



CENTER ON
RACE, POVERTY
& THE ENVIRONMENT



April 10, 2017

Via Electronic Filing on ARB Website

Richard Corey, Executive Officer
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Re: Comments on the 2017 Climate Change Scoping Plan Update

Dear Mr. Corey:

On behalf of the undersigned environmental justice, public health, and allied organizations, we submit these comments on the Proposed 2017 Climate Change Scoping Plan Update (“Proposed Plan”). The organizations, individuals, and groups listed below work directly with low-income residents and residents of color who are disproportionately impacted by industrial pollution, toxic air emissions, and climate change. Climate change solutions must protect all Californians, starting with those already overburdened by air pollution and climate change.

The Proposed Plan offers a five-scenario roadmap for achieving the 2030 target established by Senate Bill 32: (1) existing measures, a twenty percent reduction at refineries (“Refinery Rule”),¹ and

¹The twenty or thirty percent reduction in refinery emissions in the three scenarios targeted by the Board are in all cases less than the required 40 percent target for 2030, disparately leaving refinery

Cap and Trade; (2) existing measures, a refinery rule with at thirty percent reduction, no Cap and Trade, and additional direct reduction measures; (3) existing measures, the Refinery Rule, and a carbon tax; (4) existing measures, no Refinery Rule, and more reliance on Cap and Trade; and (5) existing measures, the Refinery Rule, and a cap and tax. *See* Discussion Draft at 32-36, 49-53.

The Proposed Scoping Plan suffers from four major deficiencies and should be revised. First, the Plan identifies Cap and Trade, existing measures, and the Refinery Rule as the Proposed Scoping Plan Scenario. Cap and Trade harms communities of color and low-income communities, with in-state emissions going up in several sectors, while out-of-state emissions reductions through divestment (resource shuffling) and out-of-state offsets provide the primary emissions reductions attributed to the program. Cap and Trade inflicts a racially disparate adverse impact on communities of color by allowing pollution trading and excessive offsets usage, which both condone pollution increases and deny the benefits of pollution reductions. Approval of a Plan that includes Cap and Trade would thus violate Government Code section 11135. Furthermore, the Board does not have the legal authority to implement Cap and Trade beyond 2020, and should thus revise the Scoping Plan accordingly.

Second, the Proposed Plan violates Assembly Bill 197, which directs the Board to prioritize direct emissions reductions when adopting rules and regulations to meet the 2030 target. The Plan only offers a twenty percent reduction at refineries as a potential direct reduction measures, and does not prioritize direct reductions at other stationary and mobile sources. The Board *shall* prioritize direct emissions reduction strategies for all the sources identified by Assembly Bill 197.

Third, the Proposed Plan inadequately analyzes the carbon tax alternative which, like Cap and Trade, would generate revenue and be subject to a Proposition 26 super-majority vote in the Legislature. The Plan fails to adequately analyze this alternative by constructing straw man carbon tax alternatives which fails to discuss and consider important, unique characteristics of California's current climate laws. The Board should thus revise the Draft to meaningfully consider a cap and tax as an alternative to Cap and Trade.

Fourth, the Environmental Analysis fails to adequately analyze and mitigate the Cap and Trade air quality impacts on public health.

I. Cap and Trade is an Inappropriate Strategy and Should not be Part of the Scoping Plan to Meet the 2030 Target.

A. Implementation Data Indicate Communities of Color are Adversely and Disproportionately Affected.

In September 2016, leading researchers released a report assessing the inequalities in the location of greenhouse gas-emitting facilities and the amount of greenhouse gases and particulate matter

communities behind. The apparent proposal to measure the Refinery Rule based on a refinery's product output rather than its crude input reduces the transparency of future compliance for these same communities, exhibiting both of the major flaws in the agency's past approach discussed herein.

(“PM10”) emitted by facilities regulated under Cap and Trade.² The report also provides a preliminary evaluation of changes in localized greenhouse gas emissions from large stationary sources since the advent of the program. The report found:

1. On average, neighborhoods with a facility within 2.5 miles have a 22 percent higher proportion of residents of color and 21 percent higher proportion of residents living in poverty than neighborhoods that are not within 2.5 miles of a facility.
2. These communities are home to a higher proportion of residents of color and people living in poverty than communities with no or few facilities nearby. Indeed, the higher the number of proximate facilities, the larger the share of low-income residents and communities of color.
3. The neighborhoods within 2.5 miles of the 66 largest greenhouse gas and PM10 emitters have a 16% higher proportion of residents of color and 11% higher proportion of residents living in poverty than neighborhoods that are not within 2.5 miles of such a facility.
4. The first compliance period reporting data (2013-2014) show that the cement, in-state electricity generation, oil & gas production or supplier, and hydrogen plant sectors have increased greenhouse gas emissions over the baseline period (2011-2012).
5. The amount of emissions “offset” credits exceed the reduction in allowable greenhouse gas emissions (the “cap”) between 2013 and 2014 and were mostly linked to projects outside of California.

The Proposed Plan fails to discuss this report, its supporting data, or its conclusions, despite comments on prior iterations of the Plan raising this specific issue. The report raises significant concerns and discloses new data that should foreclose the Air Board from extending the Cap and Trade program. The report demonstrates three fundamental points that environmental justice advocates have raised for years: (1) Cap and Trade disparately affects communities of color; (2) Cap and Trade denies communities the benefits of on-site reductions; and (3) greenhouse gas reductions attributed to Cap and Trade occur primarily outside of California.³ It concludes:

Preliminary analysis of the equity and emissions impacts of California’s cap-and-trade program indicates that regulated GHG emission facilities tend to be located in neighborhoods with higher proportions of residents of color and those living in poverty. There is a correlation between GHG emissions and particulate matter levels, suggesting a disparate pattern of localized emissions by race/ethnicity and poverty rate. In addition, facilities that emit the highest levels of both GHGs and particulate matter are similarly more likely to be located in communities with higher proportions of residents of color and those living in poverty. This suggests that public health and environmental equity co-benefits could be enhanced if there were more GHG reductions among the larger emitting facilities that are located in disadvantaged communities. Currently, there is little in the design of cap-and-trade to insure this set of localized results. Moreover, while the

² Lara J. Cushing, *et al.*, A PRELIMINARY ENVIRONMENTAL EQUITY ASSESSMENT OF CALIFORNIA’S CAP AND TRADE PROGRAM, attached as Exhibit 1.

³ Claimed reductions from imported electricity generation remain suspect given the Board’s creation of safe harbor exemptions from the resource shuffling prohibition, which allow greenhouse gas emissions to continue in fact as leakage. *See* Danny Cullenward, BULLETIN OF THE ATOMIC SCIENTISTS, 2014, Vol. 70(5) 35–44, attached as Exhibit 2.

cap-and-trade program has been in effect for a relatively short time period, preliminary evidence suggests that in-state GHG emissions from regulated companies have increased on average for several industry sectors and that many emissions reductions associated with the program were located outside of California. Large emitters that might be of most public health concern were most likely to use offset projects to meet their obligations under the cap-and-trade program.⁴

The Board has taken no final action to assess or prevent these impacts, and instead has consistently demonstrated its intent to prevent the public from accessing facility-specific compliance data and delayed implementation of its Adaptive Management Plan. The Board has taken the position that the public may not access critical Cap and Trade compliance and trading data, claiming that compliance with Cap and Trade constitutes “confidential business information.”⁵ When promulgating the Cap and Trade regulations in 2011, the Board claimed that it would assess and prevent adverse impacts through an Adaptive Management Plan. The Initial Statement of Reasons (“ISOR”) for the recently proposed Cap and Trade extension admits that the Board has not finalized or implemented the Adaptive Management Plan.⁶ ISOR at 302. Collectively, these two issues show how the Board withholds important information from the public regarding sources’ compliance and has not prevented Cap and Trade inequities.

More recently, the Office of Environmental Health Hazard Assessment (OEHHA) released a report that analyzed the emissions data from Cap and Trade facilities.⁷ It found strong correlations between greenhouse gas emissions and PM2.5 at all facilities, and strong correlations between greenhouse gas emissions and toxics at refineries. The OEHHA Report concluded that “these analyses suggest that reductions in greenhouse gas emissions are likely to result in lower pollutant exposures in disadvantaged communities, based overall on the positive correlations observed for the 2014 data.” Because of the correlations identified, when the Air Resources Board decides to allow pollution trading rather than direct reductions, it pursues a policy that denies communities living near Cap and Trade facilities the health benefits from direct reductions.

B. Approval of a Scoping Plan that Includes Cap and Trade will Violate Government Code Section 11135.

The Board has a duty under California civil rights law to ensure that its programs or policies do not inflict racially disparate treatment or result in racially disparate effects. Gov. Code § 11135. The Board will violate section 11135 if it adopts a Scoping Plan which includes Cap and Trade because, as set forth above in section I.A, Cap and Trade results in racially disparate and adverse impacts when it

⁴ Lara J. Cushing, *et al.*, A PRELIMINARY ENVIRONMENTAL EQUITY ASSESSMENT OF CALIFORNIA’S CAP AND TRADE PROGRAM at 7-9, attached as Exhibit 1.

⁵ *See, e.g.* Email from Edie Chang to Brent Newell, dated August 19, 2015, attached as Exhibit 3.

⁶ Even if the Board had finalized the Adaptive Management Plan, as currently proposed it would not address the section 11135 issues. The Adaptive Management Plan only proposes to take action at the Board’s sole discretion when cap and trade causes an emissions increase, and does not resolve the denial of benefits issue or negate the Board’s deliberate indifference.

⁷ Tracking and Evaluation of Benefits and Impacts of Greenhouse Gas Limits in Disadvantaged Communities: Initial Report, attached as Exhibit 4.

denies communities the benefits of direct reductions and allows sources to increase emissions through pollution trading and offsets usage. The Board has the authority to adopt alternatives to Cap and Trade, has actual knowledge of the racially disparate and adverse impacts from the denial of benefits and localized emissions increases, yet does not adequately prevent racial discrimination prohibited by Government Code section 11135.

C. The Board should Remove Cap and Trade from the Draft Scoping Plan because the Board has no Authority to Extend Cap and Trade after 2020.

The Board lacks authority to include Cap and Trade in the Scoping Plan for reductions to achieve the 2030 target. A fundamental principle of administrative law dictates that agencies only have those powers delegated by the Legislature. The Board’s authority to implement the Cap and Trade program expires on December 31, 2020 and the Board has no authority to extend the program beyond that date. Health & Safety Code §§ 38562(c), 38570.

ARB staff have claimed that AB 32 authorizes these regulations because of language in Part 3 of AB 32 related to the statewide greenhouse gas limit (the level of emissions in 1990). “It is the intent of the Legislature that the statewide greenhouse gas emissions limit continues in existence and be used to maintain and continue reductions in emissions of greenhouse gases beyond 2020.” Health & Safety Code § 38551(b). Grasping on to the words “continue reductions,” the staff believe they can extend Cap and Trade to 2030 to achieve the reductions required by Senate Bill 32. Section 38551, however, must be understood in the context of the statutory scheme as a whole. The very next subsection of section 38551 directs the Board to make recommendations to the Governor and the Legislature on how to continue reductions, and does not give the Board the authority to take those actions *sua sponte*. “The state board shall make recommendations to the Governor and the Legislature on *how* to continue reductions of greenhouse gas emissions beyond 2020.” Health & Safety Code § 38551(c) (emphasis added).

Nor has the Legislature acted to extend the Board’s authority. During the 2015 legislative session, the version of Assembly Bill 1288 (Atkins) containing an extension of the Board’s authority to implement Cap and Trade beyond December 31, 2020 did not become law. Instead, the Legislature amended Assembly Bill 1288 to add two environmental justice seats to the Board, demonstrating a legislative intent to prioritize environmental justice, not Cap and Trade. During the 2016 legislative session, Senate Bill 32 became law and requires the Board to achieve a 40 percent reduction in greenhouse gas emissions below the statewide greenhouse gas limit (1990 levels) by 2030. Stats. 2016, ch. 249, § 2, p. 88 (codified as Health & Safety Code § 38566). No provision of Senate Bill 32 amended section 38562(c) or otherwise authorized the Board to implement Cap and Trade after the year 2020. Accordingly, the Board lacks the authority to include Cap and Trade as part of the Scoping Plan.

