefits are too far away to be realized by the state's residents, this will also likely cause increased demand for California projects and decrease the available projects for selection. Over 50% of California's forests are federal lands, which are currently ineligible for the program, so developers will likely have to push into

increasingly fire-prone areas to find projects to continue generating forest offsets (Kormann, 2018).

Conservation Groups as Landowners

Conservation nonprofits often propose land they own to be eligible for carbon credits. Of all forest offset projects approved for California's cap-and-trade program, 26% are in forests managed by conservation nonprofits (Anderson et al., 2017). In order to earn credits for their project, these nonprofits must submit a baseline scenario in which they log the land under a business-as-usual plan. Leading conservation organizations such as the Nature Conservancy and Massachusetts Audubon Society (Mass Audubon) frequently present scenarios in which they would heavily log thousands of acres of land, despite historically preserving those same forests. These types of projects can threaten the integrity of measurable emissions reductions because credits are meant to represent new emissions reductions to cancel out new pollution.

In 2015, CARB approved a Mass Audubon forest offsets project worth 600,000 credits and \$6 million for forest land in western Massachusetts that the organization has maintained as a wildlife habitat for decades (Song & Temple, 2021b). CARB sets a floor for logging proposals based on how the average landowners logs their forests, and Mass Audubon submitted a logging proposal that was just 0.2% above this floor (Song & Temple, 2021b). The additionality of offsets awarded to nonprofits such as Mass Audubon are questionable given their longstanding history of preserving their forests and nature preserves. If projects do not represent the claimed level of reductions in carbon emissions, the carbon credits they earn are likely not representative of real emissions reductions. If carbon credits pay landowners to continue managing land in the

same way they were before, the magnitude of the nation's carbon sink will not increase as intended (Halper, 2021).

The Nature Conservancy spends about \$150 million purchasing land every year and proposed several of these lands for forest offset projects to sell to corporations like JPMorgan, Disney, and Blackrock (Elgin, 2020). Corporations use these offsets to meet self-imposed sustainability goals and actively promote their role as environmental stewards. Similar to the land owned by Mass Audubon, it is questionable whether the offsets they are buying from Nature Conservancy represent additional emissions reductions. The Hawk Mountain Sanctuary, in partnership with the Nature Conservancy, applied for a forest offsets project for their lands in Eastern Pennsylvania. The custodians of the land were approved and used the money for taking better care of the land and implementing improved forest management projects (Elgin, 2020). Laurie Goodrich, the Sanctuary's director of conservation science, believed that carbon credits were generated from their forestry improvements, but the Sanctuary's application reveals that a majority of the credits were granted based on a scenario of heavy logging (Elgin, 2020). Nevertheless, the forest was untouched for over 85 years, and Goodrich said "we'd still be managing the land the same way" with or without the carbon credits (Elgin, 2020). Proposals like this have been replicated by conservation nonprofits around the United States to earn credits in California's carbon market. In a study analyzing whether the projects initiated by conservation nonprofits recorded actual additionality of carbon emissions, researchers concluded that "while the state program may provide funds to these groups that could help them acquire new land, it's not likely that the offsets were changing practices in the forests they enrolled" (Kelly & Schmitz, 2016).

Nature Conservancy and Mass Audubon both responded to criticism by reiterating their commitment to a high standard of forest conservation that produces robust carbon emissions reductions. The Nature Conservancy completed an internal review, finding room for improvements in the way that they calculated logging scenarios for forest offset projects (The Nature Conservancy, 2021). The organization stated that they believe conservation nonprofits are uniquely equipped with the knowledge and resources to operate within carbon markets, but they are committed to engaging with improvements to forest offset program methodology. Mass Audubon similarly agreed that there are challenges to designing a program that accurately calculates carbon sequestration, but they see carbon markets as a necessary part of the solution to decreasing global emissions (O'Connor, 2021).

