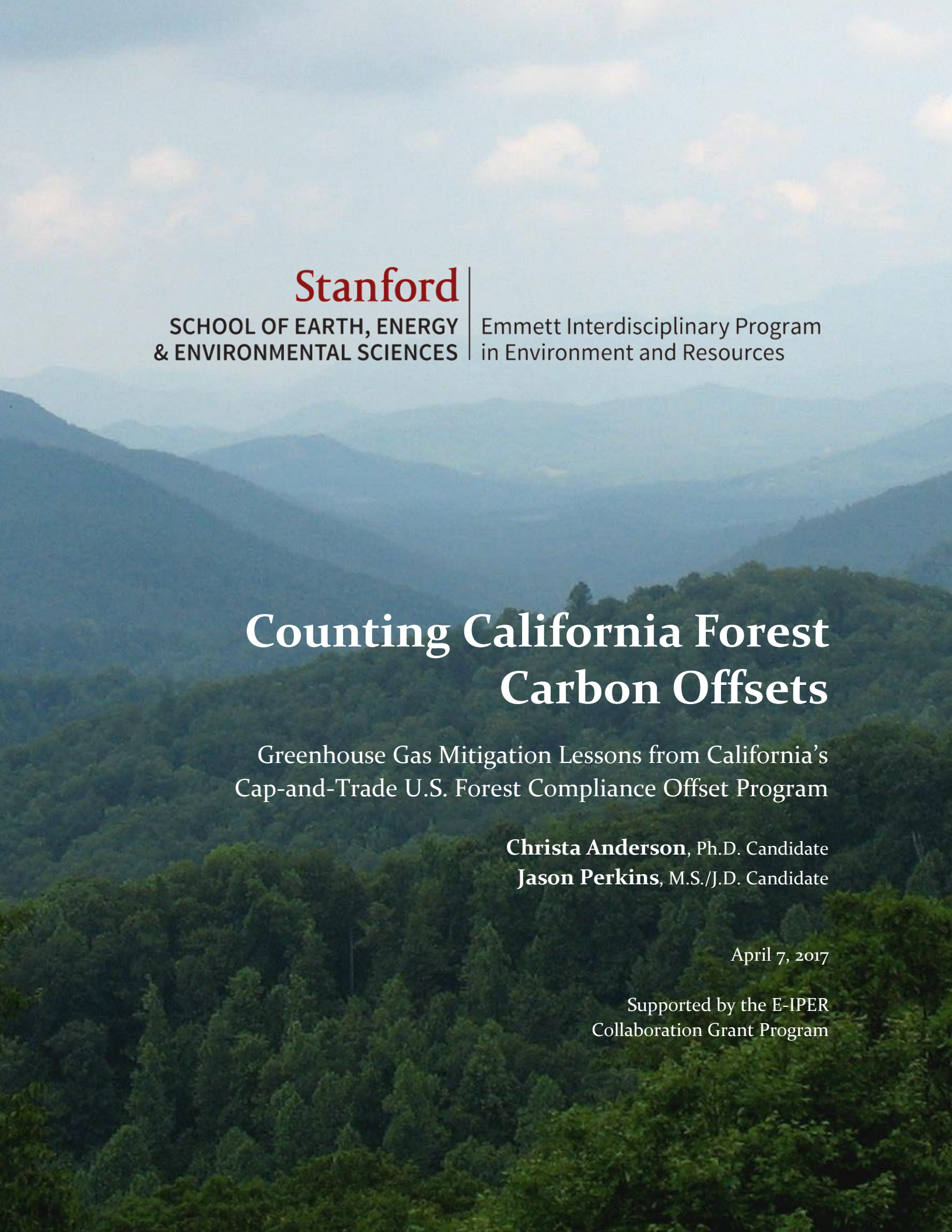

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Counting California Forest Carbon Offsets

Greenhouse Gas Mitigation Lessons from California's Cap-and-Trade U.S. Forest Compliance Offset Program

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Executive Summary

In 2013, California launched a multisector cap-and-trade market designed to reduce greenhouse gas pollution and meet the greenhouse gas mitigation targets set forth in Assembly Bill 32 (2006). Building on many years of effort and policy deliberation, California included in the cap-and-trade market the ability for covered entities with a compliance obligation to pay actors outside the program to reduce *their* emissions, frequently referred to as purchasing 'offsets'. Since 2013, California has operated a first-of-its-kind forest carbon offset program, in which 39 forest projects across the United States have earned credits through July 2016.

This research analyzes California's experience in running a first-ever compliance offset program for forests. To our knowledge, no official program evaluations of the forest offset program have been conducted to date. In the absence of identified and measurable official metrics and goals, this paper takes a more general 'lessons learned' approach, asking what the State has gotten from this policy innovation and what insights can be applied to other forest carbon sequestration efforts, like California's ongoing natural and working lands inventory.

From project design document review, survey responses and interviews with project owners and developers, we have four core findings. First, the California program has gone much further towards assuring additionality than other programs, including most voluntary forest offset programs, though some lingering and perhaps unavoidable questions remain. Second, a wide variety of California compliance entities buy forest offset credits, including some that operate facilities located in areas identified by the State as disadvantaged communities. Third, environmental benefits have been created by the program, though their financial importance may be minimal. Finally, California has taken forest offset protocols and policy to new levels, though the future of the market is quite uncertain given the need for supermajority reauthorization of the cap-and-trade program.

This paper first provides an overview of the forest offset program, its history and development, and some data about the current state of the program. It then describes the methods used in this study, and presents the above findings in detail. It concludes by illustrating several 'lessons learned' that should be incorporated by the Air Resources Board and cooperating agencies into the broader natural and working lands effort in California.

Overview and Development of the California Forest Carbon Offset Program

Before presenting the results of our research into the offset program, it is necessary to briefly describe the origins, history, policy design choices, and project performance of the California forest offset program in order to inform readers and put our findings in proper context. As of this writing, no comprehensive program evaluations have been conducted of the forest offset program.

Climate Change, Forests, and California Policy

Forest Carbon History and Potential

Forests have played an integral role in climate forcing emissions throughout American history, though only more recently have they served as a net carbon sink. Historically, American forests served as a significant net source of emissions in the 19th and early 20th Centuries, as old growth forests were harvested and trees were a primary building material and energy source. As fossil fuels replaced wood as a fuel source, and as forests regrew in the middle decades of the 20th Century, American forests became a net carbon sink, reaching their lowest net emissions rate (or, alternatively, highest carbon storage rate) in the 1980s. Since then, increased harvesting has lessened American forests' utility as a carbon sink, however significant carbon storage potential remains if deforestation is avoided in the 21st Century.[1] It has been estimated that forest carbon sequestration is equivalent to 12-19% of US fossil fuel emissions, [2] and the Obama Administration's Climate Action Plan noted the sequestration role being played by US forests,[3] though net carbon sinks from land use and forestry changes have been smaller in recent years than in 1990.[4]

California's Experience

Although the concept of forest offsets and other land use-related policies designed to incentivize carbon sequestration stretch back before the adoption of the

[1] Richard Birdsey et al., *Forest Carbon Management in the United States: 1600-2100*, 35 J. ENVIRON. QUAL. 1461, 1465 (July 2006).
[2] Michael Ryan et al., *A Synthesis of the Science on Forests and Carbon for U.S. Forests*, ISSUES IN ECOL. 13 (Spring 2010), at 1.
[3] Executive Office of the President, THE PRESIDENT'S CLIMATE ACTION PLAN (June 2013), at 11, available at https://goo.gl/KX1ULM.
[4] *See* U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2015* (February 2017) (Table 6-3 at 6-3, 6-4), available at https://goo.gl/GYpaXH.

Kyoto Protocol,[6] California's commitment to forest offsets can be traced to Senate Bill (SB) 1771 (Sher) in 2000.[7] That bill established the California Climate Action Registry (CCAR), a voluntary emissions inventory established by the state to define, measure and track greenhouse gas emissions. As part of its Climate Change Inventory, CCAR was instructed to acquire and develop data on the "costs, technical feasibility, and demonstrated effectiveness of . . . net reductions through the management of natural forest reservoirs."[8]

Land trust organizations sought to take this forest carbon data-gathering role at CCAR further, and promoted Senate Bill 812 in 2002 (Sher).[9] SB 812 directed CCAR to develop procedures and protocols for measuring and crediting the emissions impacts of "conservation and conservation-based management [activities in] . . . native forest reservoirs in California" that went beyond "applicable federal, state, and local land use laws and regulations."[10] How, exactly, CCAR would implement this measuring and crediting was a policy design task delegated to a state-convened working group that engaged land trusts, state foresters, forest industry representatives and an electric utility.[11]

This first 2002-2005 working group fleshed out many of the initial policy design questions, which led to the opening of California's voluntary carbon offset market in 2005. Importantly, from the very beginning, the state focused on a carbon-based payment structure, that is, strict accounting for forest carbon on a per-ton basis that could interface with cap-and-trade programs. The state chose not to take a practice-based or area-based payment approach to offset crediting that would have involved more general and less reliable carbon estimation and impact assumptions.[12] This tradeoff likely resulted in greater carbon sequestration from the projects who participated, perhaps multiple times more, but at the price of increasing project development and monitoring costs and thus a smaller population of potentially eligible projects. Indeed, this initial voluntary protocol (and its update in 2006) drew criticisms from other landowners not involved in conservation or conservation-based

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[6] Cornelis van Kooten et al., *How Costly Are Carbon Offsets? A Meta-Analysis of Carbon Forest Sinks*, 7 ENVION. SCI. & POL. 239, 239 (2004); Marissa Schmitz and Erin Kelly, *Ecosystem Service Commodification: Lessons from California*, 16 GLOB. ENVIRON. POLIT. 90, 90 (Nov. 2016). *See also* Mark Trexler et al., FORESTRY AS A RESPONSE TO GLOBAL WARMING (1989), available at http://goo.gl/Pwd8sg.
[7] 2000 Cal. Stat. 7482 et seq. (Ch. 1018).
[8] 2000 Cal. Stat. 7493 (Ch. 1018).
[9] Schmitz and Kelly, *supra* note 6 at 97.
[10] 2002 Cal. Stat. 2406 (Ch. 423).
[11] Schmitz and Kelly, *supra* note 6 at 97.
[12] *See* Ing-Marie Gren and Abenezer Aklilu, *Policy Design for Forest Carbon Sequestration: A Review of the Literature*, 70 FOREST POL. & ECON. 128, 130 (discussing studies of policies that took these approaches, at left).

management, as its stringent environmental and permanence requirements made initial participation rather unattractive for many for-profit private landowners and the California forest industry at the prices offered by voluntary carbon markets.[13]

A second working group, engaging more forest industry participants, followed after passage of California's landmark Assembly Bill (AB) 32 in 2006. From the beginning of planning the cap-and-trade portion of AB 32 compliance, the California Air Resources Board (ARB) signaled that forest offsets would play a cost-containment role in this new market. Cost-containment was an important concern – ARB's expectations for carbon prices in the cap-and-trade market ranged as high as $50/ton before the market began operating[14] (though in actual program experience, the allowance price has not risen above $20/ton since market launch[15]). Eventually, the State decided that entities could use offsets to meet up to 8% of their compliance burden, though use of offsets was optional and no particular participation goals were set.[16] With all reductions required to be "real, permanent, quantifiable, verifiable, enforceable, and additional" under AB 32,[17] the second protocol working group focused on "revis[ing] the early protocol to make it compliance-ready," a shift that had never before been attempted in any other jurisdiction.[18] In addition, to serve the goal of maximum participation and lower project costs (thus greater cost-containment for the cap-and-trade market), the new protocol was to be available for use nationwide, not just for projects in California.[19]

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[13] Schmitz and Kelly, *supra* note 6 at 92, 97.
[14] Marc Lifisher, *California's First Auction of Greenhouse-Gas Credits Nears*, L.A. TIMES (November 6, 2012), available at https://goo.gl/hj2u2F
[15] Danny Cullenward and Andy Coghlan, *Structural Oversupply and Credibility in California's Carbon Market*, 29 ELECTR. J. 7, 9 (2016).
[16] *See* California Air Resources Board, Resolution 11-32 (October 2011), at 4, *available at* https://goo.gl/s3IbTZ; *see also* Press Release, CARB, California Air Resources Board Adopts Key Element of State Climate Plan (Release 11-44; October 20, 2011) *available at* https://goo.gl/Ieoq5M.
[17] CARB, California Air Resources Board's Process for the Review and Approval of Compliance Offset Protocols in Support of the Cap-and-Trade Regulation [hereinafter Protocol FAQ], at 1, available at https://goo.gl/DL8Zo V; 2006 Cal. Stat. 3427 (Ch. 488), now CAL. HEALTH AND SAFETY CODE § 38562(d) (2017). *See also* Timothy Fahey et al., *Forest Carbon Storage: Ecology, Management, and Policy*, 8 FRONT. ECOL. ENVIRON. 245, 249 (2010) (providing a more general elaboration on what these terms entail in the forestry context).
[18] Schmitz and Kelly, *supra* note 6 at 100, 101.
[19] Protocol FAQ, *supra* note 17 at 10.