II. The Board Must Prioritize Direct Emissions Reductions at Stationary and Mobile Sources.

Assembly Bill 197 (Garcia) expressly directs the Board to prioritize direct emissions reductions at large stationary sources, mobile sources, and all other sources. The Board has no authority to disregard direct emissions reduction strategies for the purposes of meeting the additional reductions required by Senate Bill 32. Rather, the Board must prioritize “emissions reduction rules and regulations that result in direct emission reductions at large stationary sources of greenhouse gas emissions and

direct emissions reductions from mobile sources.” Stats. 2016, ch. 250, § 5, subdivision (a), p. 92 (codified as Health & Safety Code § 38562.5(a)).

Except for the Refinery Rule, which calls for efficiency increases to achieve a twenty percent reduction, the Proposed Plan fails to include any other direct reduction strategies at stationary or mobile sources to comply with Assembly Bill 197. Especially problematic are the Plan’s failure to require direct reduction measures for the cement plant, power plant, oil and gas, and glass factory sectors, which all emit substantial greenhouse gas and co-pollutant emissions.

The Plan itself acknowledges that the cost effectiveness of the Refinery Rule is the same or higher than other identified direct reduction measures not included in the Proposed Plan. The cost effectiveness of the refinery rule 30 percent reduction measure, the industry measure, and the oil and gas measure are all the same as the Refinery Rule (\$70 to \$200/metric ton).⁸ Direct measures for mobile sources (Mobile Source Strategy (CFT)) offer potential cost savings at the low end of the range with a high estimate no greater than the Refinery Rule (-\$150 to \$200/metric ton).⁹

The Plan thus violates AB 197 by prioritizing Cap and Trade as a reduction strategy when the plain language of the statute directs the Board to prioritize direct reduction measures. Even if the Board had discretion – which it does not – then the Plan still violates AB 197 because the Plan offers no cogent explanation for the proposal to prioritize direct measures at refineries, but not at other Cap and Trade sources.

III. The Proposed Plan Inadequately Analyzes Carbon Tax Alternatives.

Under CEQA, the Plan must include a description of alternatives to the proposed regulatory program that minimize the significant environmental impacts of the program. Pub. Res. Code § 21080.5(d)(3)(A). This requirement is necessary to further the State’s goal of “avoiding significant adverse effects on the environment where feasible,” and policy that public agencies shall not approve projects if feasible alternatives would substantially lessen the significant environmental effects of those projects. CEQA Guidelines § 15250; *accord* Pub. Res. Code § 21002. Lead agencies must examine a reasonable range of alternatives that feasibly meet most of the project’s basic objectives while avoiding or substantially reducing the significant effects of the project, even if these alternatives “would impede to some degree the attainment of the project objectives, or would be more costly.” CEQA Guidelines § 15126.6(a), (b).

While the level of detail in an alternatives analysis is not subject to any precise formulation, the examination of alternatives must “include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed project.” CEQA Guidelines § 15126.6(d). Furthermore, “the public agency bears the burden of affirmatively demonstrating that, notwithstanding a project’s impact on the environment, the agency’s approval of the proposed project followed meaningful consideration of alternatives and mitigation measures.” *Mountain Lion Foundation v. Fish and Game Commission* (1997) 16 Cal.4th 105, 134. By offering conclusory statements and cursory discussions in place of actual analyses, improperly arguing that analysis is

⁸ See Proposed Plan, Table III-3 at 65.

⁹ *Id.*

speculative, and deferring analyses of alternative regulatory programs to later rulemaking procedures, ARB failed to undertake any meaningful analysis of the alternatives. This lack of analysis renders it impossible to compare these choices to the preferred alternative, undermining CEQA's goal of "foster[ing] informed decision-making and public participation." CEQA Guidelines § 15126.6(a).

The Proposed Plan sets forth a carbon tax scenario which it then strikes down as failing to meet several criteria. Proposed Plan at 50-52. The Plan first paints a carbon tax as lacking the certainty to meet the 2030 target by not having limits at facilities individually or in the aggregate (the "cap" part of Cap and Trade), and then uses an example from British Columbia. What the Plan fails to consider or disclose are several unique characteristics in California that surround a carbon tax and provide emissions certainty. First, Assembly Bill 197 prioritizes direct emissions reductions beyond the Refinery Rule which the Draft excludes from the scenario. Additional direct reductions that apply and occur before a carbon tax provide certainty while the carbon tax places further downward pressure on emissions.

Second, the Plan ignores the Board's on-going authority to update the Scoping Plan on a five-year interval and its authority to promulgate direct reductions to address any carbon tax-related shortfalls. The Board has the overall duty to ensure that California meets the 2030 target, and the authority to make that happen through direct emissions reductions as provided in Assembly Bill 32 and Senate Bill 32. The Plan does not recognize this authority in the scenario, nor does such authority exist in the misleading British Columbia example. The Board claims a carbon tax has "no mechanism to limit the actual amount of GHG emissions either at a single source or in the aggregate" (Plan at 50) but ignores the Board's statutory authority to institute those limits. In other words, if a carbon tax underperforms, the Board could adopt the additional measures such as those identified in the No Cap and Trade Scenario, including a more stringent Refinery Rule that achieves a thirty percent (or more) reduction.

Third, the Plan states that a carbon tax forgoes existing linkages with the current Cap and Trade program and questions whether a carbon tax would comply with the Clean Power Plan. Proposed Plan at 51. The alternatives analysis should not reject an alternative as infeasible simply because it would not link with one or more Canadian province's cap and trade systems. Linking with other jurisdictions and using Cap and Trade in the Clean Power Plan are not identified as project objectives (EA at 175-177), so rejecting an alternative on these grounds would not comport with CEQA. The Plan implies that other U.S. states in the Western Climate Initiative may adopt Cap and Trade programs, but that prospect has diminished to a near-zero probability with the 2016 Presidential election and the impending rescission of the Clean Power Plan.¹⁰ Finally, even if the Trump EPA retains the Clean Power Plan, the Clean Power Plan itself recognizes that a carbon tax would be a permissible state measures strategy, something the Draft fails to recognize. Proposed Plan at 51; 80 Fed. Reg. 64662, 64836 (Oct. 23, 2015).

Finally, the Draft's analysis reflects a pattern and practice at the Board of inadequate consideration of reasonable alternatives. The 2008 Scoping Plan failed to adequately analyze and consider a carbon tax when the Board opted to pursue Cap and Trade. As a result, the Superior Court held that the Board violated the California Environmental Quality Act. This Draft reflects the same bias

¹⁰ On March 28, 2017, President Trump signed an Executive Order calling for the repeal of the Clean Power Plan.

in favor of Cap and Trade. Instead of misrepresenting a carbon tax as a flawed strategy to bolster the problematic and inequitable Cap and Trade program, the Board should engage in a good faith and reasoned analysis of the benefits that a carbon tax offers.

The Environmental Analysis's evaluation of the carbon tax and cap and tax alternatives improperly finds that the alternative may not meet Objectives 1 and 2 (reduce emissions to meet the 2030 target).¹¹ With respect to the carbon tax alternative, the EA states that "it is unclear if Alternative 3 would meet 2030 GHG emission reduction targets, because it would depend on market conditions and unforeseeable actions taken by covered entities."¹² With respect to the cap and tax, the EA states "if other measures did not perform as expected, this alternative may not achieve the 2030 target as it would not scale across the industrial and energy sectors."¹³ As discussed above, the Board has the authority and duty to review the implementation of this scoping plan and adopt additional measures to ensure the 2030 target is achieved. Moreover, the Board also has the duty to prioritize direct emission reduction measures at stationary sources in the industrial and energy sectors under AB 197. The EA does not explain why the carbon tax or cap and tax alternatives – combined with this authority and duty – would not achieve Objectives 1 and 2.¹⁴ Furthermore, the EA questions both alternatives effectiveness at eliminating leakage in a short, conclusory fashion. The EA improperly dismisses Alternatives 3 and 5 because the EA and the Plan do not explain the factual bases for its conclusory statements and the rationale do not comport with the Board's authority and duty under AB 32, SB 32, and AB 197.

Furthermore, the analysis fails to analyze whether the cap and tax alternative would be the environmentally superior alternative. As discussed in section IV, *infra*, the EA does not adequately analyze cap and trade air quality impacts. Alternative 5 does not allow offsets or allowance trading, and includes an emissions cap to drive down reductions. Accordingly, communities would not be denied the benefits of direct emissions reductions under cap and trade and would experience better air quality outcomes as compared to the Proposed Plan.

IV. The Environmental Analysis Fails to Adequately Consider and Analyze Air Quality Impacts from Cap and Trade.

Under CEQA, the Board has an obligation to identify, analyze, and mitigate the environmental impacts of the Proposed Plan. Cal. Code Regs., tit. 14, § 15252; Cal. Code Regs., tit. 17, § 60005(b); *California Sportfishing Protection Alliance v. State Water Resources Control Board* (2008) 160 Cal.App.4th 1643-45 ("[w]hile the CEQA Guidelines do not directly apply to certified regulatory programs, the information disclosure provisions and broad policy goals of CEQA still apply.").

When considering the impacts of Cap and Trade on Air Quality, the Environmental Analysis (EA) devotes a cursory two-pages and concludes, without supporting evidence, that because "ARB has received so few years of reported data to date, ARB lacks sufficient information to conclude with

¹¹ Proposed Plan, Appendix F at 182, 184-185.

¹² *Id.* at 182.

¹³ *Id.* at 184.

¹⁴ The EA finds that Alternative 5 would meet all of the other project objectives, and does not find that there would be increased environmental impacts from implementing Alternative 5. Proposed Plan, Appendix F at 184-185.

certainty that localized emissions increases have not occurred.” Proposed Plan, Appendix F at 66. Both the Plan and the EA neither discuss, disclose, or consider the Cushing Report or the OEHHA Report discussed in Section I.A, *supra*. While ARB may or may not have complete implementation data, it has a duty to undertake a good faith analysis and make that analysis available to the public to meaningfully consider the impact of Cap and Trade. ARB also has the duty to analyze the impact of Cap and Trade and mitigate impacts or adopt project alternatives. As the Cushing Report and the OEHHA Report demonstrate, greenhouse gas emissions have increased in some sectors and communities are denied health benefits from direct reductions because co-pollutant increases/decreases are directly correlated to changes in greenhouse gas emissions. This evidence, combined with the Plan’s failure to institute AB 197 direct measures impermissibly in favor of Cap and Trade, means that this project will have an impact on air quality and public health. The Plan violates CEQA by failing to analyze and mitigate that impact.

V. Conclusion

We call on the Board to direct staff to amend the Proposed Plan to remove Cap and Trade as a strategy and to meaningfully incorporate the recommendations of the Environmental Justice Advisory Committee. Furthermore, the Board should support the EJAC’s Declaration calling for carbon pricing reform by prioritizing direct emissions reductions and replacing Cap and Trade with a direct carbon pricing system.¹⁵

We look forward to a revised Proposed Plan and a climate policy that places environmental justice at its core. Thank you for your time and courtesy.

Sincerely,



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Center on Race, Poverty & the Environment

Amy Vanderwarker
California Environmental Justice Alliance

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AB 32 Environmental Justice Advisory Committee, Leadership Team

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¹⁵ See The California Environmental Justice Advisory Committee’s Declaration in Support of Carbon Pricing Reform in California, attached as Exhibit 5.