IV. Risk and Insurance in Forest Offsets

To account for the risks of long-term carbon storage, forest offsets protocols require that a portion of carbon credits are set aside for insurance in case of tree damage. The insurance requirements have not changed since the program's design, despite forests facing elevated risks including greater frequency and intensity of wildfires. The insurance does not alter emissions released, as companies are free to pollute after purchasing offset credits. If the insurance system were to fail to accurately cover tree destruction, net emissions would increase and offsets would threaten California's emission reduction goals.

To gain approval for carbon offsets, a project must guarantee that the carbon storage in the forests be protected for 100 years to ensure that the offset carbon emissions are meaningfully absorbed from the atmosphere. If the project is damaged by wildfires, illegal logging, disease, or pests, the stored carbon will be released, but the fossil fuel company will have already emitted carbon dioxide. This scenario presents a potential problem for the validity of the carbon offset program in reaching emissions reductions, especially given the increasing prevalence of wildfires and tree disease throughout California. CARB's solution to these risks of carbon release in offset projects exists in the form of a buffer pool, in which project owners contribute a set percentage of their carbon credits as an insurance policy for the potential destruction of some emissions reductions (Pontecorvo & Osaka, 2021).

Elevated Wildfire Risk

Offsets projects in California, all located in the Northern region of the state, are prone to wildfire risk. The three largest fires in California history, all in the past four years, occurred in the same regions as these projects, and scientists forecast additional increases in wildfire

intensity and frequency in the coming years as a result of climate change (California Department of Forestry and Fire Protection, 2022). Model projections of future fires in California found that the total area burned could increase by over 25% by 2040 (Gutierrez et al., 2021). The increasing risk of wildfires in regions with high concentrations of offset projects threatens the success of carbon credits at canceling out companies' emissions.

Eddie Ranch, located in Mendocino County, was approved in late 2018 as a carbon offset project, just months after a fire burned through the property (Halper, 2021). CARB approved the project based on the condition of the ranch before the fire, earning the project 270,000 carbon credits. The wildfire invalidated a significant portion of these credits, yet PBF Energy purchased the entirety of the credits from these projects and used them to continue polluting at refineries in Torrance and Martinez, California (Halper, 2021). To account for the lost carbon absorption due to a largely-burned forest, CARB backfilled offsets by withdrawing extras from the state's insurance fund—the buffer pool. Project owners must contribute a set percentage of credits based on inherent risks in their project, but these rates were set in 2008 when climate and wildfire conditions, especially in California, were vastly different (Pontecorvo & Osaka, 2021). These rates can vary depending on the location and risk of a given project, but only slightly. For wildfire risk, owners must contribute between two and four percent of their total carbon credits to the buffer pool, but this small range is identical whether the forest is in wildfire-prone Northern California or in less combustible locations in the United States (Anderegg et al., 2020).

Over 250,000 acres in the Colville Reservation in Northern Washington burned in wildfires in 2020 and 2021, just five years after the Colville Tribe sold \$80 million worth of carbon credits to BP from their forest offset project (Pontecorvo & Osaka, 2021). While these lost offsets can be covered by offsets stored in the buffer pool, the looming threat of increasing

wildfires could bankrupt the insurance plan, resulting in a significant loss of carbon storage meant to offset the persisting carbon emissions from fossil fuel companies in California. The uncertainty of trading a known amount of emissions with an unknown amount of emissions reductions threatens the integrity of California's climate goals (Pontecorvo & Osaka, 2021).