Program History: The Design Challenges of Forest Offsets

Two Key Periods of Policy Design

Throughout this formative period from 2002-2009, when California went through two full rounds of forest offset protocol design, stakeholders grappled with five critical design challenges in creating standards for offset projects. First, three commodification hurdles stemming from the United Nations Framework Convention on Climate Change proceedings had to be navigated: additionality, permanence, and leakage.[20] In short, to deliver credible climate mitigation, carbon offset projects must only receive credit for emissions reductions that would not have otherwise happened without program intervention (i.e. be 'additional' versus a conservative, business-as-usual scenario), must show that the reductions they deliver will persist over time (be 'permanent') and must demonstrate that no other emission-causing land use changes will result (no 'leakage'). In addition, two other design challenges were present – how to maintain the environmental integrity of forests managed for carbon storage, and how to ensure market availability and acceptance of offsets as a salable commodity. Table 1 below summarizes how the 2002-05 and 2007-09 working group protocol-writing periods addressed these key design questions.[21]

[20] Steven Ruddell et al., *The Role for Sustainably Managed Forests in Climate Change Mitigation*, 105 J. OF FORESTRY 314, 316-17 (September 2007). The Kyoto Protocol's Clean Development Mechanism offset program uses similar, though not exactly the same, terms. *See* UN Framework Convention on Climate Change, GLOSSARY – CDM TERMS (Version 8.0) (defining "additional", "leakage", and "long term certified emissions reduction"), available at https://goo.gl/rZQCQ3.

[21] One update did occur between these dates in 2007, though most of the changes came with respect to more technical details of forest data and verification steps. *See* Climate Action Reserve, VERSION 2.1 at https://goo.gl/HpcpJJ (last visited March 15, 2017).

Table 1. Protocol Evolution on Key Design Questions, 2005 and 2009

Design Challenge	Description	Early Protocol Approach (Version 1.0, 2005)[22]	Compliance-Ready Protocol Approach (Version 3.0, 2009)[23]
Additionality	Proving emissions reductions as compared to a no-project counterfactual (a 'baseline')	• Crediting sequestration on project lands up to the maximum allowable harvest under CA forest rules	• Quantifying primary effect, consisting of: Crediting sequestration on project lands above a standardized Common Practice baseline, taking into account growth models, legal obligations and project start date
Permanence	Delivering a long-term guarantee of emissions reductions	• Requiring a perpetual conservation easement	• Requiring a 100-year commitment • Percentage contribution to buffer pool of credits depending on project-specific reversal risks • Allowed voluntary termination
Leakage	Preventing concomitant emissions from induced land use change and activities elsewhere	• Perform an assessment for activity-shifting leakage (required) and market leakage (optional)	• Quantifying secondary effects, including a project-specific leakage adjustment factor, but not including energy effects of alternate materials. • Market leakage adjustment only for IFM projects
Environmental Integrity	Guaranteeing sustainable and environmentally-conscious management (i.e. avoiding mere 'tree farm' projects)	• Requiring a perpetual conservation easement • Maintenance of native forests • Natural forest management (preventing even-aged cutting)	• Requiring adherence to sustainable harvesting practices (certification) • Natural forest management for the project area • Increasing standing live carbon stocks
Market Availability and Acceptance	Ensuring offset credit availability and purchaser confidence for a functioning offset market	• Five-year third-party certification of forest project results	• Lifting the conservation easement requirement • Permitting even-aged management (with limits) • Six-year third-party verification, with periodic desk reviews

As Table 1 details, the two California working groups engaged in an intricate policy design process in order to meet AB 32's requirement that offsets be real, permanent, quantifiable, verifiable, enforceable, and additional. Several tradeoffs were made in order to expand the possible pool of projects that could participate across the

[22] Climate Action Reserve, FOREST PROJECT PROTOCOL VERSION 1.0 (September 2005) at https://goo.gl/IoyTIs (last visited March 15, 2017) (see PDF of that name on this webpage).
[23] Climate Action Reserve, FOREST PROJECT PROTOCOL VERSION 3.0 (September 1, 2009) at https://goo.gl/5clWdB (last visited March 15, 2017) (same).

program. Changes were made to the additionality, permanence and environmental integrity requirements that facilitated greater program participation.

Analyzing California's Protocol Changes in the Second Working Group

For additionality, California first chose a performance benchmark test in 2005, allowing credit above harvest floors permitted by California regulations.[24] Once the program expanded to cover the continental US, however, a new approach was needed rather than one reliant on California regulations.[25] The second 2009 working group developed a multi-part approach to additionality that would be applicable across the country. Projects would only receive credit for:

1) actions taken after a defined project start date;
2) sequestration above all legal, regulatory and financial harvesting and stocking constraints; and,
3) credit relative to an area-specific 'Common Practice' baseline developed using US Forest Service Forest Inventory and Analysis Program Data ('FIA data').

This approach combines three types of additionality 'tests'—legal or regulatory, common practice, and timing tests, as identified in Trexler et al (2006). This generally represents a more stringent approach to additionality than in the earlier 2005 protocol. Having multiple additionality screens almost certainly increases the proportion of credited reductions in the program that are truly additional, but at a higher cost of participation and with less supply flexibility.[26]

Stakeholders also eased the permanence requirement to broaden participation. In order to incentivize lands managed for multiple uses (and not just conservation management), the 2009 protocol no longer required conservation easements. Instead, projects were required to give a 100-year sequestration commitment, and agree to set aside a project-specific proportion of their credits in a 'buffer pool' as insurance against later losses of carbon stock, referred to as 'reversals'.

This permanence policy change no doubt made the program more attractive to for-profit timber companies and family landowners, though it did not eliminate all potential reversal risks program-wide. Buffer pools, later described as the "most commonly used" approach to program impermanence risk, neatly manage the

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[24] *See* Mark Trexler et al., *A Statistically-Driven Approach to Offset-Based GHG Additionality Determinations: What Can We Learn?*, 6 SUSTAIN. DEVEL. L. & POL. 30, 31 (Winter 2006) (describing various illustrative types of additionality 'tests').

[25] In general, states must be careful about designing state programs that affect out of state entities, since regulations with 'extraterritorial' effect are vulnerable to legal attack under the Commerce Clause of the US Constitution or federal laws. *See generally North Dakota v. Heydinger*, 825 F. 3d 912 (8th Cir. 2016) (finding that a Minnesota clean energy law had impermissible out of state effect).

[26] *See* Trexler et al., *supra* note 24 at 38 (showing tradeoff between flexibility and additionality in Fig. 8).

individual risk of projects by essentially making them insure both themselves and others in the currency of the program – credits. However, this approach to risk does *not* take into account program-level reversal risks, i.e. the fact that individual project risks may under certain circumstances, be correlated.[27] The buffer approach essentially assumes that even if one project falls victim to a reversal event (e.g. a wildfire), most others will not. This program-level assumption may not hold if projects share certain common risk-relevant characteristics, like being located in close geographic proximity to one another. Cross-cutting risks, like the increased potential for wildfires as global temperatures rise and climate change progresses, can increase reversal risk across the board, not just for isolated individual projects.

Finally, with respect to environmental integrity, several changes helped make the program more attractive to timber companies and other landowners. Instead of a conservation easement, the 2009 protocol allowed a sustainable forestry certification to suffice as a commitment to environmental integrity. Though natural forest management remained a requirement, this definition was altered to allow some degree of even-aged management over portions of the project area, and in increments less than 40 acres. Projects were also expected to maintain or increase standing live carbon stocks,[28] as a way to promote biodiversity and wildlife habitat. In general, the 2009 protocol took several important steps to ensure greater participation while generally not changing the strict verification requirements that help facilitate investor confidence in offset credits.

Administration by ARB and Subsequent Challenges

The 2005 and 2009 protocols had been adopted pursuant to SB 1771 and SB 812, in stakeholder processes run through the CCAR, which was restructured and relaunched as the Climate Action Reserve (Reserve) in 2008. When ARB included forest offsets as part of the broader cap-and-trade program, however, the protocols then became official documents of the ARB, which noted that they had been drawn from version 3.2 of the Reserve's protocol.[29] After several years of accepting projects

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[27] David Cooley et al., *Managing Dependencies in Forest Offset Projects: Toward a More Complete Evaluation of Reversal Risk*, 17 MITIG. ADAPT. STRATEG. GLOB. CHANGE 17, 17 (2011) (describing three different kinds of correlated catastrophic reversal risks – fat tails, micro-correlations, and tail-dependence – that may be present, yet are unaccounted for by buffer pools). *See also* Christopher Galik and Robert Jackson, *Risks to Forest Carbon Offset Projects in a Changing Climate*, 257 FOREST ECOL. & MGMT. 2209, 2209 (describing systemic climate risks not accounted for in project-by-project analysis).
[28] *Compare* the 2005 protocol, *supra* note 19 at 15-16, *with* the 2009 protocol, *supra* note 20 at 12.
[29] *See* CARB Resolution 11-32, *supra* note 13 at 10. *See also* CARB, COMPLIANCE OFFSET PROTOCOL U.S. FOREST PROJECTS (ADOPTED: OCTOBER 20, 2011) [2011 Forest Offset Protocol], at 7 available at https://goo.gl/OpLQvv.

designated as Early Action, the compliance portion of the offset market launched in 2013 with the beginning of the cap-and-trade program.[30]

ARB implemented compliance protocols based on the 2009 protocol and updated the protocol in 2011, 2014, and 2015. Most of the key issues described above have not changed in these updates, including project-level risk assessments.[31] Some distinctions and developments have occurred across protocol updates, though there has been more consistency than change. [32] Since 2011, ARB has mandated higher levels of professional education and skills in verification teams.[33] Also, two updates to the protocol were released in 2014 and then in 2015, along with growing amounts of interpretive guidance and FAQs posted on the ARB website.[34]

Importantly, ARB's approach to additionality under this protocol and the other offset protocols was upheld as lawful by the California Court of Appeal in 2015 in *Our Children's Earth Foundation v. California Air Resources Board*.[35] That case decided that as a legal matter, ARB had the authority under AB 32 to implement the "standards-based approach" it has taken in adopting offset regulations and protocols since 2011, including for the US forest program.[36] CARB did not have to take an idiosyncratic project-specific approach to additionality, as the challengers had wanted. Observing that it is "virtually impossible to *know* what otherwise would have occurred in most cases," ARB could not be held to an additionality standard of omniscience and perfection – the legislature had directed ARB to "establish a workable method of

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[30] CARB, OVERVIEW OF ARB EMISSIONS TRADING PROGRAM (updated February 9, 2015) at 2 https://goo.gl/qxOSqZ.

[31] *See also* CARB, COMPLIANCE OFFSET PROTOCOL U.S. FOREST PROJECTS (ADOPTED: JUNE 25, 2015) [2015 Forest Offset Protocol], at https://goo.gl/hJuX8c. See also CARB, COMPLIANCE OFFSET PROGRAM (updated March 8, 2017) (website with links to the protocols and other details from past iterations) available at http://goo.gl/WUBm4Y.

[32] For example, starting with the 2011 protocol, ARB has used the language of 'intentional' versus 'unintentional' reversals in dealing with project owner compensation liability, whereas the previous protocols had distinguished between avoidable and unavoidable reversals, though the substantive standards remain the same. *Compare* 2011 Forest Offset Protocol, supra note 25 at 59 with Climate Action Reserve, FOREST PROJECT PROTOCOL VERSION 3.2 (August 31, 2010) at http://goo.gl/XX3ubS (last visited March 15, 2017) at 63. *See also* CAL. CODE REGS. tit. 17 § 95802(a)(190) (2017) (defining intentional reversal), *available at* https://goo.gl/PUMgye.

[33] *See* Climate Action Reserve, COMPARISON OF RESERVE FOREST PROJECT PROTOCOL TO ARB COMPLIANCE OFFSET PROTOCOL FOR FOREST PROJECTS (last accessed March 15, 2017), *available at* https://goo.gl/jVrLLE (comparing Version 3.2 to the first CARB protocol).

[34] *See* CARB, COMPLIANCE OFFSET PROTOCOL U.S. FOREST OFFSET PROJECTS: ADOPTED JUNE 25, 2015 (updated December 2, 2015), *available at* https://goo.gl/7XiB8G (website explaining 2015 protocol).

[35] 184 Cal Rptr. 3d 365, 378 (2015). *See also* Alan Ramo, *The California Offset Game: Who Wins and Who Loses?*, 20 J. ENV. L. & POL. 109, 133-43 (Winter 2014), available at https://goo.gl/eCWrLQ (providing more background on the case).

[36] *Our Children's Earth Foundation*, 184 Cal Rptr.3d at 371, 373, 378.

ensuring additionality with respect to offset credits" in the context of "a market-based compliance mechanism," which is precisely what ARB did.[37]

Another important event came in 2014, when ARB recorded its first invalidation of offset credits under any protocol. The Clean Harbors Environmental Services waste incinerator in El Dorado, Arkansas participated in the Ozone Depleting Substances (ODS) protocol up until 2014, when a compliance issue with their hazardous waste environmental permit came to ARB's attention. For a period in 2012, it was found that Clean Harbors was not in compliance with their hazardous waste permit, though an investigation revealed no environmental integrity concerns with their ODS activities. After investigation, assessment, lobbying from market participants, and a final determination, ARB decided to invalidate 88,955 of the approximately 4.3 million tons of offset credits Clean Harbors had earned, sending ripples of concern through the offset marketplace.[38]

Though not the precise subject of legal action, or at least not yet, environmental justice concerns have been leveled at the offset program. Offsets are viewed skeptically by environmental justice advocates because they allow facilities located in disadvantaged communities to cover their emissions with offset reductions that happen elsewhere. This has been particularly concerning since several industry sectors have shown increased emissions since the 2013 start of the cap-and-trade market, though to date, the data made available to the public does not permit a very detailed assessment of these equity concerns. A 2016 analysis from scientists at UC Berkeley and several other California universities showed that most compliance entities did not use offsets, though those that did tended to have larger GHG emissions.[39] We discuss these environmental justice questions further in the Findings section.