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Exhibit 1



A PRELIMINARY ENVIRONMENTAL EQUITY ASSESSMENT OF CALIFORNIA'S CAP-AND-TRADE PROGRAM

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OVERVIEW

California's cap-and-trade program is a key strategy for achieving reductions in greenhouse gas (GHG) emissions under AB32, the California Global Warming Solutions Act. For residents living near large industrial facilities, AB32 offered the possibility that along with reductions in GHGs, emissions of other harmful pollutants would also be decreased in their neighborhoods. Carbon dioxide (CO₂), the primary GHG, indirectly impacts health by causing climate change but is not directly harmful to health in the communities where it is emitted. However, GHG emissions are usually accompanied by releases of other pollutants such as particulate matter (PM₁₀) and air toxics that can directly harm the health of nearby residents.

In this brief, we assess inequalities in the location of GHG-emitting facilities and in the amount of GHGs and PM₁₀ emitted by facilities regulated under cap-and-trade. We also provide a preliminary evaluation of changes in localized GHG emissions from large point sources since the advent of the program in 2013. To do this, we combined pollutant emissions data from California's mandatory GHG and criteria pollutant reporting systems,^{1,2} data on neighborhood demographics from the American Community Survey, cumulative environmental health impacts from the California Environmental Protection Agency's CalEnviroScreen tool, and information from the California Air Resources Board (CARB) about how regulated companies fulfilled their obligations under the first compliance period (2013-14) of the cap-and-trade program. Our methodology is described in greater detail in the appendix to this report.

In this analysis, we focus primarily on what are called "emitter covered emissions," which correspond to localized, in-state emissions (derived mostly from fossil fuels) from industries that are subject to regulation under cap-and-trade. The cap-and-trade program also regulates out-of-state emissions associated with electricity imported into the state and, beginning in 2015, began regulating distributed emissions that result from the burning of fuels such as gasoline and natural gas in off-site locations (e.g., in the engines of vehicles and in homes).

We found that regulated GHG-emitting facilities are located in neighborhoods with higher proportions of residents of color and residents living in poverty. In addition, facilities that emit the highest levels of both GHGs and PM₁₀ are also more likely to be located in communities with higher proportions of residents of color and residents living in poverty. This suggests that the public health and environmental equity co-benefits of California's cap-and-trade program could be enhanced if there were more emissions reductions among the larger emitting facilities that are located in disadvantaged communities. In terms of GHG emission trends, in-state emissions have increased on average for several industry sectors since the advent of the cap-and-trade program, with many high emitting companies using offset projects located outside of California to meet their compliance obligations. Enhanced data collection and availability can strengthen efforts to track future changes in GHG and co-pollutant emissions and inform decision making in ways that incentivize deeper in-state reductions in GHGs and better maximize public health benefits and environmental equity goals.

FINDINGS

1. Facilities that emit localized GHGs are located in more disadvantaged communities.

On average, neighborhoods with a facility that emitted localized GHGs within 2.5 miles³ have a 22 percent higher proportion of residents of color and 21 percent higher proportion of residents living in poverty than neighborhoods that are not within 2.5 miles of such a facility. Neighborhoods within 2.5 miles of a facility are also more than twice as likely to be among the worst statewide in terms of their CalEnviroScreen score, a relative ranking of cumulative impact based on indicators of social and environmental stressors to health (Table 1⁴).

TABLE 1
Characteristics of Neighborhoods within 2.5 miles of GHG-emitting Facilities
(N=255 facilities)

	Block groups with at least one facility within 2.5 miles (N=6,397)	Block groups with no facilities within 2.5 miles (N=16,705)
Mean % People of Color	66%	54%
Mean % People Living Below Twice the Poverty Level	41%	34%
% of Block Groups in a “Top 10%” CalEnviroScreen tract	17%	7%
% of Block Groups in a “Top 20%” CalEnviroScreen tract	31%	15%

2. Many of California’s residential communities are within 2.5 miles of more than one GHG-emitting facility (Figure 1⁵).

These communities are home to a higher proportion of residents of color and people living in poverty than communities with no or few facilities nearby. Indeed, the higher the number of proximate facilities, the larger the share of low-income residents and residents of color (Figure 2).

FIGURE 1
 Residential Proximity to Facilities Reporting Emitter Covered GHG Emissions during the 2013-14 Compliance Period (N=321 facilities)

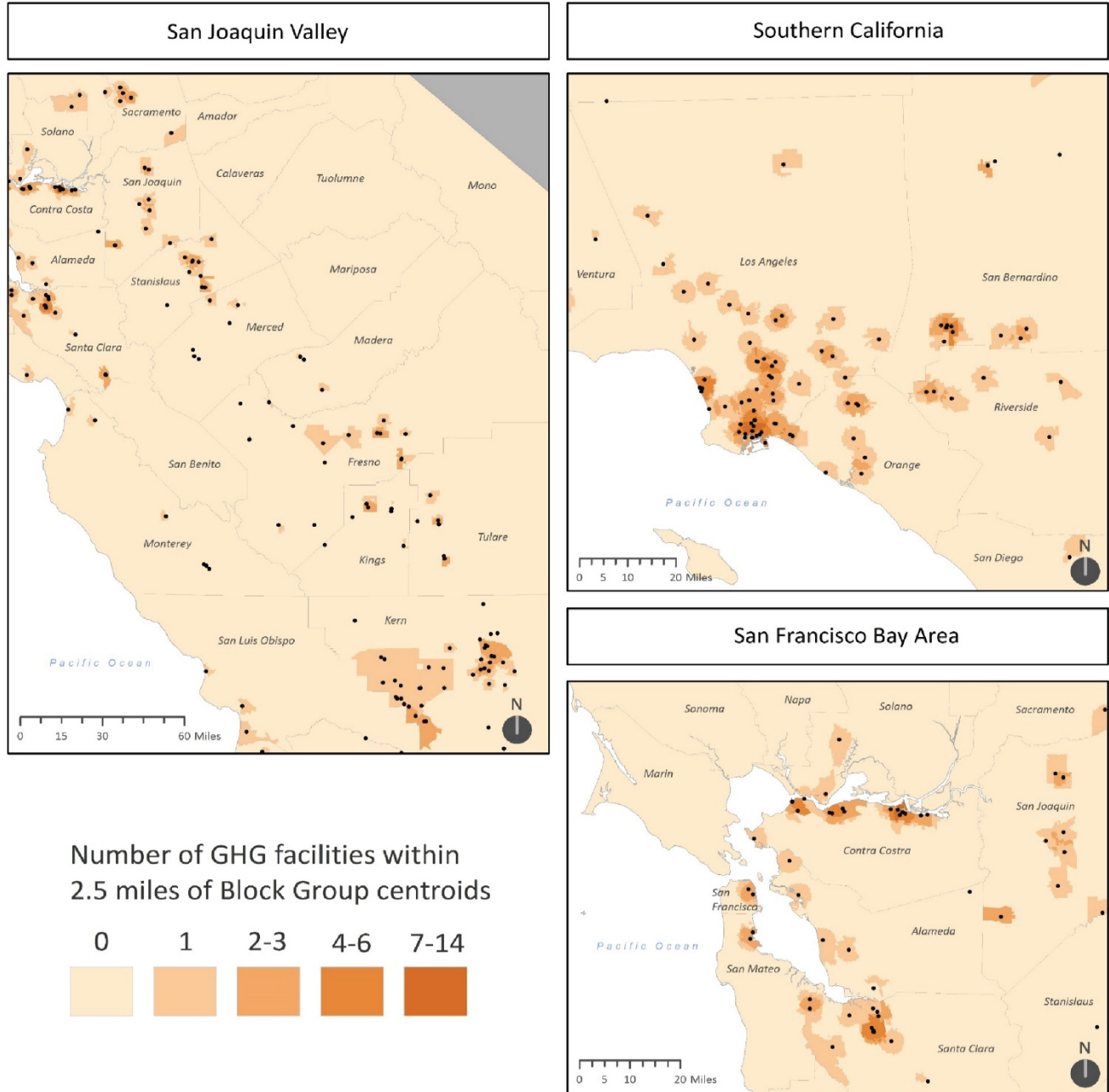
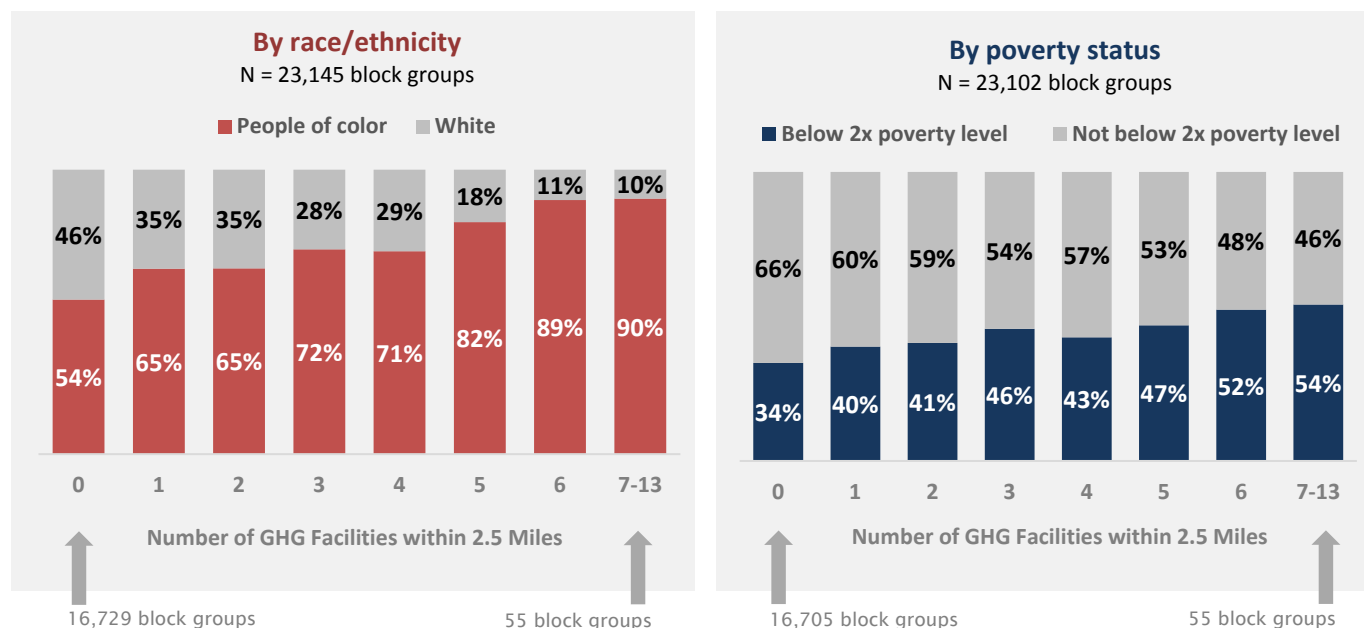


FIGURE 2
Demographics in Block Groups near GHG-emitting Facilities (N=255 facilities)



3. While GHG emissions do not generally have direct health impacts, co-pollutants such as particulate matter (PM₁₀) do. Such emissions are correlated (Figure 3⁶), with large GHG emitters reporting that they emit more particulate matter. The largest emitters of both GHGs and PM₁₀ also tend to be located near neighborhoods with higher proportions of disadvantaged residents (Table 2⁷).

The neighborhoods within 2.5 miles of the 66 largest GHG and PM₁₀ emitters (defined as the top third in emissions of both PM₁₀ and GHGs and highlighted in orange in Figure 3) have a 16 percent higher proportion of residents of color and 11 percent higher proportion of residents living in poverty than neighborhoods that are not within 2.5 miles of such a facility (Table 2). Compared to other parts of the state, nearly twice as many neighborhoods within 2.5 miles of these highest-emitting facilities are also among the worst statewide in terms of their CalEnviroScreen score. We also found that 40 (61 percent) of these high-emitting facilities reported increases in their localized GHG emissions in 2013-14 relative to 2011-12, versus 51 percent of facilities overall. Neighborhoods near the top-emitting facilities that increased emissions had higher proportions of people of color than neighborhoods near top-emitting facilities that decreased their emissions (Table 6 in the Appendix).