The Carbon Credit Buffer Pool

By not selling a percentage of their carbon credits, project owners contribute credits to California's buffer pool as insurance for the destruction of forests before the 100 years of preservation is up. Based on the varying risk factors of a given project, landowners might contribute anywhere between 11 and 20 percent of their carbon credits into the buffer pool, but these rates lacked rigorous analysis when they were decided in 2008, and many factors affecting these risks have changed in the 14 years since (Anderegg et al., 2020). Though it may undercount heightened risks forests face, the forest offsets program accounts for risks that carbon storage projects face. Fossil fuel companies, however, face zero risk in the scenario because their license to pollute does not change, no matter what happens to the trees meant to counteract their emissions. Essentially, the buffer pool is an insurance policy for the capital investment, but not the sequestered carbon in the trees (Gifford, 2020). The buffer pool ensures that the financial credits bought by fossil fuel companies remain and carbon sequestration occurs in other trees on the project site, but fails to account for the release of carbon that takes place when trees are burned or destroyed.

One potential fix for adapting to changing fire risk in forest offset projects is to include the fire regime condition within the market value of a carbon credit. By attaching the financial investment made in forest offsets to fire risk, this solution would place less value on forests that

face an increasing likelihood of wildfire destruction. Under this proposal, a unit of carbon in a fire-prone forest is worth less than a unit of carbon in a forest more resistant to fires, and thus more likely to sequester the carbon for the full 100 years (Hurteau et al., 2009). This change would gradually shift the market of forest offsets towards projects with lower disturbance risk, providing more assurance that the buffer pool would be able to account for lost carbon sequestration.

V. Environmental Justice vs. Conservation

Carbon offsets allow fossil fuel companies to emit carbon in communities with large populations of people of color across California with the goal that the emissions will be canceled out via carbon sequestration in a forest offset project elsewhere. The program, widely used by environmentalists such as conservation groups and Indigenous communities, pits the ideals of forest conservation against direct emissions reductions in environmental justice communities. The draws of financial compensation for forest compensation create an entrenched offset system that incentivizes environmental groups to support an expanded offset program rather than lobby regulators to establish more rigorous standards for carbon credits. It is politically challenging to address the system's negative impacts on California's emissions reduction goals when environmental justice activists and conservation groups are on opposing sides.

The history of the offsets program, and cap-and-trade more broadly, has been a constant battle between environmental justice groups and the CARB regulators. When Neil Tangri and Brian Nowicki resigned from the Offsets Protocol Task Force in 2021, they criticized CARB for listening almost entirely to the voices of the industry players who stood to benefit from a greatly expanded carbon offset program, sidelining the voices of the collective environmental justice movement seeking accountability and direct emissions reductions (Tangri & Nowicki, 2021). Although the Task Force's goal was to identify ways to make the program better serve Indigenous and environmental justice communities, it ultimately strengthened financial incentives for conservation groups and Indigenous tribes to want an expanded forest offset program, despite its flaws (Halper, 2021).

Specifically, environmental justice organizers believe the program is delaying promised results. Alicia Rivera, who works with Communities for a Better Environment in Wilmington,

pointed out that her community has had plenty of time experiencing cap-and-trade to see that it is not working at reducing emissions at nearby refineries (Halper, 2021). Cap-and-trade has existed for seven years, yet community members in refinery neighborhoods have failed to see direct and immediate reductions to local sources of emissions, which is ultimately a goal of the program. In the first several years of cap-and-trade, 52% of California facilities regulated by cap-and-trade actually increased their emissions (Cushing et al., 2018). During this same period, companies used offsets to emit four times more carbon than the targeted emissions reduction cap-and-trade was meant to allow. Compared to communities that experienced emissions reductions during the first years of cap-and-trade, communities with increased emissions had higher proportions of people of color, lower incomes, and less educational achievement (Cushing et al., 2018). For the climate and the state's program, all emissions reductions are treated as equal. But disadvantaged communities in California incur the highest costs and delayed emissions reductions in an offsets program that does not account for historical environmental injustices.