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[37] *Id*. at 379.

[38] *See* California Air Resources Board, Final Determination: Air Resources Board Compliance Offset Investigation Destruction of Ozone Depleting Substances (November 14, 2014), *available at* https://goo.gl/KGeHrr; Laurel Rosenhall, CalMatters, *A Little Town in Arkansas and its California Connection* 89.3 KPCC (July 26, 2015), *available at* https://goo.gl/bnwI11; Gloria Gonzalez, *Despite Market Outcry, California Voids Some Carbon Offsets*, ECOSYSTEM MARKETPLACE (November 14, 2014), *available at* https://goo.gl/Obv367.

[39] Lara Cushing et al., USC Dornsife Program for Environmental and Regional Equity, A PRELIMINARY ENVIRONMENTAL QUALITY ASSESSMENT OF CALIFORNIA'S CAP-AND-TRADE PROGRAM: RESEARCH BRIEF – SEPTEMBER 2016 [hereinafter Climate Equity Brief] at 7-10, *available at* http://goo.gl/2VrnXm.

Current Status of Today's Forest Offset Market

A Small But Notable Part of the Cap-and-Trade Market

According to the latest ARB Compliance Instrument Report at the time of this writing (up through Q4 2016), 95% of program compliance has been achieved through the use of allowances. Of the remaining 5% of offsets, a majority (3% of the total) comes from US Forest projects, with the remainder primarily coming from the Ozone Depleting Substances protocol and smaller amounts from livestock and mine methane capture projects. The amount of offset credits issued is slightly greater, as seen in Table 2. More credits have been issued than have been retired to-date, and Table 2 includes credits that are held back in the forest buffer pool and those that are held by offset project owners, market participants or compliance entities for future compliance. These figures are presented in Figure 2 and Table 2 below.

Table 2. ARB Offset Credits Issued as of March 11, 2017

Project Type	Ozone Depleting Substances	Livestock	U.S. Forest	Urban Forest	Mine Methane Capture	Rice Cultiv.	Totals
Compliance	7,222,320	1,521,590	21,851,822	- -	1,259,314	- -	31,855,046
Early Action	6,336,710	1,695,029	13,276,494	- -	2,879,684	- -	24,187,917
Totals	13,559,030	3,216,619	35,128,316	- -	4,138,998	- -	56,042,963

Source: ARB, Compliance Offset Program website,[40] at https://goo.gl/gBSWoj

[40] The text appearing alongside this table on the CARB website is: *Table includes all offset credits issued including offset credits placed in ARB's Forest Buffer Account, offset credits returned to an Early Action Offset Program's forest buffer pool, and offset credits subsequently invalidated.*

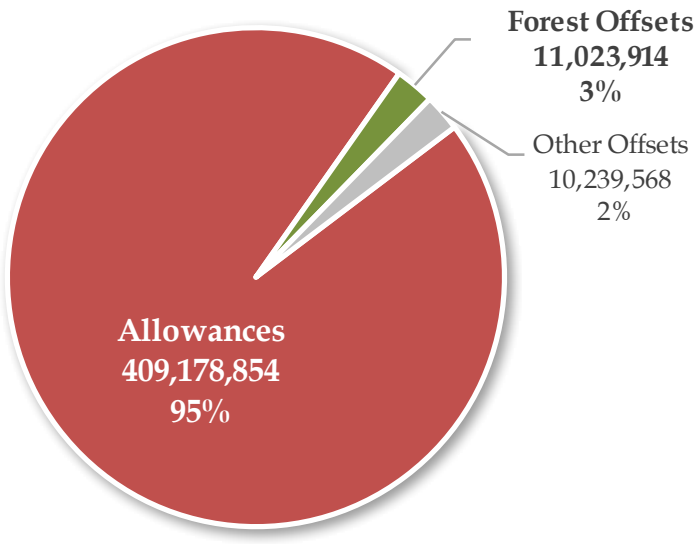

Figure 1. Retired Compliance Instruments Used 2013-16 in the California Cap-and-Trade Program. Source: ARB Compliance Instrument Report, Data through Q4 2016, accessed March 11, 2017, available at https://goo.gl/Jsj8kf

Given that offsets account only for 5% of the total compliance instruments used so far in the cap-and-trade program, it would be easy to dismiss their role in the sweep of California's aggressive climate policies. Indeed, one author likened the cap-and-trade market as a whole to 'dessert' after a full meal of other 'complimentary policies' for climate action including building energy efficiency standards, tailpipe emission standards, the Low Carbon Fuel Standard and renewable energy mandates. These policies are expected to account for approximately 70% of California's climate action, with cap-and-trade's 30% "no ton is left behind" contribution following at the end.[41] In this conception, offsets would be the garnish on that dessert – playing a small role in the last-in-line climate policy. Depending on the future carbon price, of course, offsets could stand to play a much larger role. If carbon prices increase considerably and more entities use closer to their full 8% allotment of offset-based compliance, then it is possible that offsets will exert considerable influence over the overall cap-and-trade program's economic and environmental outcomes.

Whether a large or small portion of compliance, offsets are somewhat financially beholden to the vagaries of the broader cap-and-trade market. Given that they are substitutes, offset prices according to market participants are generally pegged to the going rate for allowances, though at a small discount likely due to the additional search and transactions costs investing in offsets requires. With market data indicating

[41] Michael Wara, *California's Energy and Climate Policy: A Full Plate, But Perhaps Not a Model Policy*, 70 BULL. OF THE ATOM. SCI. 26, 27, 28 (2014).

a structural oversupply of compliance instruments in the cap-and-trade market,[42] the latest allowance price floor[43] of $13.57 may operate as somewhat of a price ceiling on offsets, especially when allowances are abundantly available for purchase from ARB or in the secondary market.

However, as a financial matter offsets should not so easily be dismissed. Both from published data made public by ARB,[44] and from anonymous survey results collected in this research, offset prices have been in the general vicinity of $9-13 per ton CO_2e. This price range combined with the information in Table 2 above suggests that the 56 million offsets issued to-date by ARB are in total worth around $500 million, with about $300 million of that in forest offsets alone. As a matter of state policy and as an unprecedented experiment in carbon sequestration program design, the forest offset program is certainly worthy of close examination.

Explaining the Distribution of Offset Credits by Project Type

As seen in Table 2 and Figure 2 above, the US Forest offset program accounts for a clear majority of both the credits earned and the offsets surrendered for compliance. This research also draws on project design documents available through the forest offset program, pulled from the climate registry websites as of July 2016. This analysis was conducted for all the projects that had then earned or were earning credits in the program.[45] Looking at just these projects that had made it all the way through the application process helps show how the project protocols are playing out in practice. From the project document data analyzed for this study, we draw the following project summary statistics in Tables 3 and 4, and the map in Figure 3 below.

Table 3. Credit-Earning Projects in the U.S. Forest Offset Program, July 2016

	Number of Projects	Total Credits	Total Acres
Improved Forest Management	33	24,142,947	854,598
Avoided Conversion	6	1,376,803	8,588
Reforestation	0	0	0
Totals	**39**	**25,519,750**	**863,186**

[42] Cullenward and Coghlan, *supra* note 15 at 13.
[43] CARB, FEBRUARY 2017 JOINT AUCTION #10: SUMMARY RESULTS REPORT (last accessed March 15, 2017), *available at* https://goo.gl/MSDdTD.
[44] *See* CARB, 2015 SUMMARY TABLE OF MARKET TRANSFERS (last accessed March 15, 2017), *available at* https://goo.gl/qwxFDS.
[45] Other analysis has focused on all projects listed in the program, an earlier step in the crediting process. *See* Erin Kelly and Marissa Schmitz, *Forest Offsets and the California Compliance Market: Bringing an Abstract Ecosystem Good to Market*, 75 GEOFORUM 99, 102 (2016).

Table 4. Credit-Earning Projects in the Offset Program by Protocol Type

	Compliance Program			*Early Action Program*		
	Number of Projects	**Total Credits**	**Total Acres**	**Number of Projects**	**Total Credits**	**Total Acres**
Improved Forest Management	16	16,757,595	691,393	17	7,385,352	163,204
Avoided Conversion	0	0	0	6	1,376,803	8,588
Reforestation	-	-	-	-	-	-
Totals	**16**	**16,757,595**	**691,393**	**23**	**8,762,155**	**171,792**

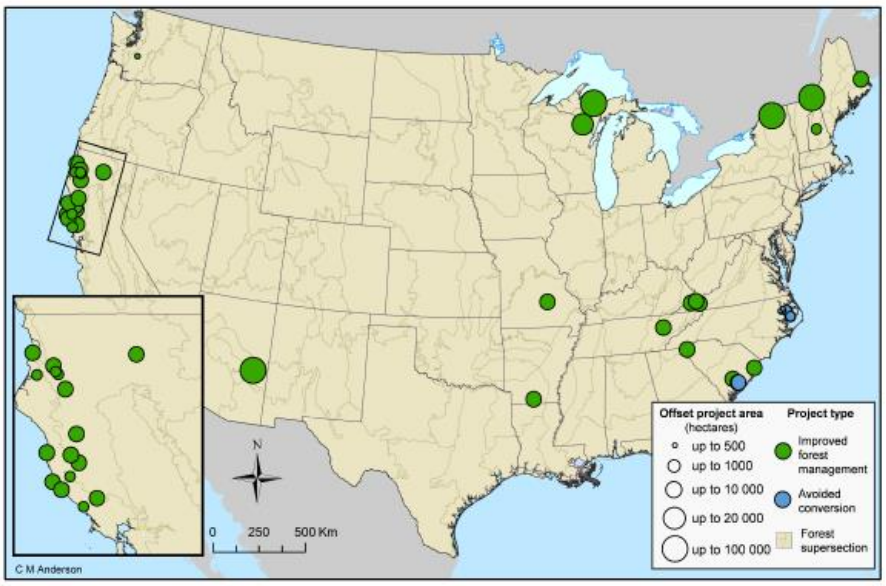

Figure 2. Map of Credit-Earning Projects in the U.S. Forest Offset Program, July 2016

Several trends stand out in the project data presented above. First, improved forest management (IFM) projects dominate the pool of projects that have made it to the crediting phase of the program. The potential reasons for this are several, though interviewees highlighted three important ones. Given that tree growth from plantings does not begin to show financially significant returns in terms of carbon accumulation for 15-20 years, the financial payback period for reforestation projects is simply too

long, explaining why no projects have yet been credited. Second, only a handful of avoided conversion projects have been successfully credited in the program. This may be in part because in ARB's protocol, projects must show that the anticipated alternative land use for the project is more than 80% higher than its current forested value or face credit reductions.[46] This requirement essentially imposes a property conversion value test whereby converting to another land use must nearly double the value of the land, or face credit erosion by an 'uncertainty discount factor'. The purpose of this discount factor is additionality – only projects with high potential conversion values (i.e. those most likely to actually be converted) can make it into the program and receive full credit. Finally, IFM projects have the benefit of obtaining credit in the first year for the amount of carbon stock above their own modeled harvest baseline and above the Common Practice baseline. Put differently, this means that when an IFM project comes into the program, in the first year they are eligible for an initial crop of carbon offset credits for their current carbon stock that is above both the regional average stock (Common Practice baseline), and above the project-specific modeled baseline that includes financial, legal, and regulatory constraints. In short, above-average forests earn significant credits up front, and multiple interviewees acknowledged that this initial tranche of credits is all but essential for IFM project participation.[47] Many interviewees note that part of the initial revenue inflow is often used to finance startup costs.

Two additional pieces of evidence reinforce the essential role of up-front revenue. Published research on the potential financial returns from potential small offset projects in the northeastern US found that initial carbon stocking above the Common Practice baseline was the strongest predictive variable of financial returns.[48] Also, our analysis of project documents for the IFM projects currently earning credits indicates that 4 out of every 5 IFM projects in the program entered with carbon stocking above the Common Practice baseline. The quartile boxplot in Figure 4 below shows that most projects come in above, and many come in significantly above their area's Common Practice baseline. For a project at the median carbon stock (32 tons/acre above) and of a median size (9,753 acres for IFM projects), this means roughly 300,000 credits will be awarded up-front. At approximately $9 a credit, that amounts to $2.7 million in year 1 revenue for the project. Figure 5 below shows how IFM projects earn credit over time, demonstrating that about 70% of credits come in the first year and small annual amounts after, reflecting the (slow) net growth of carbon stock after year one.

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[46] 2015 Forest Offset Protocol, *supra* note 31 at 72.
[47] *See also* Kelly and Schmitz, *supra* note 45 at 105.
[48] Charles Kerchner and William Keeton, *California's Regulatory Forest Carbon Market: Viability for Northeast Landowners*, 50 FOREST POL. & ECON. 70, 75 (2015).