FIGURE 3
Correlation between Emitter Covered GHG Emissions and Particulate Matter (N=317 facilities)

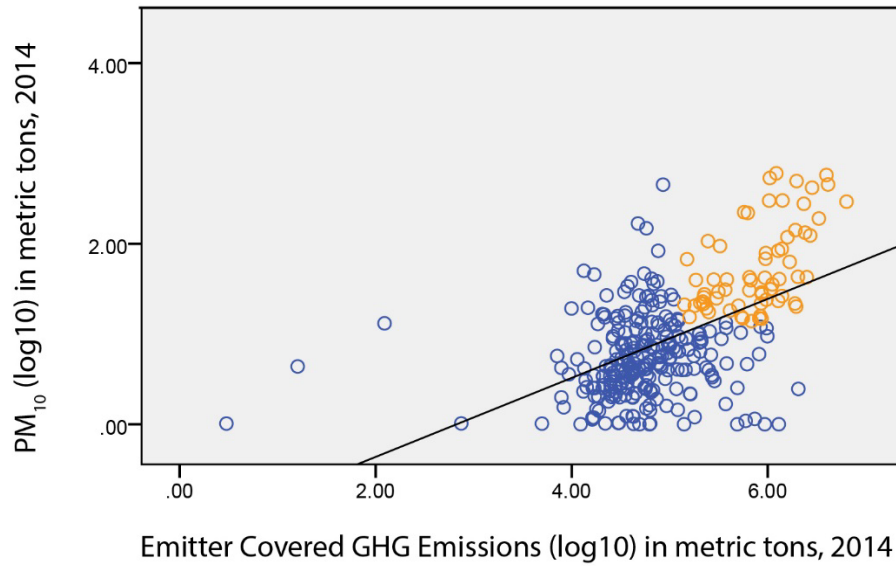


TABLE 2
Characteristics of Neighborhoods within 2.5 miles of the top GHG- and PM₁₀- Emitting Facilities (N=66 facilities)

	Block groups within 2.5 miles of the largest GHG and PM ₁₀ emitters (N=1,290)	All other block groups (N=21,812)
Mean % People of Color	66%	57%
Mean % People Living Below Twice the Poverty Level	40%	36%
% of Block Groups in a "Top 10%" CalEnviroScreen tract	18%	9%
% of Block Groups in a "Top 20%" CalEnviroScreen tract	35%	19%

4. While overall, GHG emissions in California have continued to drop from a peak in 2001, we find that, on average, many industry sectors covered under cap-and-trade report increases in localized in-state GHG emissions since the program came into effect in 2013.⁸

Only a portion of the state’s total GHG emissions are regulated under the cap-and-trade system. For example, the industrial and electrical sectors accounted for about 41 percent of the state’s estimated total GHGs emissions in 2014.⁹ (The remainder originated from sectors such as transportation, commercial and residential buildings, and agriculture.) As a result, overall emissions and emissions regulated under cap-and-trade can exhibit slightly different patterns. Moreover, not all emissions regulated under the cap-and-trade program occur in-state. For example, according to CARB’s 2016 Edition of the California GHG Emission Inventory, emissions from electrical power decreased by 1.6 percent between 2013 and 2014. However, when these emissions are disaggregated, we see that it is the emissions associated with *imported* electricity that decreased, while emissions from *in-state* electrical power generation actually increased.⁸

Figure 4 shows the distribution of the change in localized GHG emissions regulated under cap-and-trade for two time periods: the two years prior and the two years after the program came into effect. We present the range in emissions changes reported by individual facilities within seven industry sectors for 2013-14 versus 2011-12; this includes the median (50th percentile), mean (average), and 10th to 90th percentile of changes in emitter covered emissions for 314 GHG facilities. For example, six of the nine cement plants included in **Figure 4** reported increases in emissions during 2013-14 relative to 2011-12. The median value corresponds to the 143,295-ton increase reported by the cement plant in the middle of the distribution (5th highest emitting facility out of the nine total). Similarly, the 25th and 75th percentiles correspond to the increases reported by the 3rd and 7th highest emitting facilities. The facilities with the minimum and maximum emissions changes are not shown in this graph to make it more legible; for example, the Cemex Victorville cement plant reported an increase of over 843,000 tons, an amount that far exceeds the range portrayed in **Figure 4**.

FIGURE 4
Change in Emitter Covered GHG Emissions by Industry Sector (N=314 facilities)

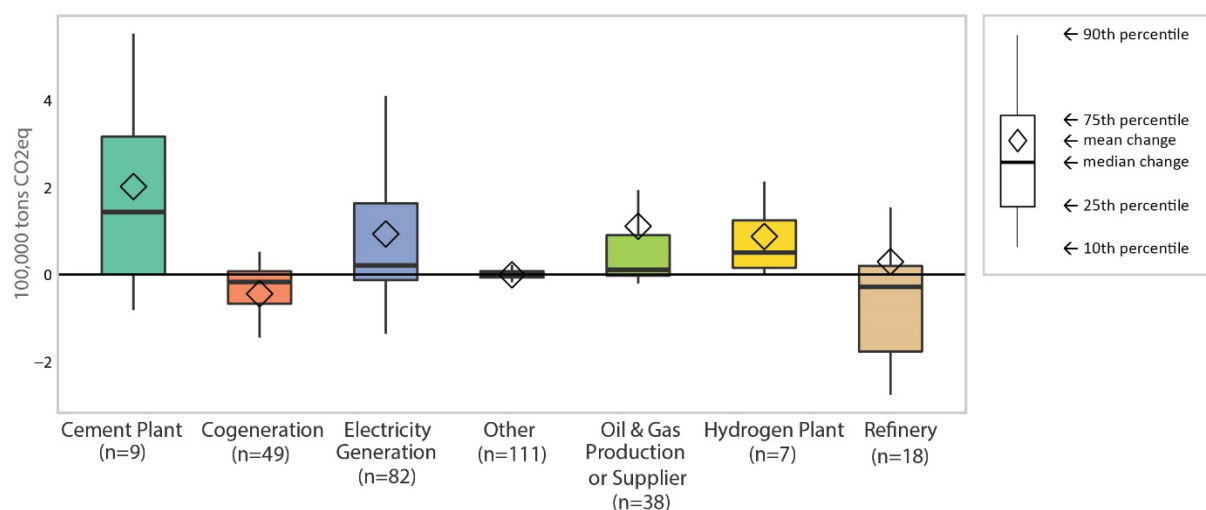
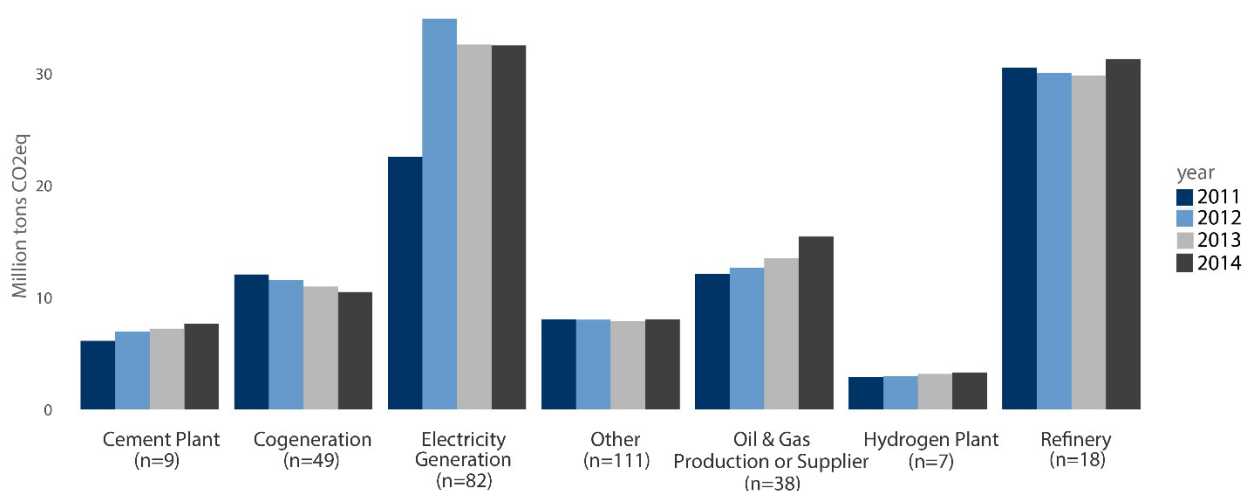


Figure 5 shows temporal trends in total emitter covered emissions (the sum of emissions from all individual facilities) by industry sector for 2011-2014. The number of facilities can change from year to year due to shutdowns, startups, and changes in emissions that affect whether facilities are required to report GHG emissions to CARB. In both **Figure 4** and **Figure 5**, we included only those facilities that: 1) report to the inventory every year during the four-year period, and 2) report at least some emitter covered emissions during those same four years. Again, the upward trend in several sectors is notable.

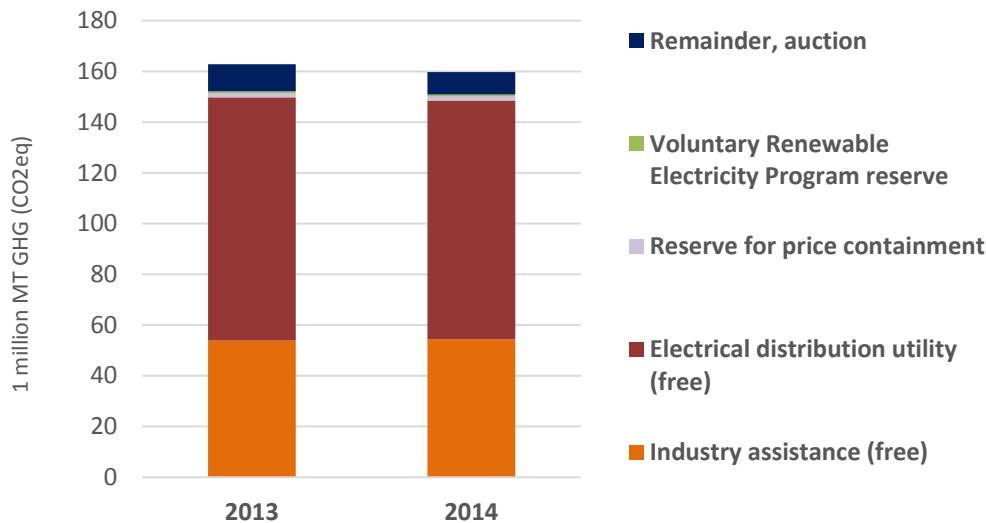
FIGURE 5
Temporal Changes in Total Emitter Covered GHG Emissions by Industry Sector



5. Between 2013 and 2014, more emissions “offset” credits were used than the total reduction in allowable GHG emissions (the “cap”). These offsets were primarily linked to projects outside of California, and large emitters of GHGs were more likely to use offset credits to meet their obligations under cap-and-trade.

The cap-and-trade program requires regulated companies to surrender one compliance instrument—in the form of an allowance or offset credit—for every ton of qualifying GHGs they emit during each compliance period. These instruments are bought and sold on the carbon market. The total number of allowances is set by the “cap,” which decreases by roughly 3 percent per year in order to meet GHG reduction targets. In 2013 and 2014, most allowances were given to companies for free for leakage prevention, for transition assistance, and on behalf of ratepayers (**Figure 6**). Additional offset credits were generated from projects that ostensibly reduce GHGs in ways that may cost less than making changes at a regulated facility.