Indigenous Tribe Projects

The Yurok tribe has earned tens of millions from carbon credits and purchased almost 60,000 acres of land that it now protects and restores through forest offset projects (Song & Temple, 2021a). Not every tribe member is satisfied with the decision to enroll their lands in forest offsets projects. Jene McCovey, a tribal elder, said "I think we did a good thing by saving the trees, but I'm not happy with it. It's not viable. It allows polluters to pollute" (Kormann, 2018). This echoes a frequent criticism of forest offsets, in that there are inherent climate benefits in preserving forests, but when the money for conservation is directly tied to corporations continuing to pollute frontline communities, it is hard to view the program as an authentic

climate solution. Marty Lamebear, member of the Yurok Tribe Forestry Program's fire department, expressed a similar sentiment, "we're selling [carbon credits] to these big industries so they can keep doing what they do. They buy our air, so they can, you know, pollute theirs" (Kormann, 2018).

Still, Indigenous communities see value in creating an economic value for forests besides logging. Ed Mann is the Yurok tribe's forestry director and he sees immense value in providing tribes a way to earn income to protect forests and purchase additional land for conservation. Tribes are restoring old-growth forests, creating wildlife sanctuaries, and carrying out the traditional practice of prescribed burning to reduce likelihood of wildfires (Kormann, 2018). Cody Desautel, president of the Intertribal Timber Council, sees offset projects as necessary because forests are not often maintained if there is no value associated with owning forest land (Song & Temple, 2021a). The Rights and Resources Initiative found massive benefits to returning land to Indigenous communities, as forests under their management store millions of tons of carbon worldwide (Sirica, Bautista and Kalliongis, 2018).

Equity in Governance

In order to create an equitable system of governance within CARB's regulation of forest offsets, the decision makers must reflect those affected most by the cap-and-trade program outcomes. In his resignation letter from the Compliance Offsets Task Force, state climate policy director for the Center for Biological Diversity Brian Nowicki called out that the majority of the members on the Task Force stood to benefit financially from an expanded offset program (Tangri & Nowicki, 2021). The Task Force position was unpaid, meaning that project developers corporations could pay their staff to dedicate hours to this work, while environmental justice and

Indigenous communities, the intended beneficiaries, did not have the resources for this. This arrangement kept the two environmental community advocates on the sidelines of key discussions, while industry representatives influenced reform discussions to prioritize expanding the offsets program. Environmental justice groups ultimately lack influence with market administrators, leaving the implementation of market instruments without a justice and equity lens. Systems such as cap-and-trade and forest offsets break down nature into measurable and quantifiable components, and the financial mechanisms in play strictly protect the components involved in generating income (Finley-Brook, 2017). Although cap-and-trade was meant to make polluters pay because a price on carbon would drive down emissions, it instead became a market that allowed companies to pay to continue polluting (Bigger, 2016).

The current carbon market maintains a financial reliance on polluters, meaning communities rely on continued pollution to receive the funds from offset credits. Instead, communities need a solution that provides a steady stream of revenue independent of fossil fuel use. This year, Assemblymember Isaac Bryan introduced the California Justice40 Act, which would require a minimum of 40% of federal climate and infrastructure funds provide direct benefits to “low-income, Indigenous, and rural communities and communities of color” (Nguyen & Shaikh, 2022). California will receive \$45.5 billion over the next five years due to the passage of the federal Infrastructure Investment and Jobs Act, and Justice40 ensures that funding is directed towards communities that are on the frontline of the climate crisis (Nguyen & Shaikh, 2022). This proposal will end disadvantaged communities’ reliance on investments and funding that are a direct result of continued carbon emissions.

VI. Implications

Forest offsets, included in California's cap-and-trade program to deliver net-neutral conditions that ease companies' transition to reduced emissions over time, have failed to deliver on the goals they were intended to achieve. Offsets were meant to provide incentives for landowners to change their land use management practices, but instead the flaws in implementation have led to shortcuts and loopholes. Instead of strengthening California's cap-and-trade program, forest offsets water down the ambition of emissions reduction goals by failing to represent necessary, real, and robust emissions reductions (Victor & Cullenward, 2020). In order to reach the state's 2030 climate goal, California lawmakers and regulators must equitably address the inherent problems that forest offsets pose to meaningful emissions reductions. In the development of its 2022 scoping plan, CARB can keep California on track as a global climate leader by excluding offsets from the future of cap-and-trade and being accountable to the disadvantaged communities that bear the greatest costs from continued fossil fuel production under the current offset system.