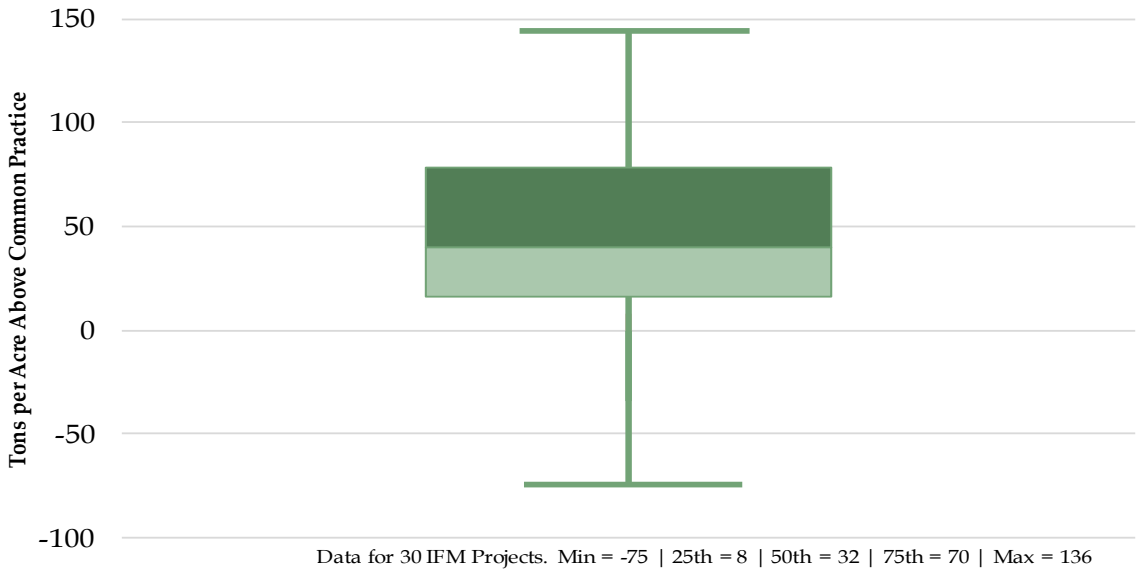

Figure 3. Boxplot of Initial Tons per Acre Above Common Practice from IFM Projects in the US Forest Offset Program as of July 2016.

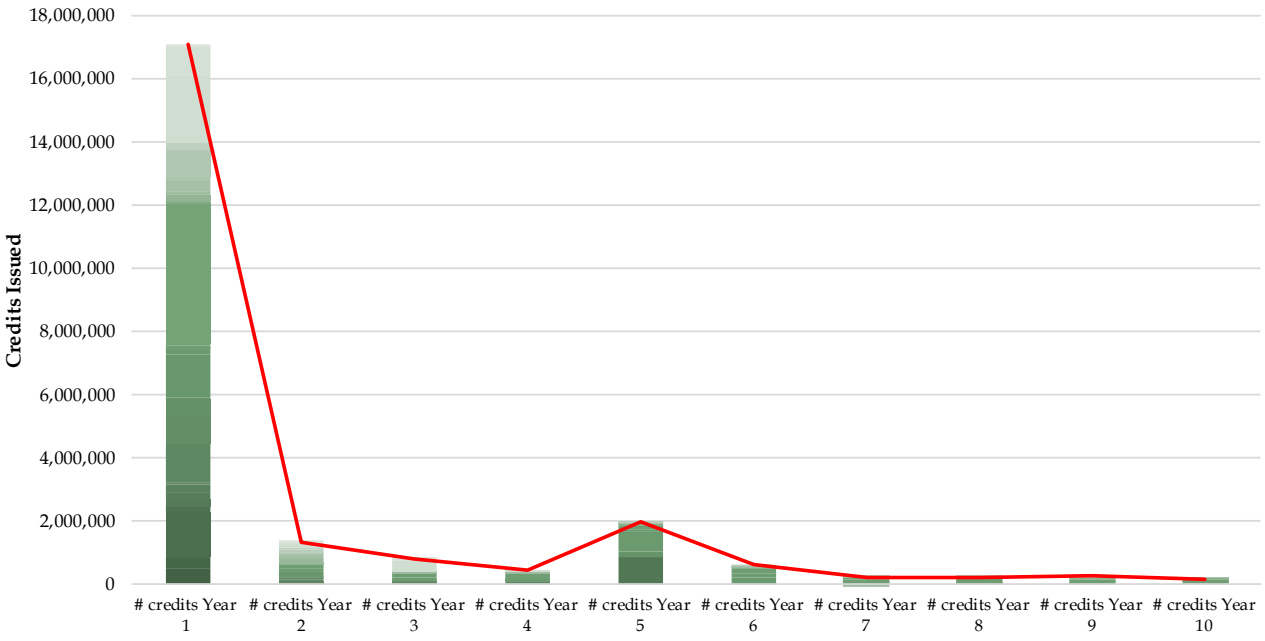

Figure 4. Total Credits per Year Earned by IFM Projects in the US Forest Offset Program as of July 2016.

Summary

In summary, today's California forest offset market is populated by several dozen projects selected for their exceedingly good fit under the rules of the program as specified in the ARB protocol. With a multifaceted approach to additionality, stringent verification and monitoring expectations and robust carbon accounting rules, the projects in the program reflect ARB's emphasis of quality over quantity in the number of projects that earn credits. Project developers have previously reported that only 5-10% of the projects they initially investigate end up being profitable enough to proceed given these high program hurdles.[49]

However, with over 100 projects listed in the program so far (an initial stage in the application process), it is possible that significantly more projects could complete the process and begin earning credits if the price of carbon increases. Reauthorization of the cap-and-trade program past 2020 could cause such a price spike, which would likely lead to the crediting of many more IFM and avoided conversion projects. These projects would presumably be less financially dependent on returns from crediting their initial stocking over the Common Practice baseline, as future growth would be more remunerative. It remains to be seen whether any plausible market scenario will bring reforestation projects into the program, though. What is clear is that future market dynamics will depend largely on future developments in state policy and carbon prices.

[49] Kelly and Schmitz, *supra* note 45 at 104.

Methods

This review undertook three approaches to assessing forest offset project and program characteristics. First, we conducted an assessment of all 39 credited forest offset projects (listed in Appendix I) using a text review of the public project documents available for each project. Projects must meet stringent reporting requirements, and must be listed on approved carbon registries with public project documents. For this research, available documents included an offset verification statement, annual offset project data reports, offset project listings, and biennial project emissions reporting, yielding a database of 46 variables for each project.

Second, we administered a survey of forest owners/operators and a separate survey of forest offset project developers to gain information beyond what is reported in project documents. The surveys included questions about participant motivations, forest offset credit sales, and other project characteristics, experiences, and opinions. Online surveys were sent to all 32 identified project owners/operators. Postcard reminders were mailed, seven survey reminders were sent by email, and hard copy surveys were sent to those who did not respond within a week. 17 complete survey responses were collected, with a survey response rate of 53%.[50] These responses covered 21 of the 39 credited projects, also 53% of the total. The same process was used for the project developer survey. Three of four project developers responded. For context, we estimate that 72% of all projects in the program used a project developer to implement their forest offset project.

Third, we conducted in depth interviews with eight project owners (including four on-site forest visits) and with two project developers. These in depth interviews provided nuanced details for specific projects and corroborated information gained from the document review and survey. Between surveys and interviews, this research obtained detailed data from the owners of 28 of the 39 projects credited in the program (72%). This paper draws on each of these three data sources—documents, survey responses, and interviews—in formulating the following findings and lessons.

Last, we compiled additional data for mapping forest offset use in disadvantaged communities (see Finding 2 below). Using a combination of publicly available data from ARB and other sources, we analyzed the share of forest offsets that were used at facilities in disadvantaged communities (estimated to be a pro-rata share of their parent entity's offset use) as compared to offset-linked facilities not located in disadvantaged communities. This analysis used forest offset data from 2013-2015, and annual emissions from facilities in 2014, as described further in footnote 60 below.

[50] The majority of projects covered in survey responses were Early Action projects.

Findings

Based on document analysis, interviews, and surveys, we elaborate four primary findings on California's forest offset program below.

Finding #1: Additionality is Much Stronger than in Other Forest Offset Programs, But Questions Remain

Project 'additionality' refers to the idea that a forest offset project earns credits for changing practices from what would have happened without the project. For example, forest owners can earn credits by cutting less timber than they would have otherwise, or by keeping forest land standing that they would have otherwise converted to agriculture. The challenge with credit accounting under this approach is that it is never possible to know the counterfactual (what would have happened in the absence of the forest offset project) for certain. By definition, all counterfactuals are hypothetical exercises. Many forest offset programs have been plagued by difficulty in determining the appropriate counterfactual or 'baseline' activity level. California's program continues to face this challenge as well, but it has gone several steps further than prior efforts on forest offsets.

Efforts to Ensure Additionality

This analysis finds that California's forest offset program has incorporated several accounting and protocol elements in an effort to ensure project additionality. First, projects entail rigorous carbon accounting with standardized baselines across the country which are established with long-term forest data from the US Forest Service Forest Inventory and Analysis program.[52]

Second, forests are required to provide data showing that the project-specific harvest baseline against which their project will be credited would have been financially viable.[53] That is, when forests set counterfactual timber harvest levels or forest conversion rates, they are required to provide a net present value analysis or recent sales records from neighboring forests showing that the proposed baseline timber harvest is financially viable for the duration of the offset project.

Third, projects are required to exclude any forest carbon that is already legally protected by another mechanism.[54] Forest carbon that is already legally protected from harvest would by definition not be harvested, and any crediting for such carbon would

[52] 2015 Forest Offset Protocol, Appendix F, *supra* note 31 at 139.
[53] 2015 Forest Offset Protocol, *supra* note 31 at 28, 62.
[54] 2015 Forest Offset Protocol, *supra* note 31 at 27.

clearly not be additional. Common legally protected forest carbon in offset projects, for which projects do not receive credits, include legal prohibitions from harvest near streams, on steep slopes, or near endangered species. Another common legal prohibition that prevents some forests from participating in the offset program is the presence of a longstanding conservation easement that prohibits timber harvest on the forest land in question.[55] The rigor of these requirements is new to the California offset program; preceding voluntary forest offset programs have not generally required this level of scrupulousness.

The Views of Forest Owners and Operators on Additionality

Our survey asked forest owners and project developers to assess their confidence in the additionality of both their forest offset project and other projects. Not surprisingly, the majority of respondents were confident that both their project and other projects in the program are additional (Figure 5).

Figure 5. Survey responses from 17 forest owners re: confidence in additionality.

In more detailed narrative survey responses there were two types of information that stood out on additionality. First, some project owners and operators shared that as long as they maintained property ownership, they were unlikely to have harvested timber at the baseline level calculated in project documents. This would be a concern for project additionality. Second, in both interview and survey responses, project owners and operators emphasized that the *commitment* to carbon sequestration was

[55] For early action projects which started prior to the compliance market start, projects that already had conservation easements were grandfathered in to the program.

additional. In other words, projects were thought to be additional regardless of the counterfactual because they ensured a 100-year commitment to maintaining forest carbon. The counterfactual would be no *commitment* to maintaining carbon and thus an uncertain future for the forest carbon in question.

Our survey also asked forest owners and operators whether participation in the forest offset program changed their forest management practices. A change in forest management practices would signify a change from the baseline activity and would serve as another indicator for project additionality. Of survey respondents, 4 reported that starting a forest offset project changed their forest managed practices, an additional 6 reported that practices changed somewhat, and 6 reported that practices did not change (Figure 6). Management changes reported by project operators included decreasing harvest levels, adding a forest certification, and purchasing additional forest land.

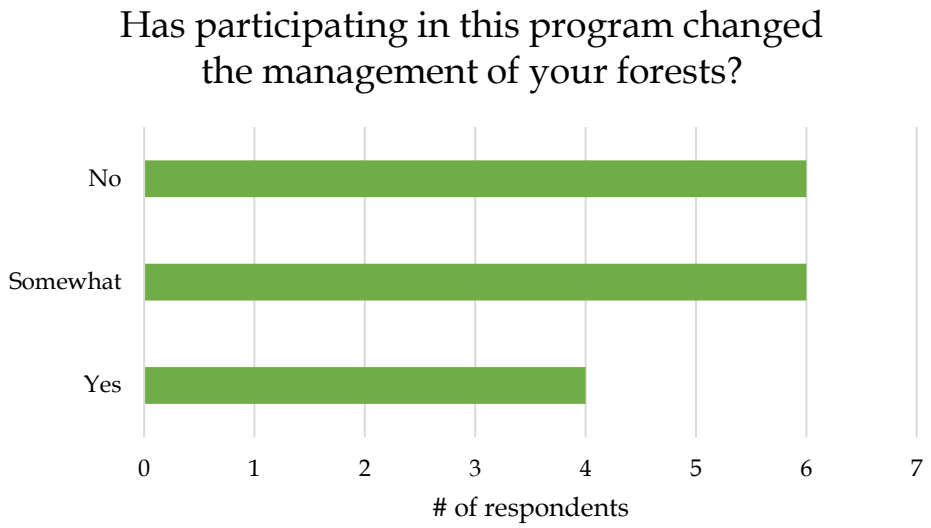

Figure 6. Survey responses from 16 forest owners re: forest management.