FIGURE 6
Allocation of Allowances



Regulated companies are allowed to “pay” for up to 8 percent of their GHG emissions using such offset credits. The majority of the offset credits (76 percent) used to date were generated by out-of-state projects (**Figure 7**). **Figure 8** shows that most offset credits were generated from projects related to forestry (46 percent)¹⁰ and the destruction of ozone-depleting substances (46 percent). Furthermore, over 15 percent of offset credits used during the first compliance period were generated by projects undertaken before final regulations for the cap-and-trade program were issued in 2011, calling into question whether these GHG reductions can be attributed to California’s program, or whether they might have happened anyway.

FIGURE 7
Origin of Offset Credits

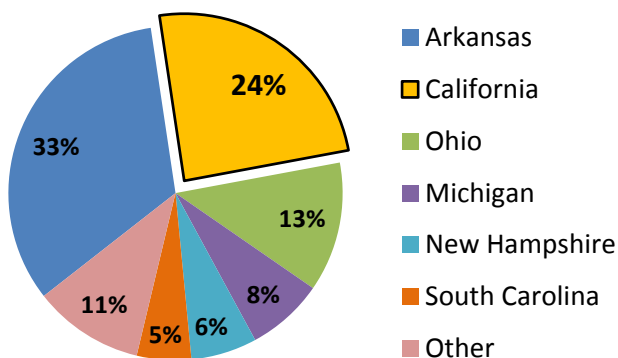
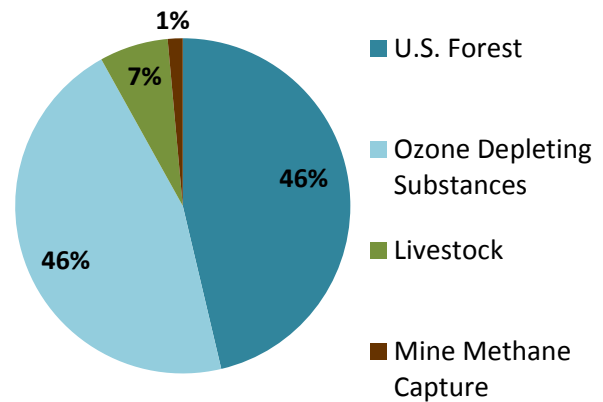


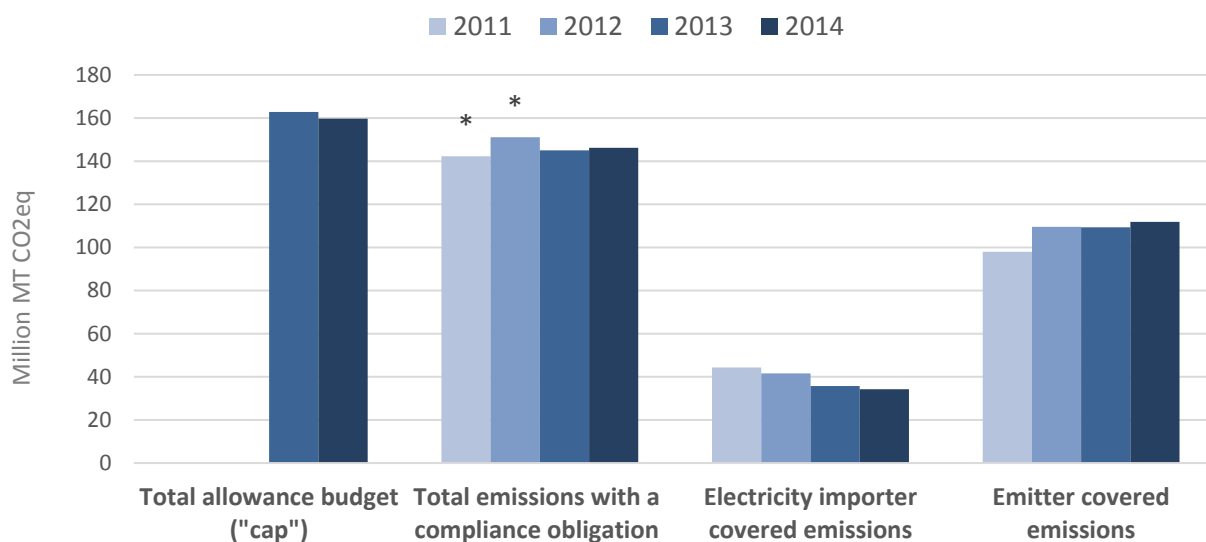
FIGURE 8
Offset Credits by Project Type



During the first compliance period of 2013-14, the total emissions that were subject to a compliance obligation (the second set of columns in **Figure 9**) were lower than the cap set by the allowance budget (left-most set of columns in **Figure 9**). This total includes both the emitter covered emissions that have been the focus of our analysis so far (right-most set of columns in **Figure 9**) and out-of-state emissions associated with imported electricity (which went down every year during the four-year period as shown by the third set of columns in **Figure 9**). Offset credits worth more than 12 million tons of CO_{2eq} were utilized to meet these obligations. These offsets represent 4.4 percent of the total compliance obligation of all regulated companies and over four times the targeted reduction in GHG emissions from 2013 to 2014 as established by the cap (**Figure 10**).

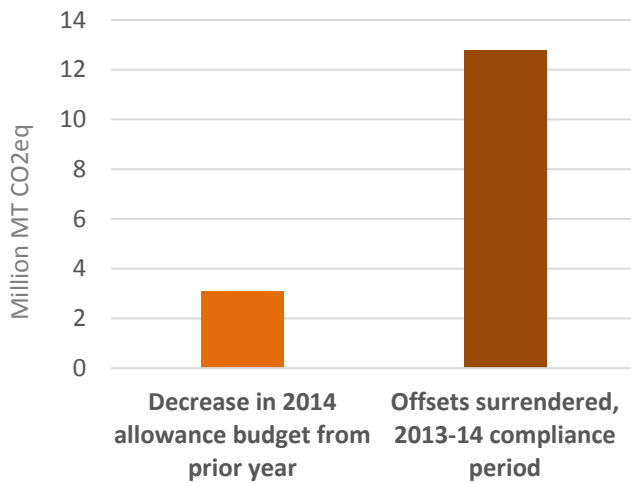
We found that the majority of companies did not use offset credits to meet their compliance obligation; however, those companies that *did* use offsets tended to have larger quantities of GHG emissions. The top 10 users of offsets account for 36 percent of the total covered emissions and 65 percent of the offsets used. These top offset users included Chevron (1.66 million offsets), Calpine Energy Services (1.55 million offsets), Tesoro (1.39 million offsets), SoCal Edison (1.04 million offsets), Shell (0.62 million offsets), PG&E (0.44 million offsets), Valero (0.43 million offsets), La Paloma Generating Company (0.40 million offsets), San Diego Gas & Electric (0.39 million offsets), and NRG Power (0.33 million offsets).

FIGURE 9
Total GHG Budget



* Only emissions during 2013 and 2014 were subject to a compliance obligation. Estimates of comparable emissions during 2011 and 2012 were derived by summing the "emitter covered" and "electricity importer covered" emissions reported by regulated facilities for those years.

FIGURE 10
Offset Credits vs. Decrease in Allowance Cap



CONCLUSIONS

California's efforts to slow climate change by reducing GHG emissions can bring about additional significant co-benefits to health, particularly in disadvantaged communities. Preliminary analysis of the equity implications of California's cap-and-trade program indicates that regulated GHG-emitting facilities tend to be located in neighborhoods with higher proportions of residents of color and residents living in poverty. There is a correlation between emissions of GHGs and PM₁₀, and facilities that emit the highest levels of both GHGs and PM₁₀ are similarly more likely to be located in communities with higher proportions of residents of color and residents living in poverty. This suggests that the public health and environmental equity co-benefits of California's cap-and-trade program could be enhanced if there were more emissions reductions among the larger emitting facilities that are located in disadvantaged communities.

Currently, there is little in the design of cap-and-trade to ensure this set of localized results. Indeed, while the cap-and-trade program has been in effect for a relatively short time period, preliminary evidence suggests that in-state GHG emissions from regulated companies have increased on average for several industry sectors and that many emissions reductions associated with the program were linked to offset projects located outside of California. Large GHG emitters that might be of most public health concern were the most likely to use offset projects to meet their obligations under the cap-and-trade program.

Further research is needed before firm policy conclusions can be drawn from this preliminary analysis. As regulated industries adapt to future reductions in the emissions cap, California is likely to see more reductions in localized GHG and co-pollutant emissions. Thus far, the state has achieved overall emissions reductions in large part by using offsets and replacing more GHG-intensive imported electricity with cleaner, in-state generation. Steeper in-state GHG reductions can be expected going forward if the use of offsets were to be restricted and the opportunity to reduce emissions by replacing imported electricity with in-state generation becomes exhausted.

However, ongoing evaluation of temporal and spatial trends in emissions reductions will be critical to assessing the impact of the cap-and-trade program. Several recommendations would strengthen future analyses and facilitate better tracking of the public health and environmental equity aspects of the cap-and-trade program going forward.

These include:

- Building better linkages between state facility-level databases on GHG and co-pollutant emissions. To conduct this preliminary analysis, we had to do a series of matches between datasets with different facility ID codes (see Appendix for details). Harmonization of facility ID codes between relevant data sources could be built into facility emissions reporting requirements going forward in order to facilitate analysis of temporal and spatial GHG and co-pollutant emissions trends.
- Publicly releasing data on facility- and company-specific allowance allocations.
- Tracking and making data available on facility- and company-specific allowance trading patterns.

Good quality, publicly accessible data and robust analysis will be critical to informing policy discussions and improving regulatory implementation of California's climate law in ways that incentivize deeper in-state GHG reductions and that achieve both sustainability and environmental equity goals.

ACKNOWLEDGEMENTS

We thank USC PERE Data Manager Justin Scoggins, Graduate Research Assistant Melody Ng, and Communications Specialist Gladys Malibiran for their assistance in the production of this brief; the California Environmental Justice Alliance for helpful feedback on an early version of this brief; and the Energy Foundation (grant number G-1507-23494), the Institute for New Economic Thinking (grant number INO1500008), and the Resource Legacy Fund for their support of this work.

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APPENDIX

This appendix includes a description of the methods used in our preliminary environmental equity assessment of California's cap-and-trade program. We also present supplemental analyses, including a comparison of neighborhood demographics near regulated GHG facilities using different buffer distances to define proximity.

Methods

GREENHOUSE GAS EMISSIONS

To start, we downloaded annual, facility-specific GHG emissions data for 2011-2014 from the Mandatory Reporting of Greenhouse Gas Emissions (MRR) program.¹ The MRR includes self-reported estimates of annual emissions of greenhouse gases (GHGs)—carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated GHGs—from regulated industries that have been verified by an independent third party. Emissions are given in units of CO₂-equivalents, a metric that combines the quantity of individual gases emitted with the potency of each gas in terms of its contribution to climate change over a 100-year time frame (also known as “global warming potential”). Our analysis focused on one class of emissions included in this database called “emitter covered emissions,” which corresponds to localized, in-state emissions resulting from “the combustion of fossil fuels, chemical and physical processes, vented emissions...and emissions from suppliers of carbon dioxide”¹¹ as well as emissions of GHGs other than CO₂ from biogenic fuel combustion. The term “covered” refers to the fact that these emissions are subject to a compliance obligation under the cap-and-trade program; releases of CO₂ that result from the combustion of biogenic fuels, for example, are exempted. The cap-and-trade program also regulates out-of-state emissions associated with electricity imported into the state and, beginning in 2015, began regulating distributed emissions that result from the burning of fuels such as gasoline and natural gas in off-site locations (e.g., in the engines of vehicles and in homes); although we did not analyze distributed emissions in this report, this category of emissions will be a future research topic.