Nine years into the cap-and-trade program, it is important to determine whether forest offsets are delivering the promised climate mitigation necessary to confirm their legitimacy as a policy mechanism. States such as Oregon and Washington are currently developing cap-and-trade programs that mirror California's, and it is crucial that flaws are identified and avoided in any jurisdiction that adopts California's model.

Alternatively, California can make polluters pay more and use this money to fund forest protection instead of tying community investments to profits from selling forest offsets. The carbon market has created a financial reliance on polluters, meaning that communities rely on the pay to pollute model to receive funding for crucial projects and investments in climate resiliency

(Callahan et al., 2021). This arrangement creates challenges for lawmakers and state agencies to build long term budgets for climate programs because the annual revenue from allowance auctions in cap-and-trade is uncertain and reliant on continued emissions. If the forest offset program were to be altered or removed, the stream of revenue for these programs might shrink. The California Justice40 Act could fill this funding gap by directing 40% of federal climate investments to disadvantaged communities, providing a constant stream of revenue for communities who bear the costs of continued emissions by polluters (Callahan et al., 2021).

If CARB maintains forest offsets as a central component of California's cap-and-trade program, the price of carbon credits should be increased via a higher price floor. In 2020, carbon credits from offsets sold for \$13.67 per ton to polluters (Badgley et al., 2021). The United States Government Interagency Working Group on the Social Cost of Carbon estimates that the current social cost of carbon is \$51 per ton, and will be at least \$79 per ton by 2030 (Schatzki & Stavins, 2018). The low price of carbon offsets, relative to the social cost of carbon, ensures that polluters are able to pay less than they should be charged to continue polluting.

This problem also affects the type of forest offset projects selected for California's cap-and-trade program. Companies are encouraged to buy the cheapest offsets, which are often the lowest quality and less likely to represent real emissions reductions (Victor & Cullenward, 2020). This system of selling offset credits keeps companies in a race to the bottom because developers will always seek out projects that generate the most credits, which most often exploit the flaws in the program and have questionable climate benefits. This low offset price does not include key factors that affect emissions reductions, such as the length of carbon storage, the risk of forest destruction, or social equity concerns (Joppa et al., 2021). The CEO of Lyme Timber, a top participant in California's forest offset program that has earned \$53 million by selling carbon

credits, proposed a new form of offsets projects that demonstrates real, measurable reductions in timber harvesting in their forests (Elgin, 2022). By decreasing logging by 15% on a specific project and guaranteeing increased carbon storage, he calculated that an offset that reflects the lost profit from timber sales would need to cost at least \$60 per ton. The current range of \$10 to \$15 per offset is only enough to fund offsets projects that cut corners and exploit program flaws, but is not enough to fund projects representing robust carbon sequestration (Victor & Cullenward, 2020). In addition to implementing a price floor, CARB could also implement a higher price of offsets for companies located in heavily-polluted, disadvantaged communities across California (Cushing et al., 2018).

Even a perfect forest offset system, devoid of existing flaws and challenges, only delivers net neutral benefits to the climate. Emissions produced are matched 1:1 with emissions reductions through increased carbon sequestration in forests. Scientists are clear that we need to rapidly decrease emissions to avoid catastrophic global temperature increases, and investing significant time and energy into a solution that provides at best net neutral benefits will not get our world to the emissions reductions needed. Additionally, anything less than a perfect forest offsets program creates a net increase in carbon emissions. Polluters' emissions are real and quantifiable, while the emissions reductions will always be uncertain because of the subjectivity of carbon accounting in determining offset worth.

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