Concerns about Project Additionality

One of the most commonly voiced concerns about additionality in the forest offset program concerns conservation easements. California's forest offset protocol allows projects to simultaneously implement a conservation easement together with a forest offset program, and this is a common occurrence in the program. This type of joint implementation of an easement and offsets would be considered additional under a 'barriers test' of additionality, which assumes that a project would not be possible (i.e. would face insurmountable barriers) without implementing both the offset project

and the easement jointly.[56] However, in the initial Early Action period of the forest offset program, projects were able to join the program even if they had long standing conservation easements already in place. Any easement stipulations prohibiting timber harvest still had to be excluded from crediting, but this early period included multiple projects with long-standing conservation easements already in place. It is an important positive amendment that such projects are no longer permitted to join the offset program.

Finding #2: A Wide Variety of Entities Purchase Offset Credits

Forest Offset Credit Buyers

In the California cap-and-trade market as of 2015, 272 entities and 438 facilities fall under the cap. (Each 'entity' may have multiple facility sites.) According to data from CARB[57] analyzed in this study, 150 facilities purchased offsets and 79 have used forest offsets from 2013 through 2015. The cap-and-trade policy limits each entity to covering a maximum of 8% of its obligations by using offsets. As discussed earlier, the total rate of use falls well below the 8% maximum at present.

Among forest project owners surveyed, 53% of project owners sell their forest offsets directly to entities with a California offset obligation. The remainder of owners sell their credits to brokers and intermediaries who in turn sell credits to entities in the cap-and-trade program. Offsets were initially included in California's cap-and-trade program to serve as a cost containment mechanism. Capped facilities could avoid or delay the most expensive emissions reductions investments by purchasing offsets. However, since the carbon price in the California market has remained very low through the duration of the market to date,[58] offsets have not served as a cost containment mechanism, and the cost of offset credits has also remained low. 11 survey respondents anonymously reported on their average carbon sales price. The average price from this data is $10.20/ton, with a range of $9-$13/ton. As shown below in Figures 13 and 14, most respondents anticipated that prices would increase slightly or stay about the same up to 2020. Estimations were similar for prices after 2020, with the addition of a few respondents anticipating prices to increase significantly (more than a 25% increase).

[56] *See* Trexler et al., supra note 24 at 31.
[57] See explanation in footnote 60 below.
[58] Cullenward and Coghlan, *supra* note 42 at 13.

Forest Offset Credits and Environmental Justice

The environmental justice community in California has voiced concern that use of offsets disproportionately impacts disadvantaged communities in the state. Environmental justice advocates have argued that facilities that buy offsets are likely located in disadvantaged communities, and if emissions were reduced onsite instead of through offsets, those communities would gain health benefits from reduced pollution, especially of non-GHG co-pollutants such as particulate matter and air toxics.[59] We used offsets sales data and facility emissions data from CARB to construct a first-order approximation of the connection between offsets and emissions in disadvantaged communities and to assess whether forest offsets have been used disproportionately in disadvantaged communities.[60]

Forest offsets account for a small share of facility emissions across all facilities. 79 of 438 facilities in the cap-and-trade program (total as of 2015) used forest offsets. Of these facilities, 43% (34) are located in disadvantaged communities (see Figure 7). In 2014, facilities in disadvantaged communities on average offset 2.2% of their emissions with forest offsets, whereas facilities not in disadvantaged communities used offsets slightly more, covering 3.2% of their emissions. As with the rate of use, the total *number* of estimated forest offsets used is also higher outside of disadvantaged communities. Where facilities in disadvantaged communities used close to 70,000 forest offset credits on average, facilities outside of disadvantaged communities used

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[59] *See* Climate Equity Brief, *supra* note 39 at 7-10.

[60] This analysis weaves together the forest offsets information reported in the CARB Compliance Reports (available for 2013-14 and 2015) and compares it to facility information made available in CARB's the Integrated Emissions Visualization Tool, with an overlay of the OEHHA's CalEnviroScreen 3.0 shapefile for disadvantaged community location (defined here as a score of 75 or above). We first downloaded all data for the facilities listed as subject to cap-and-trade as of 2013 in the Integrated Emissions Visualization Tool (324 facilities). Then we matched that facility information with the forest offset usage data reported in the Compliance Report's Compliance Offsets Detail tab by entity ID. This matching used the Entity ID data, and ARB GHG ID info reported in the Compliance Summary tab of the Compliance Reports to link entities, and the facilities they own, with offsets usage. Unfortunately, because CARB does not report offset usage down to the facility level, our analysis at that point had to use a pro-rata estimate for each entity; that is, if a particular entity had purchased and retired 100,000 offsets, and owned four facilities subject to cap-and-trade, we have assumed that they retired 25,000 offsets for compliance at each facility. More detailed information would need to be made public about both offset purchase and retirement as well as about facility location and emissions in order for finer and more instructive sets of analyses to be conducted. We recommend that CARB at a minimum commission a program evaluation of the environmental and equity impacts of the offsets program using more finely grained data than what has been made publicly available. For data sources, please visit CARB, INTEGRATED EMISSIONS VISUALIZATION TOOL (last accessed March 15, 2017), available at http://goo.gl/WJGiVF; CARB, CAP-AND-TRADE PROGRAM (last accessed March 15, 2017), available at http://goo.gl/4qeAfj (specifically, under Publicly Available Market Information, the 2013-14 and 2015 Compliance Reports); Office of Environmental Health Hazard Assessment, CALENVIROSCREEN 3.0 (last accessed March 15, 2017), available at http://goo.glK9Foqg (specifically the CalEnviroScreen 3.0 Results Shapefile).

more than 130,000 forest offset credits on average. Initial analysis suggests that trends are similar when all offsets, not just forest offsets, are considered. Facilities in disadvantaged communities used 6.4 million offsets cumulatively, while facilities outside of disadvantaged communities used 10.2 million offsets cumulatively. Further analysis and more finely-grained data are needed to more precisely compare the effects of offsets on emissions in and out of disadvantaged communities.

Though any lessening of the incentive to reduce pollution in disadvantaged communities is concerning, and though offset data alone cannot tell us precisely what would have happened in the absence of offset availability, it appears that the use of offsets to date affects but does not appear to disproportionately impact disadvantaged communities. As compared to other areas, fewer facilities in disadvantaged communities purchase offsets, and those that do use a smaller share of offsets. But, this trend could change over time and should continue to be monitored.

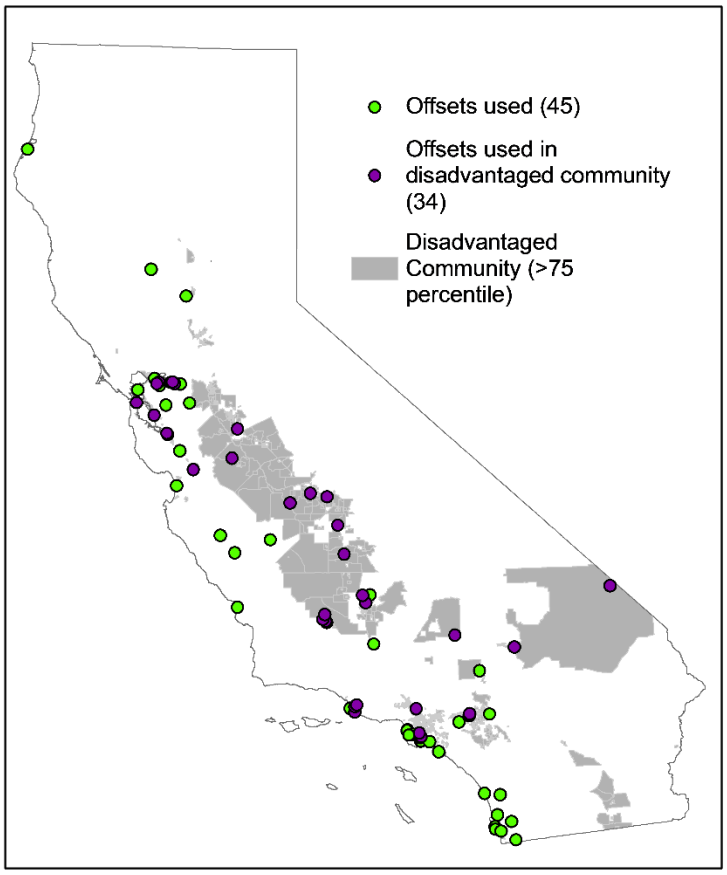

Figure 7. Location of Cap-and-Trade Facilities whose Parent Entities Retired Offsets to Meet Compliance Obligations.

Finding #3: Project Co-Benefits Are Not Monetized

Project document review, interviews, and surveys all corroborate that forest offset projects convey co-benefits for conservation and sustainable forest management. However, delivery of these project co-benefits is a decidedly secondary concern to the financial success of projects, which is conveyed by carbon credits. Project co-benefits may be of greater interest in the long run, and several projects report potential for 'benefit stacking,' or deriving financial benefit from co-benefits alongside carbon revenues from participating forest land.

From our analysis of project design documents, 92% of credited offset projects report having at least one environmental co-benefit. In the survey data, however, most respondents report that co-benefits are not important in the sale of their offset credits (11 of 16, 69%). This indicates that while forest owners are aware of the existence of co-benefits, these co-benefits are not financially relevant to the sale of offset credits, though they may be relevant to other ecosystem services markets. Similarly, interviewees often noted their co-benefits with interest, and enjoyed telling stories about them, but generally acknowledged that carbon credit buyers do not ascribe monetary value to co-benefits.

Survey respondents report that their projects provide a number of co-benefits. Most respondents also report that co-benefits are present, but few expend resources to measure these benefits.

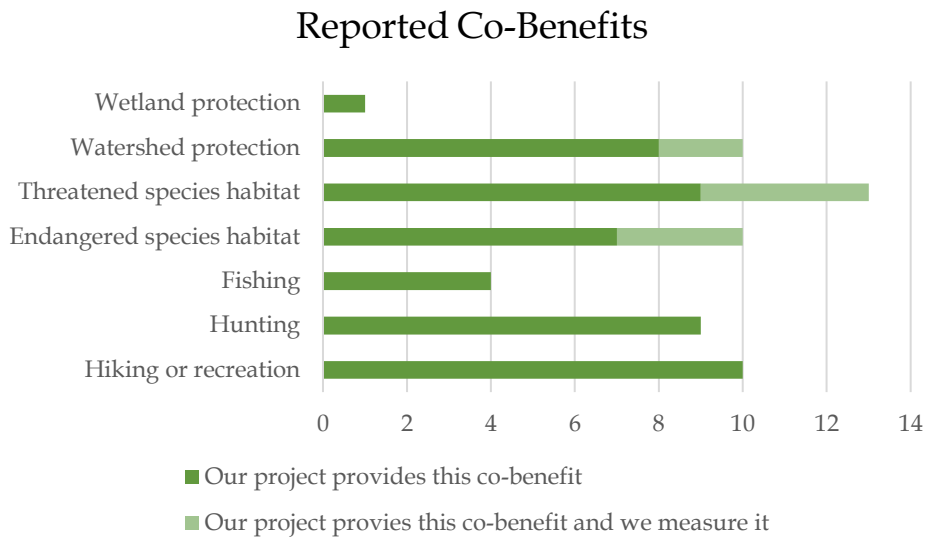

Figure 8. Survey Responses from 17 Forest Owners on project co-benefits.

No project operators or developers that we interviewed or surveyed were interested in additional reporting requirements, on co-benefits or otherwise, although at least one noted that if nationally standardized tracking metrics were developed, the reporting burden to California would be manageable. Respondents were concerned that reporting requirements are already onerous, so any future co-benefit reporting would likely need to have clear benefits for project operators and the state. We note that higher expected carbon prices might alter these assessments.

Finding #4: California Offsets Have Broken New Ground, but Regulatory Risks Hamper Further Development

Transitioning Into a More Mature Policy and Marketplace

The California forest offset program is currently in somewhat of an interstitial period, having traveled far up the learning curve of forest carbon policy experimentation, but still beset with uncertainty about the future. Unlike some other protocols the IFM and avoided conversion portions of the forest offset program have experienced notable project uptake. These areas have delivered emissions reductions and credits used by compliance entities and stand ready to deliver more in the future. Yet judging by the lengthy project listings and the persistently low price of offsets beneath an already low allowance price floor, the offset market seems to be in somewhat of a holding pattern while market participants wait to see how California policymakers chart a climate policy course past 2020.

Survey and interview results tend to confirm these indications. As detailed below, although ARB generally receives good marks in its program implementation thus far, market participants do not have the policy certainty they need to continue growing the program with more participating projects.

Bright Spots: Readiness and Program Experience

Although the price of allowances since 2013 has never risen high enough to necessitate the use of offsets as a cost-containment mechanism,[61] California's unprecedented innovation in developing a compliance-quality program and protocol for forest carbon offsets has resulted in a marketplace with dozens of credited projects. It is possible that many more could participate in the future. Projects that are now marginally economic at a carbon price of around $10/ton could be brought into the program in the future if the price rises. If the carbon price rises significantly, it is

[61] Cullenward and Coghlan, *supra* note 15 at 7.

possible that whole project types that are not currently financially attractive, such as reforestation projects and urban forest projects, may become economically viable.