The number of facilities reporting to the MRR can change from year to year due to shutdowns, startups, and changes in emissions that affect whether facilities are required to report. In our analysis of trends in emissions across industry sectors, we excluded facilities that did not report to the emissions inventory every year during 2011-14, as well as facilities that reported no emitter covered emissions during the four-year period. Facilities were categorized according to the sector reported in the MRR with slight modifications to reduce the number of categories. Facilities described as a refinery alone or in combination with any of the following were categorized as a refinery: hydrogen plant, CO₂ supplier, or transportation fuel supplier. Facilities described as “other combustion source” or “other combustion source/ CO₂ supplier” were categorized as “other.”

We determined or confirmed the geographic location of each facility using a variety of data sources and methods. Geographic point locations for some facilities were obtained directly from the California Air Resources Board (CARB), and facility addresses reported in CARB's online GHG visualization tool were geocoded.¹² We located some sites using individual internet searches. All locations inside California were visually confirmed, and point locations were adjusted for accuracy using aerial imagery in Google Earth Pro.

CO-POLLUTANT DATA (PM₁₀)

We obtained emissions of criteria air pollutants from the California Emission Inventory Development and Reporting Systems (CEIDARS) database for years 2011-14.² Reporting requirements, including the way in which facilities are defined, the numeric identifier attached to each facility, and the frequency of reporting, differ between CEIDARS and the MRR GHG database. This presents a challenge for combining emissions estimates from the two sources. In particular, criteria air pollutants are not required to be reported annually, and emissions estimates contained in the 2014 CEIDARS database may correspond to estimates from prior years. We joined data on PM₁₀ emissions from the 2014 CEIDARS with GHG emissions information from the MRR GHG database based on the facility name, city, and ZIP code. For some GHG facilities listed in the MRR GHG database, we obtained addresses from CARB's Facility GHG Emissions Visualization and Analysis Tool.¹² Since the CEIDARS database also contains addresses, we were able to use the address field to confirm and find additional matches. When all variables (facility name, city, and ZIP code) did not match between the two data sources, matches were confirmed by hand through internet searches of company websites and online databases containing facility names and addresses.

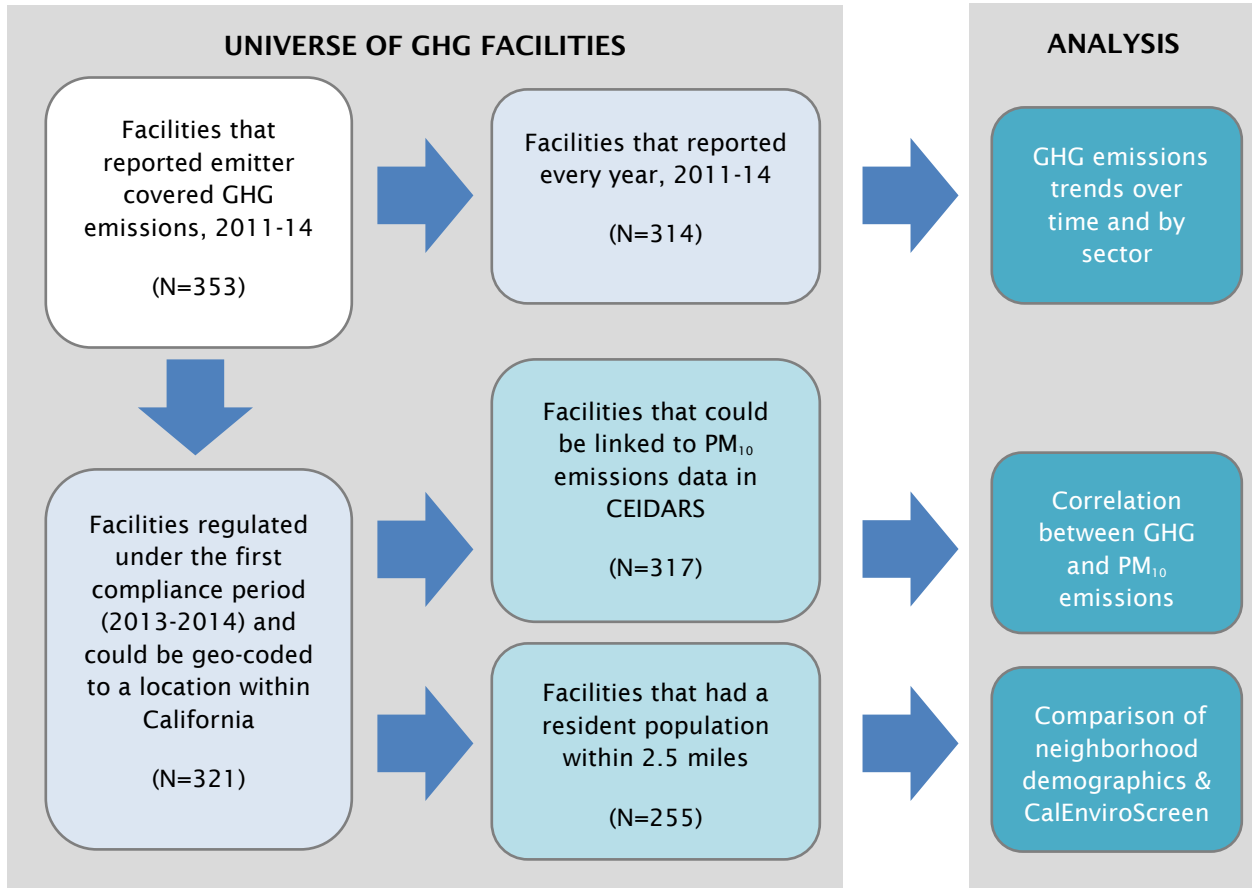
NEIGHBORHOOD DEMOGRAPHICS AND CUMULATIVE IMPACT

We defined neighborhoods on the basis of 2010 vintage Census block group boundaries provided by the U.S. Census.¹³ Block group centroids were created by using the point-to-polygon tool in ArcGIS and the distance between block group centroids and GHG facility locations was calculated using the point-distance tool in ArcGIS (ESRI, Redlands, CA).

Demographic information for each block group was obtained from the 2014 5-year American Community Survey estimates. White individuals were defined as those who self-identified as white but not Hispanic. People of color were defined as all other individuals, including those who identified as multiracial or of Hispanic ethnicity. Poverty was defined as twice the federal poverty level (FPL) to reflect increases in the cost of living since the FPL was established and California's high cost of living.

CalEnviroScreen is a state-level screening tool developed by the California Environmental Protection Agency that helps identify California communities that are disproportionately burdened by multiple sources of pollution.¹⁴ It includes indicators of proximity to environmental hazards and population vulnerability to derive a relative score of cumulative environmental health impact. We assigned block groups the most recent CalEnviroScreen score of their census tract in order to compare CalEnviroScreen rankings near GHG facilities to the rest of the state. **Figure 11** summarizes the construction of our facility-level dataset.

FIGURE 11 – Construction of the Dataset



ALLOWANCES AND OFFSETS

Unlike the emissions data, information on the allocation of allowances and ways in which regulated industries are complying with the cap-and-trade program is reported on an industry- and company-specific basis, rather than at the facility level. One company may own several regulated facilities. Information on the allocation of allowances was compiled from the California Code of Regulations (17 CA ADC § 95841 and 17 CCR § 95870) and CARB publications on the public allocation of allowances and estimates of state-owned allowances.¹⁵ We obtained the number of allowances and offsets surrendered by each company at the completion of the first compliance period from CARB's 2013-14 Compliance Report.¹⁶ Information on individual offset projects was compiled from CARB documents on offsets issued as of August 10, 2016¹⁷ and individual project descriptions provided in the American Carbon Registry and Climate Action Reserve carbon offset registries.¹⁸

Supplemental Analyses

Consistent with the findings presented in **Table 1** in the main text, **Table 3** shows that neighborhoods within 1.5 miles of a facility with localized GHG emissions have a 16 percent higher proportion of residents of color, a 26 percent higher proportion of residents living in poverty, and a higher likelihood of scoring among the worst statewide in terms of their CalEnviroScreen score than neighborhoods that are not within 1.5 miles of such a facility. **Table 4** and **Table 5** show similar trends when neighborhoods up to a larger distance of 3.5 and 6 miles away are considered. These results confirm that the findings presented in our main analysis were not sensitive to our choice of buffer distance.

TABLE 3
Characteristics of Neighborhoods within 1.5 miles of GHG-emitting Facilities
(N=255 facilities)

	Block groups with at least one facility within 1.5 miles (N=2,710)	Block groups with no facilities within 1.5 miles (N=20,392)
Mean % People of Color	66%	57%
Mean % People Living Below Twice the Poverty Level	44%	35%
% of Block Groups in a “Top 10%” CalEnviroScreen tract	20%	9%
% of Block Groups in a “Top 20%” CalEnviroScreen tract	36%	18%

TABLE 4
Characteristics of Neighborhoods within 3.5 miles of GHG-emitting Facilities
(N=255 facilities)

	Block groups with at least one facility within 3.5 miles (N=9,991)	Block groups with no facilities within 3.5 miles (N=13,111)
Mean % People of Color	66%	51%
Mean % People Living Below Twice the Poverty Level	39%	33%
% of Block Groups in a “Top 10%” CalEnviroScreen tract	15%	6%
% of Block Groups in a “Top 20%” CalEnviroScreen tract	29%	13%

TABLE 5
 Characteristics of Neighborhoods within 6 miles of GHG-emitting Facilities
 (N=255 facilities)

	Block groups with at least one facility within 6 miles (N=16,365)	Block groups with no facilities within 6 miles (N=6,737)
Mean % People of Color	65%	41%
Mean % People Living Below Twice the Poverty Level	37%	32%
% of Block Groups in a “Top 10%” CalEnviroScreen tract	13%	3%
% of Block Groups in a “Top 20%” CalEnviroScreen tract	25%	7%

In the main text, we defined the 66 largest GHG and PM₁₀ emitting facilities as those that were within the top third in terms of their 2014 emissions of both PM₁₀ and localized GHGs, and highlighted them in orange in **Figure 2**. We found that 40 (61 percent) of these high-emitting facilities reported increases in their localized GHG emissions in 2013-14 relative to 2011-12, versus 51 percent of facilities overall. Neighborhoods near the top-emitting facilities that increased emissions had higher proportions of people of color than neighborhoods near top-emitting facilities that decreased their emissions (**Table 6**).

TABLE 6
 Characteristics of Neighborhoods near top GHG- and PM₁₀-Emitting Facilities that Increased and Decreased GHG Emissions (N=66 facilities¹⁹)

	Block groups within 2.5 miles of at least one top emitting facility that increased GHG emissions (N=675)	Block groups within 2.5 miles of at least one top emitting facility that decreased GHG emissions (N=669)
Mean % People of Color	74%	58%
Mean % People Living Below Twice the Poverty Level	46%	34%
% of Block Groups in a “Top 10%” CalEnviroScreen tract	25%	14%
% of Block Groups in a “Top 20%” CalEnviroScreen tract	46%	28%

ENDNOTES

¹ Mandatory Reporting of Greenhouse Gas Emissions (MRR), <http://www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/ghg-reports.htm>.

² CEIDARS, <http://www.arb.ca.gov/ei/disclaim.htm>; <http://www.arb.ca.gov/ei/drei/maintain/dbstruct.htm>.

³ GHG facilities were limited to those that report emitter covered emissions during the first compliance period of cap-and-trade (2013-14), could be geo-coded in California, and had a resident population within 2.5 miles (N=255). We define neighborhoods using Census block groups. Residential proximity to a GHG facility was based on the distance between the facility location and each block group's centroid. We chose a 2.5 mile distance due to its common use in other environmental justice analyses. The Appendix gives results using alternative distance buffers.

⁴ For calculations in Table 1, we used the universe of block groups for which there are valid data (i.e., non-missing data) for all four measures shown. However, the results were the same when we included all block groups with valid data for each measure on an individual basis.

⁵ The map in Figure 1 shows 66 additional facilities that are not included in Table 1 and Figure 2 because they are not within 2.5 miles of a block group centroid with a resident population. See Figure 11 in the Appendix for details.

⁶ Because there are several PM₁₀ values that are between zero and one metric ton, in Figure 3 we added 1 to the PM₁₀ value for all facilities prior to taking the log10 to avoid reporting negative values.

⁷ Similar to Table 1, for calculations in Table 2, we used the universe of block groups for which there are valid data (i.e., non-missing data) for all four measures shown. However, the results were the same when we include all block groups with valid data for each measure on an individual basis.

⁸ The results were qualitatively similar when we compared 2014 emissions to 2012 emissions. That is, the median and mean for each industry sector were in the same direction as shown in Figure 4 (above, near, or below zero), with one major exception: electricity generators on average decreased their emitter covered emissions in 2014 relative to 2012.

⁹ California GHG Emission Inventory, 2016 Edition, http://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2014/ghg_inventory_trends_00-14_20160617.pdf.

¹⁰ Some have critiqued the appropriateness of forestry projects for carbon offset purposes. For example, tree planting projects can take decades to reach maturity in terms of their ability to sequester carbon. Younger trees sequester less carbon and often take decades to fully mature. Moreover, it is challenging to measure and quantify the ability of forestry projects to sequester carbon over time. In particular, the permanence of forestry projects cannot be guaranteed as they remain susceptible to fire, disease, natural decay, clearing, or mismanagement. Forestry projects are also vulnerable to "leakage." This refers to the fact that, unless global demand for wood products goes down, a reduction in logging in one location can simply result in greater deforestation in another location. (See http://www.ipcc.ch/ipccreports/sres/land_use/index.php?idp=0 and <http://www.web.uvic.ca/~repa/publications/REPA%20working%20papers/WorkingPaper2007-02.pdf> for overviews of these issues.)

¹¹ <https://www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/2014-ghg-emissions-2015-11-04.xlsx>

¹² http://www.arb.ca.gov/ei/tools/ghg_visualization/

¹³ https://www.census.gov/geo/maps-data/data/cbf/cbf_blkgrp.html

¹⁴ <http://oehha.ca.gov/calenviroscreen/report/calenviroscreen-version-20>

¹⁵ <http://www.arb.ca.gov/cc/capandtrade/allowanceallocation/publicallocation.htm>;

<http://www.arb.ca.gov/cc/capandtrade/allowanceallocation/edu-ng-allowancedistribution/electricity-allocation.pdf>;

<http://www.arb.ca.gov/cc/capandtrade/stateauction.htm>

¹⁶ <http://www.arb.ca.gov/cc/capandtrade/2013-2014compliance/2013-2014compliancereport.xlsx>

¹⁷ http://www.arb.ca.gov/cc/capandtrade/offsets/issuance/arb_offset_credit_issuance_table.pdf

¹⁸ <http://americancarbonregistry.org>; <http://www.climateactionreserve.org>

¹⁹ 66 GHG facilities fell in the top third in terms of both PM₁₀ and localized GHG emissions. We found that 40 of these facilities increased localized GHG emissions, 23 decreased emissions, and three did not report to the database all four years (2011-2014) so we could not determine an increase or decrease.

Exhibit 2



Feature

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How California's carbon market actually works

Danny Cullenward

Abstract

Almost 10 years ago, California's legislature passed Assembly Bill 32, the Global Warming Solutions Act of 2006. AB 32 set the most ambitious legally binding climate policy in the United States, requiring that California's greenhouse gas emissions return to 1990 levels by the year 2020. The centerpiece of the state's efforts—in rhetorical terms, if not practical ones—is a comprehensive carbon market, which California's leaders promote as a model policy for controlling carbon pollution. Over the course of the past 18 months, however, California quietly changed its approach to a critical rule affecting the carbon market's integrity. Under the new rule, utilities are rewarded for swapping contracts on the Western electricity grid, without actually reducing greenhouse gas emissions to the atmosphere. Now that the Environmental Protection Agency is preparing to regulate greenhouse gases from power plants, many are looking to the Golden State for best climate policy practices. On that score, California's experience offers cautionary insights into the challenges of using carbon markets to reduce greenhouse gas emissions.

Keywords

California, cap-and-trade, carbon market, climate policy, emissions, leakage, resource shuffling

For years, Southern California Edison imported electricity from the Four Corners Power Plant, a coal-fired facility in northwestern New Mexico. When California's groundbreaking carbon market took effect in 2013, Edison, like all other in-state utilities, became responsible for the climate pollution from its generating fleet. A few months later, the company sold its interest in the coal plant to an Arizona utility (APS, 2013). Whatever replacement supplies Edison selects will be cleaner than coal, the most carbon-intensive fossil fuel, and Edison will

report reduced emissions in California's carbon market.

At first this sounds like a positive story: Policy puts price on carbon, pollution falls. But this transaction will not reduce net greenhouse gas emissions to the atmosphere. The coal plant will keep emitting pollution just as before—only now it serves customers in Arizona, not California.

As it has with many other environmental issues before, California aims to set an example for the United States on climate policy. The key to its success, according to state officials, is a

comprehensive carbon market—featuring “good policy design, clear oversight and strong enforcement” (Nichols, 2014). Ironically, one of the most visible consequences of the market’s first year is a rush to swap coal power imports for cleaner replacements, limiting the extent to which California’s policy leadership actually helps the climate. Is this perverse outcome the unavoidable consequence of California acting without its neighbors’ support, or could the state have done more to ensure that its market creates real environmental benefits?

An efficient theory

The slow birth of American climate policy coincides with a transition in the way our country manages its environmental problems. Most of our national environmental laws were drafted at a time when both political parties supported government regulation of the private sector. That was, of course, a different era. Since then, the center of national political opinion has shifted dramatically in favor of the free market. And that trend is visible in contemporary environmental policy, which, over the last few decades, has moved away from traditional regulatory approaches to controlling pollution. Flexible, market-based mechanisms are now the preferred route.

The thinking goes something like this: Rather than impose specific requirements on individual companies or industries, it is more efficient for the government to set economy-wide policy targets and let the private sector find the cheapest way to meet them. In theory, this not only increases the flexibility of regulated industries’ compliance options but also reduces the policy’s

administrative complexity. Thus, if done right, economic approaches to environmental policy should result in a win-win.

Enter a uniquely American invention, the carbon market—also known as emissions trading or cap-and-trade.¹ The idea is simple, though the practice is not. Economic theory says that all a government needs to do is: set a quantitative cap on emissions; create and freely distribute or auction emissions permits, with the total number of permits equal to the cap; and require polluters to turn in a permit for each unit of pollution they emit. With this framework in place, the government steps back to let the private sector do what it does best: trade permits to minimize costs.

The most critical component of a carbon market is the cap. Typically, the cap is expressed as a maximum quantity of emissions allowed in any given year, with each year’s limit declining toward a long-term goal. Think of it like a game of musical chairs—with carbon pollution as the players, and the chairs representing emissions permits. At the end of every year, the music stops and the players must seat themselves. When there are more people than chairs, market forces dictate who leaves the game and who can stay; the government’s role in this analogy is only to set up the rules and remove the correct number of chairs at each stage. So long as the government counts the right number of chairs, everything should work out fine.

California’s climate policy

After the United States withdrew from the Kyoto Protocol and elected George W. Bush, whose administration strongly opposed legally binding federal climate

policy, momentum shifted to the states. California moved to claim its traditional role as an environmental policy leader by passing AB 32, the Global Warming Solutions Act of 2006. Most notably, this bill requires California's emissions to fall to 1990 levels by the year 2020. AB 32 also designated a primary regulator, the California Air Resources Board (CARB), making CARB responsible for developing specific policies and measures that would lead California to its 2020 target.

The key to understanding California's climate policy system lies in recognizing the overlapping structure of the instruments that CARB and other agencies eventually adopted. Arguably the state's best-known climate policy is its comprehensive carbon market, which CARB designed and implements. At the same time, California has a number of robust regulatory programs that apply to sectors that are also covered by the carbon market. For example, California has one of the strongest renewable portfolio standards (requiring utilities to purchase 33 percent of their electricity from renewable sources by 2020), as well as world-class energy efficiency programs and a clean transportation fuels policy.

Climate experts refer to these programs as "complementary policies"—a phrasing that suggests they exist to support the primary instrument, a carbon market. In practice, however, the complementary policies do most of the work. When CARB created its plan for meeting California's 2020 emissions target, it relied on complementary policies for approximately 80 percent of the reductions, leaving a mere 20 percent to "additional reductions" in the sectors covered by the state carbon market (CARB, 2008)—meaning that most of the emissions reductions are being

accomplished by individual policies, not driven by the comprehensive market price on carbon. As my colleague Michael Wara (2014) explains elsewhere in this issue, the complementary policies effectively hide the true cost of California's climate policy: Because most of the necessary emissions reductions are required by separate regulation, rather than left to the carbon market, the carbon price reflects only a fraction of the state's climate policy efforts.²

California's market design

California benefits from the experience of the emissions trading systems that came before it. By carefully observing the early years of the European Union's Emissions Trading Scheme (ETS), for example, CARB was able to avoid many of the hiccups that confronted its predecessors. These successes are all the more laudable because California has implemented the most comprehensive market to date. While the northeastern states' Regional Greenhouse Gas Initiative controls only emissions from power plants, California's market currently covers the power and industrial sectors (as does the European ETS), and will expand next year to include the transportation fuels and natural gas sectors. All told, this will encompass about 85 percent of the state's total emissions—a comprehensive policy by any standard.

On the other hand, California faces many new challenges that previous markets never had to address. In particular, the state must contend with the fact that it is only a small part of a regional electricity transmission grid stretching from the Pacific Ocean to the Rocky Mountains. The scale of the Western grid matters because California is a

significant net importer of electricity. Recognizing that the emissions profile of its electricity imports is part of California's carbon footprint, regulators rightly included electricity imports in the cap-and-trade program. But geography introduced new headaches. Because California is the only western state that prices its greenhouse gas emissions, utilities and power traders now face an incentive to swap their high-emitting imports for cleaner replacements—a practice known as resource shuffling. (Recall the earlier example of Southern California Edison divesting its interest in a New Mexico-based coal power plant: Emissions reported in California go down, but emissions across the western United States do not change.)

If utilities are allowed to shuffle electric power imports, the emissions reductions they report in California's carbon market will not reflect reduced emissions to the atmosphere. Instead, the dirty resources California utilities divest will continue polluting the air under new, unregulated ownership. Given this dilemma, what should carbon market regulators do?³

A quiet coup

As it happens, the California Legislature anticipated these concerns. When the legislature delegated broad authority to CARB to create climate policy, it also issued guidelines that the regulator must incorporate in its policies. Specifically, state law requires that “to the extent feasible,” climate regulations must “minimize leakage.”⁴ California law defines leakage as “a reduction in emissions of greenhouse gases within the state that is offset by an increase in emissions of greenhouse gases outside the state.”⁵

In plain English, this requirement means that CARB should not give credit to actions that merely shift the responsibility for greenhouse gas emissions beyond state borders. Instead, AB 32 dictates that CARB should only recognize net reductions in emissions to the atmosphere. For a time, CARB followed this instruction. Its initial carbon market regulations banned resource shuffling, and went so far as to require companies' executives to attest that they were not engaged in this practice.⁶

But this approach proved controversial. In the months leading up to the beginning of the market's first compliance period, several stakeholders objected to the resource shuffling rules and began agitating for reforms. The first public proposal came from California's investor-owned utilities, which in September 2012 advocated a series of exemptions to the prohibition on resource shuffling (Joint Utilities Group, 2012). The following month, CARB directed its staff to develop modifications to the resource shuffling regulations, providing 13 fully developed “safe harbor” exemptions to the definition of resource shuffling (CARB, 2012a)—directly comparable to, if not more permissive than, the Joint Utilities Group proposal. A few weeks later, CARB staff released a new regulatory guidance document that incorporated these safe harbors, almost word for word (CARB, 2012b).