In addition, ARB has received generally encouraging reviews in both survey and interview responses collected for this study. Of 17 responses, only three project owners expressed dissatisfaction with ARB's handling of the program overall, and only two expressed dissatisfaction with individual project application handling. Only two owners expressed that they would not consider expanding or bringing new land into the program in the future, while more than half of respondents expressed interest in the possibility. These results are conveyed in Figures 9, 10 and 11 below. When asked a narrative question about whether their satisfaction levels with ARB had changed over time though, responses were mixed. Some project owners remarked that ARB's project application reviews had become less predictable and more cautious, and others hypothesized that application interactions had become more frustrating because of an increase in application volume without an increase in ARB processing capacity. (Interestingly, no project owner expressed dissatisfaction with their developer or their registry, although at least one interviewee did indicate having markedly different impressions of two developer entities, one negative and one positive.)

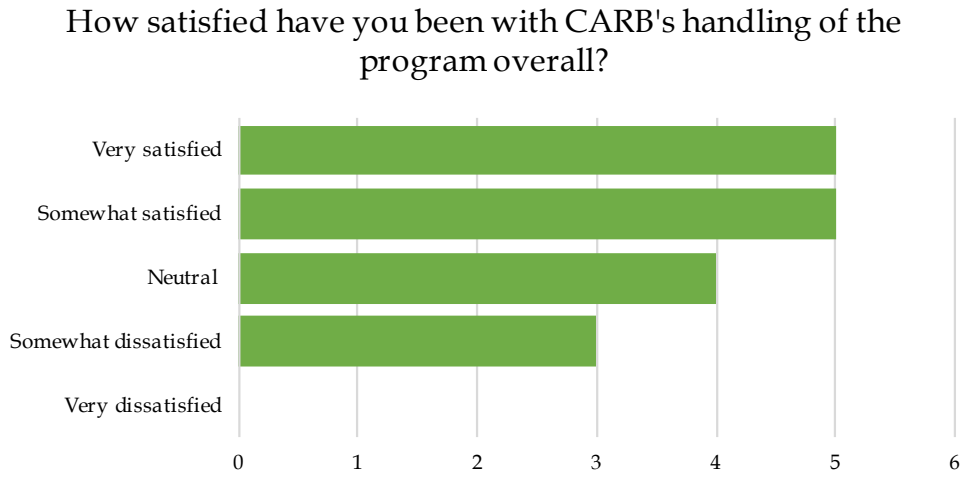

Figure 9. Survey Responses from 17 Forest Owners on CARB's performance.

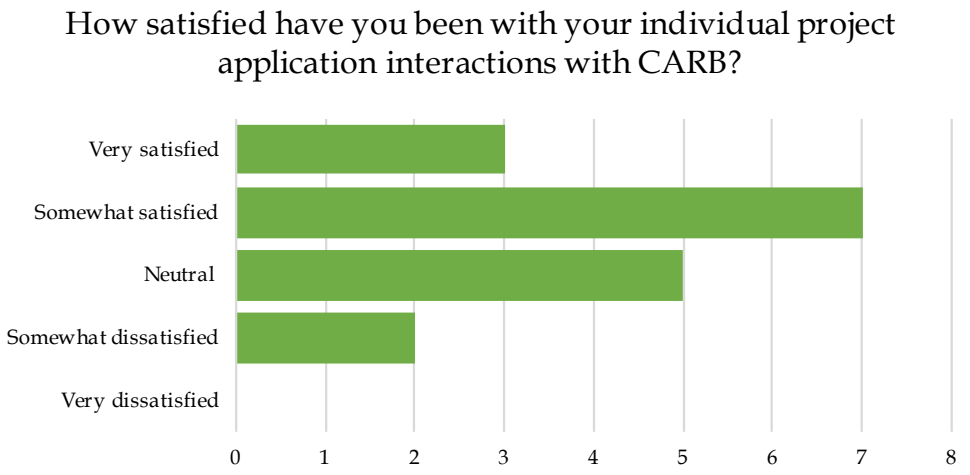

Figure 10. Survey Responses from 17 Forest Owners on CARB's application handling.

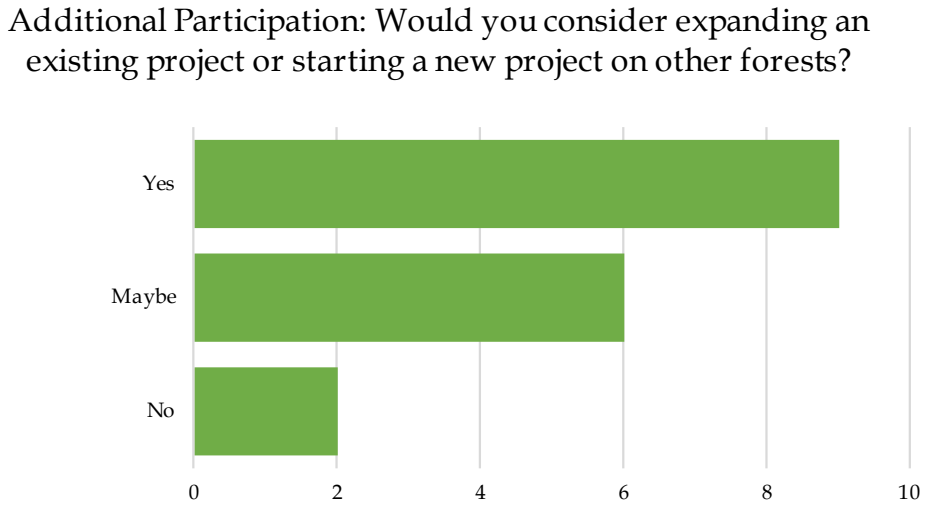

Figure 11. Survey Responses from 17 Forest Owners on additional participation.

Project developers were less sanguine in their appraisal, however. Only one respondent indicated satisfaction with the program (the others had neutral feelings), and divergent satisfied/unsatisfied opinions were reported about individual project interactions. All expressed that their satisfaction had changed over time, with two voicing concern that inefficiencies and the expense of meeting program requirements had not improved.

Both project developers and owners agreed in their general praise for CARB's approach to project risks. Two of three developers and 16 of 17 project owners reported that CARB has been appropriately accounting for project risks through the individualized project assessment and buffer pool requirements. The lonely dissenters took issue with 20% as the standard buffer pool credit contribution and advocated an individualized fire risk assessment for a particular project, respectively, but generally speaking ARB's approach to risk was reportedly appropriate in the eyes of market participants. Although the subject came up in some interviews, only one developer and one project owner reported being concerned about invalidation risks in their surveys.

Concerns: Instability, Carbon Price Uncertainty and Rising Verifier Costs

Project owners have much more divergent opinions about what the future may hold for the offset program, reflecting the general uncertainty about state policy and carbon prices that have the offset program in somewhat of a holding pattern. Although the state has committed to continuing climate programs in some form after the year 2020 with the passage and signing of Senate Bill 32 in 2016,[62] program participants report not being sure yet whether this new policy commitment will impact the return from their current projects. Figure 12 below presents the results from a survey question asked of offset project owners, reflecting their unresolved uncertainty in the wake of SB 32. This uncertainty may help explain the six 'maybe' answers reported above with respect to additional participation in the program – so much depends on the next few steps state policymakers take in extending the cap-and-trade program (or not), that possible future projects may simply wait until there is more certainty about the future of the program.

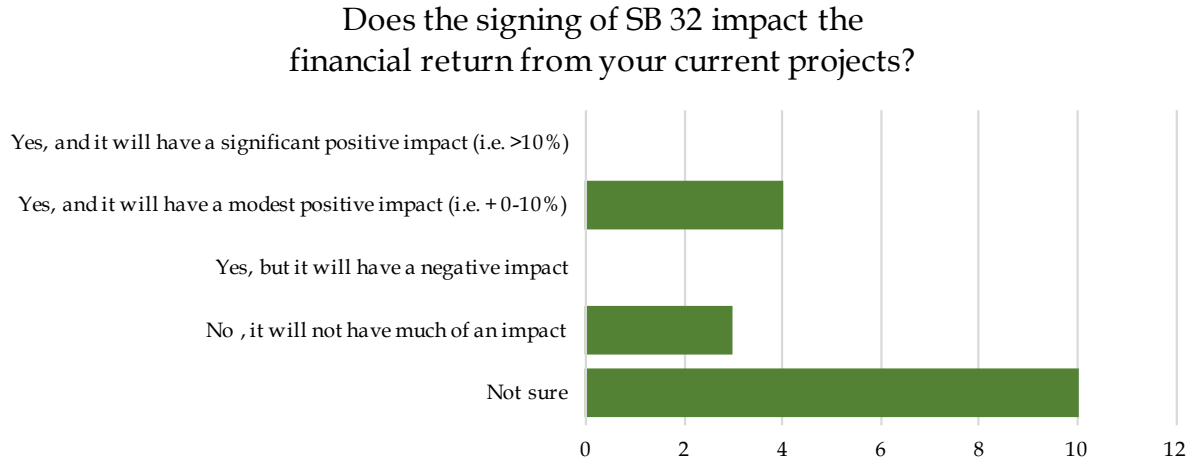

Figure 12. Survey Responses from 17 Forest Owners on the impact of Senate Bill 32.

[62] *See* Chris Megerian and Liam Dillon, *Gov. Brown Signs Sweeping Legislation to Combat Climate Change* L.A. TIMES (September 8, 2016), *available at* https://goo.gl/ewXwbN (describing SB 32).

Project owners generally seem optimistic about future price trends, assuming policy stability is provided. An open-ended narrative question on the project owner survey elicited many responses that cited program complexity, changing regulations and future policy uncertainty as major barriers in the program. But, when asked in an anonymous portion of the survey for their opinions about future price trends, project owners in general expressed bullishness and confidence about both near and longer term price trends. As seen in Figures 13 and 14 below, a 60% majority of respondents thought average sale prices for offsets would increase slightly in the time before 2020, and a majority believed they would rise slightly or significantly after 2020 as compared to today. However, when read together with the more cautious additional participation responses and concerns about policy certainty and complexity, this optimism may not translate to deeper program participation without more stability.

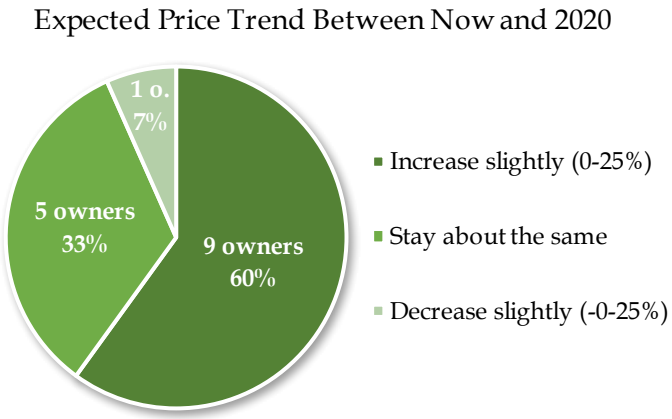

Figure 13. Survey Responses from 15 project owners re: near term price trend expectations

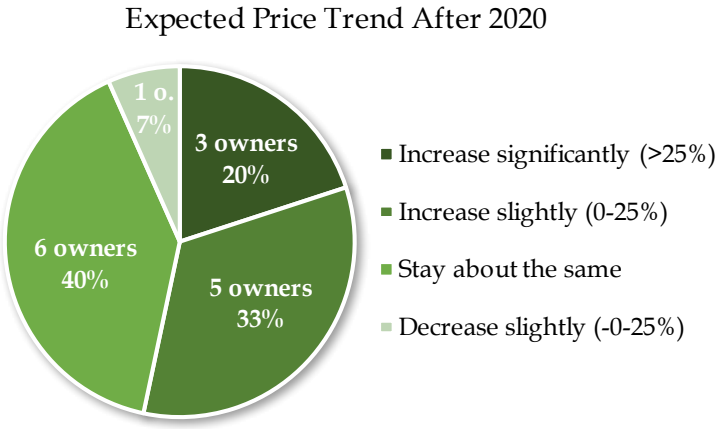

Figure 14. Survey Responses from 15 project owners re: longer term price trend expectations

While owners were conditionally bullish about future price trends, a worry that was repeatedly raised in multiple interviews and in survey data as well was rising verification costs. Other answers to the barriers question cited the steep and rising costs of monitoring and verification. In response to a question asking for their opinion of published verification and monitoring costs appearing in Kerchner and Keeton,[63] several respondents with recent verification cost experience stated that the published verification costs were much lower than actual costs. While opinions on that question were somewhat mixed and included five 'I don't know' answers, multiple interviewees expressed the same concern about rising verification costs. Some speculated that invalidation risk concerns had increased the length of verifications and financial exposure of the verifiers. However, most interviewees who mentioned the subject indicated that the likely causes are a short supply of verifiers and verification bodies, and large demands of verification in a compliance program as compared to in the voluntary market. ARB staff have reported that expanded training opportunities for verifiers are on the way to address this shortage. But, these efforts may need to bear fruit in the nearer term in order to keep pending projects from being dissuaded from joining the program at current carbon prices.

[63] *See* Kerchner and Keeton, *supra* note 49 at 75 (reporting ~$8,000 annual monitoring costs plus $15,000 costs incurred every six and $27,000 every 12 years).

Lessons for Natural and Working Lands

The State of California is in the process of updating its climate scoping plan, which sets goals for GHG emissions in each state sector. For the first time, the scoping plan will cover the period to 2030 and will include goals for carbon on natural and working lands, including agricultural lands and forests.[64] The draft scoping plan sets as an overarching goal that natural and working lands would be an overall emissions sink rather than a source. There are a number of activities and plans associated with this goal. We offer several recommendations for the state's goals in natural and working lands based on its experience thus far managing land-based carbon through the forest offset program:

- **Lesson #1**: Rigor of approach to carbon accounting drives implementation cost

The Forest Offset Program requires a very rigorous approach to carbon accounting, estimating the exact tonnage of forest carbon present on individual project lands. This is currently achieved at the project level through forest inventory, growth and yield modeling, and third party verification.[65] Detailed accounting through these methods cannot be scaled statewide. This level of detailed accounting is appropriate and feasible when dealing with compact and contiguous project lands, but costly and infeasible to conduct on a statewide basis. The State should and does consider methods of carbon accounting on Natural and Working Lands that are significantly less onerous than the Forest Offset Program, but that are still meaningful in terms of measuring changes in emissions and carbon sinks.[66] This is a case in which the Forest Offset Program uses a method that works well, but cannot be used at the scale of Natural and Working Lands.

The Proposed Plan offers a scale-appropriate method for carbon accounting on lands in California. It indicates that an updated Natural and Working Lands emissions inventory presently underway "applies airborne and space-based technologies to monitor forest health and quantify emissions associated with land-based carbon."[67] Combining remotely-sensed data with ground-based data is a good approach to take at the scale of the state-wide inventory, and should be continued as the inventory is expanded in the coming years.

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[64] California Air Resources Board, THE 2017 CLIMATE CHANGE SCOPING PLAN UPDATE: THE PROPOSED STRATEGY FOR ACHIEVING CALIFORNIA'S 2030 GREENHOUSE GAS TARGET (January 20, 2017), at 107-17, *available at* https://goo.gl/ZBkyCN. Hereafter 'Proposed Plan'.
[65] *See generally* 2015 Forest Offset Protocol, *supra* note 31.
[66] *See* Proposed Plan at 108.
[67] Proposed Plan at 108.

- **Lesson #2**: Transparency and Accessibility of Program Information

The Forest Offset Program produces voluminous data about carbon accounting, project details, and offset usage, and much of it is available to the public through CARB's website and project registries. However, these data are not easy to locate or interpret. Data sheets can be difficult to find online, and reporting categories change over time, making consistent comparison over time difficult. In this case, the Forest Offset Program is not using best practices, and based on this experience we recommend a more coordinated approach for Natural and Working Lands data transparency and accessibility.

A clear and pre-designed framework for reporting on Natural and Working Lands should be devised as a part of the Integrated Natural and Working Lands Climate Change Action Plan ("Action Plan").[68] This will avoid difficulty in reporting and evaluation later on. The Proposed Plan states that the California will "develop implementation tracking and performance monitoring systems for the Action Plan."[69] This is especially important and should be a high priority as reporting in the Natural and Working Lands sector requires complex multi-agency efforts.

- **Lesson #3**: Approaches to Uncertainty and Risk

Uncertainty: Emissions accounting on Natural and Working Lands, like that for forests, comes with fundamental risks and uncertainties. The designers of the Forest Offset Program developed a number of notable mechanisms to deal with risk and uncertainty in carbon accounting and carbon crediting. For uncertainty, the Forest Offset Program reduces credits earned proportional to the sampling error of an on-the-ground forest inventory.[70] A similar approach could be applied to data used for carbon accounting on Natural and Working Lands.

At present neither the Proposed Plan nor Appendix G refer to estimation of uncertainty in developing goals or in developing the Action Plan for Natural and Working Lands.[71] Including uncertainty estimates in ongoing modeling and in the Action Plan will help ensure that the State accomplishes its carbon sink goal for Natural and Working Lands. Including uncertainty estimates is also consistent with

[68] Proposed Plan at 114.
[69] Proposed Plan at 117.
[70] 2015 Forest Offset Protocol at 112.
[71] *See* Proposed Plan at 117; *see also* California Air Resources Board, PROPOSED PLAN: APPENDIX G, NATURAL AND WORKING LANDS MODELING (January 2017), *available at* https://goo.gl/axN6vS.

IPCC Good Practice Guidance.[72] This is a case in which the Forest Offset Program is using a successful practice that can be adapted for use on Natural and Working Lands.

Risk: For risk, the Forest Offset Program also reduces carbon crediting based on the estimated risk of fire, pests, and other 'reversal' risks – the risk of releasing forest carbon to the atmosphere over the life of the project.[73] Carbon credits deducted based on a project's risk rating are allocated to a buffer pool of credits, which can be used in case of carbon loss due to fire, disease, or other unintentional losses.

The Natural and Working Lands sector does not need an explicit buffer account because of its more general carbon sink goals (discussed below), but it does need to plan for unavoidable carbon reversals. The Proposed Plan rightly acknowledges that "recent trends indicate that significant pools of carbon [are at] risk [of] reversal," and that climate change may exacerbate these risks, especially for wildland fire.[74] Risk should be explicitly incorporated into ongoing Natural and Working Lands modeling to ensure that the State meets its goals for the sector. We recommend adapting the buffer pool approach used in the Forest Offset Program and 'buffer' the Action Plan with activities that would exceed the State's carbon sink goal. This would ensure a 'contingency fund' of emissions reductions and enhanced sinks in case of 'reversal'. Risk estimations could be improved over time as improved data and modeling are available. At present, the Proposed Plan and Appendix G do not discuss accounting for risk in GHG emissions goal-setting for Natural and Working Lands.

- **Lesson #4**: Setting a Broad Carbon Sink Goal is Advisable

The experience of the Forest Offset Program shows that modeling future carbon stock, even at the project scale, is a difficult task. Land-based carbon stocks carry risk and uncertainty, as discussed above. The Forest Offset Program dealt with risk by carefully measuring carbon and creating a forest buffer pool—a sort of insurance pool or contingency fund of carbon credits to be used in case of unintentional loss of carbon. The Forest Offset Program further ensures accuracy by requiring multiple levels of verification. While measurement methods for Natural and Working Lands should continue to take advantage of improvements in remote sensing and ground-based data, the method of detailed ton-by-ton carbon accounting used by the Forest Offset Program is not currently feasible at a statewide scale.

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[72] *See generally* Intergovernmental Panel on Climate Change, 2013 REVISED SUPPLEMENTARY METHODS AND GOOD PRACTICE GUIDANCE ARISING FROM THE KYOTO PROTOCOL at 2.57-2.60 (Section 2.4.3 'Uncertainty Assessment'), *available at* https://goo.gl/bJWwZW.
[73] 2015 Forest Offset Protocol, *supra* note 31 at 131-36.
[74] Proposed Plan at 108.

The Proposed Plan states that "California's climate objective of natural and working lands is to maintain them as a carbon sink (i.e., net zero or even negative GHG emissions)."[75] The Proposed Plan rightly acknowledges that "the State's lands, as well as sub-tidal waters, can be both a source and a sink for GHG emissions."[76] The State's goal of maintaining Natural and Working Lands as a carbon sink is an appropriate one. An alternative goal would be to specify a particular percentage or numerical decrease in emissions and/or increase in sinks on Natural and Working Lands. Such an exact goal would be inappropriate because it would necessitate many of the onerous measurements and verification activities pursued under project-based programs like the Forest Offset Program, which are impractical for statewide inventories, as mentioned above. Also, measuring carbon in some sectors of Natural and Working Lands (such as soils) remains quite difficult. The overall 'carbon sink' goal is less precise but is also therefore feasible to both measure and attain in a statewide inventory.

While we support the overall 'carbon sink' goal for Natural and Working Lands, we recommend that the Proposed Plan clarify whether this is a cumulative or annual goal covering the years between now and 2030. There is likely to be considerable year-to-year variability in emissions from Natural and Working Lands, due to fire and other natural causes. The goal is referred to as cumulative on page 109 of the Proposed Plan, but the measure is not specified in the initial statement of the goal.[77] The Initial Scoping Plan (2008) set a specific annual goal for forest carbon sequestration, [78] and this goal has been difficult to measure and attain on an annual basis.

- **Lesson #5**: The Offsets Program Does Not Measure Co-Benefits, But Many Are Clearly Delivered

In part because the Forest Offset Program has stringent and detailed carbon accounting requirements, it was not practical, at least in initial years of the program, to require additional accounting of individual project co-benefits. As detailed in the attached report, we advise that the Forest Offset Program now take up 'no cost' opportunities for co-benefits reporting. Co-benefits reporting is even more feasible and important for Natural and Working Lands. Because the Natural and Working Lands goals and accounting can take advantage of remotely sensed data, and can tolerate

[75] Proposed Plan at 107.
[76] Proposed Plan at 108.
[77] Proposed Plan at ES5, 107.
[78] California Air Resources Board, CLIMATE CHANGE SCOPING PLAN: A FRAMEWORK FOR CHANGE (December 2008) at 64-65, *available at* https://goo.gl/UFhkyT.

greater uncertainty in acre-level carbon data, state agencies should be able to collect data and account for carbon *and* co-benefits.

The Proposed Plan rightly notes that policies must advance both carbon sequestration and co-benefits[79] and states that "strategies that reduce GHG emissions or increase sequestration in the natural and working lands sector often overlap and result in synergies with other sectors."[80] Accounting for these co-benefits will allow the state to measure the synergies and efficiency gains it is earning by implementing policies that have win-win benefits for carbon, water, agriculture, biomass utilization, land restoration, and conservation. As the State develops tracking and monitoring systems for Natural and Working Lands, these co-benefits should be included. In the Proposed Plan section for 'Scoping and Tracking Progress',[81] the text should be amended to read, "develop implementation tracking and performance monitoring systems for the Action Plan, *[including accounting of carbon and other co-benefits].*"[82]

[79] Proposed Plan at 107.
[80] Proposed Plan at 110.
[81] Proposed Plan at 116-17.
[82] Proposed insertion in brackets. *See* Proposed Plan at 117.

Appendixes

Below are two appendixes that provide more information about the sources, methods, and findings of this analysis. The first appendix presents a list of the 39 projects for whom we compiled and analyzed project design document information. The second appendix presents the list of entities who were reported as retiring forest offsets from 2013-15, and the forest offset projects those offsets came from.

Appendix I – Projects Included in Design Document Analysis

	ARB Project ID #	Project Name	State	Type of Protocol	Registry[83]	Project Documentation Locator
1	CAFR0030	Blue Source – Francis Beidler Improved Forest Management Project	SC	Early Action	CAR	CAR683
2	CAFR0087	Finite Carbon – Brosnan Forest	SC	Early Action	CAR	CAR658
3	CAFR0063	Green Assets – Middleton Avoided Conversion	SC	Early Action	CAR	CAR749
4	CAFR5034	Finite Carbon – The Forestland Group CT Lakes	NH	Compliance	ACR	ACR199
5	CAFR0088	Finite Carbon – Shannondale Tree Farm	MO	Early Action	CAR	CAR780
6	CAFR5089	Finite Carbon – The Forestland Group Champion Property IFM	NY	Compliance	CAR	CAR1088
7	CAFR5029	Green Assets-Brookgreen Gardens Improved Forest Management Project	SC	Compliance	ACR	ACR192
8	CAFR5016	Miller Forest	CA	Compliance	ACR	ACR189

[83] CAR = Climate Action Reserve; ACR = American Carbon Registry

9	CAFR0070	Finite Carbon – Berry Summit	CA	Early Action	CAR	CAR1004
10	CAFR0049	The Van Eck Forest	CA	Early Action	CAR	CAR101
11	CAFR0064	Yurok Tribe Sustainable Forest Project	CA	Early Action	CAR	CAR777
12	CAFR0029	Blue Source – Alligator River Avoided Conversion	NC	Early Action	CAR	CAR497
13	CAFR5043	Blue Source – Goodman Improved Forest Management Project (Michael Hart)	WI	Compliance	ACR	ACR202
14	CAFR5028	Round Valley Indian Tribes Improved Forest Management Project	CA	Compliance	ACR	ACR173
15	CAFR0040	Garcia River Forest	CA	Early Action	CAR	CAR102
16	CAFR5096	Brushy Mountain	CA	Compliance	CAR	CAR1095
17	CAFR0041	Big River / Salmon Creek Forests	CA	Early Action	CAR	CAR408
18	CAFR0042	Gualala River Forest	CA	Early Action	CAR	CAR660
19	CAFR0001	Willits Woods	CA	Early Action	CAR	CAR661
20	CAFR0116	Finite Carbon – NEFF (New England Forestry Foundation)	NH	Early Action	CAR	CAR672
21	CAFR5072	White Mountain Apache Tribe Forest Carbon Project	AZ	Compliance	ACR	ACR211

22	CAFR5095	Ashford III	WA	Compliance	CAR	CAR1094
23	CAFR0058	Virginia Conservation Forestry Program – Clifton Farm	VA	Early Action	CAR	CAR686
24	CAFR0057	Virginia Conservation Forestry Program – Rich Mountain	VA	Early Action	CAR	CAR696
25	CAFR5037	Virginia Highlands I	VA	Compliance	CAR	CAR1032
26	CAFR0103	Finite Carbon – MWF Brimstone IFM Project I	TN	Early Action	CAR	CAR582
27	CAFR0073	McCloud River	CA	Early Action	CAR	CAR429
28	CAFR5055	Buckeye Forest Project	CA	Compliance	CAR	CAR1013
29	CAFR0100	Rips Redwoods	CA	Early Action	CAR	CAR1015
30	CAFR5076	Trinity Timberlands University Hill Improved Forest Management Project	CA	Compliance	CAR	CAR1046
31	CAFR0031	Blue Source – Pocosin Lakes Forest Conservation Project (Avoided Conversion)	NC	Early Action	CAR	CAR676
32	CAFR5084	Finite Carbon – Potlatch Moro Big Pine CE IFM	AR	Compliance	CAR	CAR1086
33	CAFR0002	Finite Carbon Farm Cove Community Forest Project	ME	Early Action	CAR	CAR657
34	CAFR0026	Blue Source – Pungo River Forest Conservation	NC	Early Action	CAR	CAR659

		Project (Avoided Conversion)				
35	CAFR0027	Blue Source – Noles South Avoided Conversion Forest Project	NC	Early Action	CAR	CAR802
36	CAFR0028	Blue Source – Noles North Avoided Conversion Forest Project	NC	Early Action	CAR	CAR688
37	CAFR5003	Blue Source-Bishop Improved Forest Management Project	MI	Compliance	CAR	CAR973
38	CAFR5011	Yuork Tribe/Forest Carbon Partners CKGG Improved Forest Management Project	CA	Compliance	CAR	CAR993
39	CAFR5012	Hanes Ranch Forest Carbon Project	CA	Compliance	ACR	ACR182

Appendix II – Compliance Entities Using Offset Credits

This information is drawn from the Compliance Reports available on the CARB website at https://goo.gl/m61Kj1, and matched with data from project design documents for the projects listed in Appendix I above.

Compliance Entities Retiring Forest Offsets, 2013-15

California Cap-and-Trade Compliance Offset Program: Retired Forest Offsets by Compliance Obligation Entity			
For Offsets Redeemed 2013-2015			
CARB Entity ID	**Compliance Obligation Entity**	**# of Forest Projects Obtained From**	**Number of Retired Credits**
CA1248	AES Alamitos, LLC	2	100,105
CA1089	Air Products and Chemicals, Inc.	1	96,601
CA1281	Algonquin Power Sanger, LLC	1	1,620
CA1328	Applied Energy, LLC - NAS North Island	3	16,605
CA1406	California Dairies, Inc.	1	10,140
CA1119	Calpine Energy Services, LP	4	686,178
CA1592	Carson Cogeneration Company	1	1,378
CA2039	Chevron Power Holdings, Inc.	1	49,187
CA1075	Chevron U.S.A., Inc.	10	4,019,283
CA1101	City of Glendale	1	17,649
CA1370	Coalinga Cogeneration Company	1	30,730
CA1311	Double C Limited	1	347
CA1183	Dynegy Moss Landing, LLC	2	165,460
CA1742	Energia Azteca X, S.A. de C.V. and Energia de Baja California S. de R.L. de C.V. (La Rosita Power Marketing)	1	9,814
CA1234	Fresno Cogeneration Partners, LP	1	1,298
CA1070	GenOn Energy Management, LLC	1	7,667
CA1116	GWF Energy, LLC	1	20,867
CA1291	High Desert Power Project, LLC	1	125,000
CA1307	High Sierra Limited	1	353
CA1253	Ingomar Packing Company, LLC	1	5,841
CA1312	Kern Front Limited	1	318
CA1343	Kern River Cogeneration Company	2	102,040
CA1017	La Paloma Generating Company, LLC	4	74,356

CA1552	Macpherson Oil Company	1	17,516
CA1077	Mariposa Energy, LLC	1	3,344
CA1476	Martinez Cogen Limited Partnership	1	9,630
CA1367	Mid-Set Cogeneration Company	1	32,547
CA1107	Midway Sunset Cogeneration Company	1	39,478
CA1138	NRG Power Marketing, LLC	1	245,756
CA1137	OLS Energy - Chino	1	19,960
CA1046	Pacific Gas and Electric Company	1	61,495
CA2106	PBF Energy Western Region, LLC	3	140,179
CA1326	Praxair, Inc.	1	5,000
CA1925	Pro Petroleum, Inc.	1	35,000
CA1204	Rio Tinto Minerals Inc.	1	26,532
CA1136	Russell City Energy Company, LLC	1	39,964
CA1371	Salinas River Cogeneration Company	1	32,244
CA1085	San Diego Gas & Electric Company	1	27,602
CA1372	Sargent Canyon Cogeneration Company	1	32,987
CA1762	SEI Fuel Services, Inc.	3	103,840
CA1251	Shell Energy North America (US), LP	2	209,000
CA1029	Southern California Edison Company	5	501,170
CA1338	Sycamore Cogeneration Company	1	100,608
CA1165	Tesoro Refining & Marketing Company, LLC	10	1,488,172
CA1325	The Procter & Gamble Paper Products Company	1	25,691
CA1195	TransAlta Energy Marketing (U.S.), Inc.	1	6,773
CA1057	Ultramar, Inc.	1	13,857
CA1419	Union Pacific Railroad Company	1	38,184
CA1056	Valero Refining Company-California, Benicia Refinery and Asphalt Plant	3	103,112
CA1590	Valley Electric Association, Inc.	2	813
		Grand Total	**8,903,291**

Compliance Entities and The Forest Offsets They Buy

Forest Offsets -- Retired Credits by Compliance Obligation Entity and Project Name

Compliance Entities and Forest Offset Projects	# of Listings in Compliance Report	Total Quantity
AES Alamitos, LLC	2	100,105
Blue Source – Francis Beidler IFM Project	1	94,705
Hanes Ranch Forest Carbon Project	1	5,400
Air Products and Chemicals, Inc.	1	96,601
Blue Source-Bishop IFM Project	1	96,601
Algonquin Power Sanger, LLC	1	1,620
Blue Source – Pungo River Forest Conservation Project	1	1,620
Applied Energy, LLC - NAS North Island	5	16,605
Finite Carbon – Shannondale Tree Farm	1	2,077
Green Assets – Middleton Avoided Conversion	3	11,687
Round Valley Indian Tribes IFM Project	1	2,841
California Dairies, Inc.	1	10,140
Garcia River Forest	1	10,140
Calpine Energy Services, LP	8	686,178
Finite Carbon – The Forestland Group CT Lakes	1	275,000
Hanes Ranch Forest Carbon Project	1	70,349
Trinity Timberlands University Hill IFM Project	1	222,398
Willits Woods	5	118,431
Carson Cogeneration Company	1	1,378
Green Assets – Middleton Avoided Conversion	1	1,378
Chevron Power Holdings, Inc.	1	49,187
Blue Source-Bishop IFM Project	1	49,187
Chevron U.S.A., Inc.	38	4,019,283
Blue Source – Francis Beidler IFM Project	3	250,000
Blue Source – Goodman IFM Project	1	693,615
Blue Source – Noles North Avoided Conversion Forest Project	6	14,795
Blue Source – Noles South Avoided Conversion Forest Project	6	14,090
Blue Source – Pungo River Forest Conservation Project	6	21,115
Blue Source-Bishop IFM Project	2	379,649

Brushy Mountain	2	1,250,441
Finite Carbon – The Forestland Group Champion Property IFM	1	678,550
Finite Carbon Farm Cove Community Forest Project	1	146,666
Willits Woods	10	570,362
City of Glendale	1	17,649
Big River / Salmon Creek Forests	1	17,649
Coalinga Cogeneration Company	2	30,730
Blue Source-Bishop IFM Project	2	30,730
Double C Limited	1	347
Willits Woods	1	347
Dynegy Moss Landing, LLC	4	165,460
Buckeye Forest Project	1	100,000
Willits Woods	3	65,460
Energia Azteca X, S.A. de C.V. and Energia de Baja California S. de R.L. de C.V. (La Rosita Power Marketing)	1	9,814
Garcia River Forest	1	9,814
Fresno Cogeneration Partners, LP	1	1,298
Willits Woods	1	1,298
GenOn Energy Management, LLC	2	7,667
Willits Woods	2	7,667
GWF Energy, LLC	3	20,867
Willits Woods	3	20,867
High Desert Power Project, LLC	2	125,000
Finite Carbon – The Forestland Group CT Lakes	2	125,000
High Sierra Limited	1	353
Willits Woods	1	353
Ingomar Packing Company, LLC	1	5,841
Green Assets – Middleton Avoided Conversion	1	5,841
Kern Front Limited	1	318
Willits Woods	1	318
Kern River Cogeneration Company	4	102,040
Blue Source-Bishop IFM Project	2	86,918
Willits Woods	2	15,122
La Paloma Generating Company, LLC	4	74,356
Finite Carbon – Brosnan Forest	1	1,314

McCloud River	1	15,038
Trinity Timberlands University Hill IFM Project	1	10,473
Willits Woods	1	47,531
Macpherson Oil Company	1	17,516
Green Assets – Middleton Avoided Conversion	1	17,516
Mariposa Energy, LLC	1	3,344
Willits Woods	1	3,344
Martinez Cogen Limited Partnership	1	9,630
The Van Eck Forest	1	9,630
Mid-Set Cogeneration Company	2	32,547
Blue Source-Bishop IFM Project	2	32,547
Midway Sunset Cogeneration Company	1	39,478
Willits Woods	1	39,478
NRG Power Marketing, LLC	4	245,756
Gualala River Forest	4	245,756
OLS Energy - Chino	2	19,960
Blue Source – Francis Beidler IFM Project	2	19,960
Pacific Gas and Electric Company	1	61,495
Willits Woods	1	61,495
PBF Energy Western Region, LLC	9	140,179
Big River / Salmon Creek Forests	3	52,762
Garcia River Forest	1	48,456
The Van Eck Forest	5	38,961
Praxair, Inc.	1	5,000
Virginia Conservation Forestry Program – Clifton Farm	1	5,000
Pro Petroleum, Inc.	1	35,000
Big River / Salmon Creek Forests	1	35,000
Rio Tinto Minerals Inc.	1	26,532
Big River / Salmon Creek Forests	1	26,532
Russell City Energy Company, LLC	1	39,964
Willits Woods	1	39,964
Salinas River Cogeneration Company	2	32,244
Blue Source-Bishop IFM Project	2	32,244

San Diego Gas & Electric Company	2	27,602
Trinity Timberlands University Hill IFM Project	2	27,602
Sargent Canyon Cogeneration Company	2	32,987
Blue Source-Bishop IFM Project	2	32,987
SEI Fuel Services, Inc	1	28,756
Finite Carbon – MWF Brimstone IFM Project I	1	28,756
SEI Fuel Services, Inc.	2	75,084
Finite Carbon – Shannondale Tree Farm	1	35,084
Green Assets – Middleton Avoided Conversion	1	40,000
Shell Energy North America (US), LP	2	209,000
Blue Source-Bishop IFM Project	1	84,000
Miller Forest	1	125,000
Southern California Edison Company	5	501,170
Blue Source – Francis Beidler IFM Project	1	30,295
Finite Carbon – The Forestland Group CT Lakes	1	125,000
Hanes Ranch Forest Carbon Project	1	6,548
Round Valley Indian Tribes IFM Project	1	241,164
Trinity Timberlands University Hill IFM Project	1	98,163
Sycamore Cogeneration Company	2	100,608
Blue Source-Bishop IFM Project	2	100,608
Tesoro Refining & Marketing Company, LLC	11	1,488,172
Blue Source – Francis Beidler IFM Project	1	908
Finite Carbon – Berry Summit	1	193,277
Finite Carbon – Shannondale Tree Farm	1	50,000
Finite Carbon – The Forestland Group CT Lakes	1	316,601
Green Assets – Middleton Avoided Conversion	2	50,000
Green Assets-Brookgreen Gardens IFM Project	1	160,000
McCloud River	1	65,000
Miller Forest	1	94,084
Trinity Timberlands University Hill IFM Project	1	13,209
White Mountain Apache Tribe Forest Carbon Project	1	545,093
The Procter & Gamble Paper Products Company	1	25,691
Blue Source-Bishop IFM Project	1	25,691

TransAlta Energy Marketing (U.S.), Inc.	1	6,773
McCloud River	1	6,773
Ultramar, Inc.	1	13,857
Blue Source – Francis Beidler IFM Project	1	13,857
Union Pacific Railroad Company	1	38,184
Finite Carbon – Brosnan Forest	1	38,184
Valero Refining Company-California, Benicia Refin. and Asphalt Plant	3	103,112
Blue Source – Francis Beidler IFM Project	1	36,143
Finite Carbon Farm Cove Community Forest Project	1	48,888
Willits Woods	1	18,081
Valley Electric Association, Inc.	2	813
Blue Source-Bishop IFM Project	1	5
The Van Eck Forest	1	808
	Grand Total	**8,903,291**