When a regulator issues a guidance document that publicly describes how to interpret its rules, that description provides a legal defense to any private party that reasonably relies upon it. After all, it would be extremely unfair if following the regulator's own advice could get one in legal trouble. But consider what this meant for the carbon

market. On the eve of the program's launch in January 2013, the regulator quietly rewrote its own rules through informal guidance documents. Formally, its regulations prohibited resource shuffling. Yet CARB's own guidance document indicated that this straightforward prohibition would not apply to 13 broad categories of transactions. Thus, when the market began operation in 2013, its practical function had already diverged from its formal legal rules.

The market springs a leak

My colleague David Weiskopf and I had been studying CARB's resource shuffling rules during this tumultuous time. We recognized that CARB faced an incredibly difficult task in writing effective and legally permissible cross-border accounting rules, yet we were surprised at the scope of CARB's informal guidance document. We believed that a compromise was possible, to give utilities clear and flexible rules without undermining the environmental integrity of the market.

Meanwhile, we were deeply concerned that the informal guidance document effectively revoked the prohibition on resource shuffling. We published our analysis of the safe harbors and the leakage risks they created in July 2013 (Cullenward and Weiskopf, 2013). Most important, we described how several of the safe harbors were broader than the underlying prohibition. In addition, we pointed out that two safe harbors explicitly allowed California utilities to divest their long-term contracts with out-of-state coal power plants.

As it happens, these coal power imports account for a significant portion of California's emissions. We calculated that if California utilities relied on the

safe harbors to divest from just six coal power plants, they could cause between 108 and 187 million tons of carbon dioxide to leak out of California's market—a quantity that is roughly equivalent to the expected size of the market, after accounting for the likely impact of the complementary policies. Furthermore, we realized that our analysis was consistent with calculations from CARB's own economic advisory committee, called EMAC, which found that resource shuffling of all types could lead to leakage of between 120 and 360 million tons of carbon dioxide (Borenstein et al., 2013). (The EMAC report did not assess whether the safe harbors would enable leakage; it looked only at what the effects of resource shuffling would be if there were no prohibition against it.)

In addition to presenting our concerns, we also developed a complete regulatory text to implement an alternative approach to controlling resource shuffling. Even if our suggestions could have been helpful, they probably arrived too late. That same month, CARB hosted a workshop to consider draft regulatory amendments that would codify the safe harbors into law. As it became clear that CARB would proceed without any public acknowledgment of the leakage problem, I wrote an op-ed in the *San Jose Mercury News* raising the issues described here (Cullenward, 2013a), as well as two comment letters addressing the technical and legal questions in the formal administrative process (Cullenward, 2013b, 2014a).

Over the following months, three of the six coal power plants that Weiskopf and I identified became involved in resource-shuffling-related transactions, leaking between 30 and 60 million tons of carbon dioxide out of California's carbon market (Cullenward, 2014b).

Two of these contracts have already left the regulatory system, while a third—under which the Los Angeles utility LADWP imports power from the coal-fired Navajo Generating Station on tribal lands in Arizona—is on its way out. In a regulatory filing connected with its purchase of replacement power, LADWP even disclosed that a benefit of divestment from the Navajo Generating Station would be “relieving LADWP from having to purchase emission credits” in the carbon market (LADWP, 2013: 3). Yet, as I pointed out in my second comment letter to CARB (Cullenward, 2014a), there is little doubt that the utility’s divestment plan fits squarely in one or more of the safe harbors, and therefore does not violate CARB’s guidance. By the time CARB unanimously voted to approve its new regulations, it had substantial evidence that its safe harbors were facilitating significant leakage—despite AB 32’s clear requirements to the contrary.

A weak cap

What does leakage mean for California’s climate policy? First and foremost, it means the “cap” in cap-and-trade is much less than it seems.

Return for a minute to the analogy of carbon markets as a game of musical chairs. Earlier, I suggested that so long as the government sets out the right number of chairs (a shrinking supply of emissions permits), the game should run smoothly. But resource shuffling essentially allows players to leave the game—say, by offering them an open spot on a comfortable couch in a nearby room. If resource shuffling is allowed, counting the number of chairs no longer provides reliable information about the environmental performance of the system.

And that’s the major flaw in California’s system. Now that resource shuffling is happening, we know that California’s supposed reductions reflect bad bookkeeping, because the market cap is no longer firm. If the remaining coal power imports leave the carbon market, or if utilities take full advantage of the other safe-harbor provisions, a significant majority of the market’s apparent emissions reductions will be attributable to leakage, not progress.

Although the market is no longer producing the net emissions reductions for which it was designed, it does have other, positive impacts. Notably, it sets a minimum price, which was \$11.34 per metric ton of carbon dioxide in July 2014. The price had previously ranged from approximately \$13 to \$20 per ton, but began a steady decline in approximately July 2013. As this article went to press, it rested slightly above the price floor, as can be seen at the California Carbon Dashboard website (<http://calcarbon-dash.org>). These data show that an oversupply of emissions permits—caused in no small part by reduced demand due to resource shuffling—has crashed the market price down to its legal minimum.

Curiously, so long as these conditions persist, the market actually looks like a carbon tax. In other words, after years of complex negotiations, emissions trading, and hundreds of pages of market rules, California’s market operates much like the carbon tax (or “fee”) policies preferred by both moderate Republicans (Paulson, 2014; Shultz and Becker, 2013) and grassroots environmentalists (Citizens’ Climate Lobby, 2014)—only without the transparency and accountability mechanisms that motivate many of these advocates’ positions.⁷ Perhaps simplicity is a virtue in climate policy after all.

In all fairness, California has managed to create the highest price on carbon pollution in the United States. It also has robust energy policies that are encouraging the expanded use of clean and efficient resources. These are all significant accomplishments, but the carbon price is still too low to do much good. We know it is lower than the actual cost of California's clean energy policies—for example, CARB reports that California's clean fuels policy credits were trading between \$63 and \$79 per metric ton of carbon dioxide during the last three months of 2013 (CARB, 2014), well above the carbon market price—and therefore the carbon market is not driving compliance in those sectors. In any case, the market price is certainly lower than the levels needed for the long-term transformation of the energy system.

A cautionary tale

Can anything be done about the failure of California's flagship carbon market to live up to expectations? Yes, but the political challenges are far greater than the technical issues. At this point, there is only one solution that can preserve the market's integrity: CARB must observe the leakage that results from its permissive resource shuffling rules, then tighten the overall market cap accordingly. (In my musical chairs analogy, this means removing a chair for every person who leaves the game before the music stops.) But acknowledging and resolving the problem will likely increase the carbon market price, and hence political opposition.

Some stakeholders prefer to place hope in new developments in state and federal climate policy. They argue that resource shuffling will be less of a problem if enough of California's neighbors

adopt their own climate regulations. For example, the leaders of California, Oregon, Washington, and British Columbia signed an agreement to harmonize their approach to climate policy (Center for Climate and Energy Solutions, 2013). There is little chance, however, of a similar agreement with southwestern states, where most of California's legacy coal power imports originate. Waiting for the Environmental Protection Agency to act isn't an option, either. Assuming that the EPA's proposed rules are finalized and survive intense litigation, they won't produce results until after 2020, the current end date for California's legally binding market. (Moreover, the proposed federal rules do not apply to tribal lands, yet two of the three coal-fired power plants that have already leaked from California's market are located in Navajo territory.) Thus, the prospects for California's neighbors to independently resolve this problem are dim.

Even if CARB fails to address the leakage issue, California's experience offers useful insights into the politics of climate policy—though the precise lessons depend on one's point of view. The optimistic perspective looks something like this: Perhaps the flaws in the current plan reflect realistic concessions on the road to deep, long-term emissions reductions. (State policy makers are currently discussing how to set a goal for 2030 and have a nonbinding aspirational target of reducing emissions 80 percent below 1990 levels by 2050.) Even the most proactive government officials have to navigate a maze of political obstacles, technically complex issues, and the constant threat of litigation—especially when working on controversial issues such as climate policy, which challenges powerful established interests.

Sometimes policy makers make mistakes, and sometimes they make compromises. Whatever the case here, the good news is that a state can only rely on leakage once: After the high-emitting resources are gone, there are no more opportunities for resource shuffling. Instead of fighting over complex market rules, climate policy makers should focus on raising the minimum market price in future reforms. Their critics should remember that the complementary policies are unaffected by a weak market cap.

Taking a less optimistic perspective, one might question the credibility of the market regulators. At the end of the day, CARB let the utilities write their own rules. Whether CARB intended to rely on leakage to artificially lower the market price, or simply didn't understand what its economic advisers were saying about the probable consequences of these reforms, it deferred to the industry it was charged with regulating. Political realists who worry about costs should also be concerned with the environmental performance of policy instruments designed to keep costs low; California will need these policies to work if it is to achieve long-term climate targets. Equally important is consistency with the rule of law, which will be necessary to strengthen climate policy over the coming decades. From this perspective, relying on questionable accounting tricks is hardly the mark of a strong regulator that is prepared to impose tough rules for 2030 and beyond.

If there is a broader lesson in California's experience, it is this: The political and technical challenges of implementing climate policy are greater than most people appreciate—even within the expert community, which tends to view

carbon markets as both eminently tractable (Newell et al., 2014) and politically expedient (Stavins, 2014). It is not enough to pass legislation or propose new regulations. Indeed, that is only the beginning.

Acknowledgements

Thanks to Jonathan Koomey, Michael Wara, and David Weiskopf for their feedback and insights. Any errors and all opinions are my own.

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Notes

1. Many people incorrectly think of the carbon market as a European invention because the European Union was the first to apply it to climate policy. Europe did create the world's largest carbon market, the EU Emissions Trading Scheme, as part of its Kyoto Protocol obligations (Ellerman et al., 2007). Nevertheless, emissions trading actually got its start in the United States. For example, the US Environmental Protection Agency developed cap-and-trade markets to control lead in gasoline in the 1980s (Stavins, 2014) and for sulfur dioxide pollution from power plants in the 1990s (Ellerman et al., 2000).
2. This is not to say that California's climate policy is too expensive. My point is merely that the apparent cost observed in the carbon market is significantly lower than the true cost.
3. This challenge is not unique to California; it applies to nearly all sub-national carbon markets, including the Regional Greenhouse Gas Initiative and the pilot programs in China (Cullenward and Wara, 2014). So long as the carbon market is smaller than the region's electricity market, cross-border accounting issues will be present.
4. See California Health and Safety Code (2014: §§ 35852(b), (b)(8)).

5. See Legislative Counsel of California (2014: § 38505(j)).
6. See California Code of Regulations (2014: § 95852(b)(2)). The attestation requirement was suspended soon after adoption and recently repealed in its entirety.
7. Although advocates of these policies use different terminologies, they share the common goal of putting a price on emissions—for all practical purposes, a tax. But framing matters in politics. Citizens' Climate Lobby eschews "tax" and prefers "fee and dividend," returning all revenue back to households. Shultz and Becker promote a "revenue-neutral carbon tax," which they distinguish from other taxes by requiring that all revenues be returned to individual (and potentially corporate) taxpayers. Finally, others, like Paulson, refer simply to a carbon tax, without specifying how the revenue would be used.

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Author biography

Danny Cullenward is the inaugural Philomathia Research Fellow at the Berkeley Energy and Climate Institute (BECI) at the University of California, Berkeley, USA. An energy economist and lawyer by training, his work focuses on the design and implementation of science-based climate policy. Cullenward has been working on carbon markets for 10 years. In 2013, he represented climate scientists before the Ninth Circuit, successfully defending the constitutionality of California's climate policy. He holds a PhD in Environment & Resources (E-IPER) from Stanford University and a JD from Stanford Law School.

Exhibit 3

From: [Chang, Edie@ARB](mailto:Chang_Edie@ARB)
To: [Brent Newell](mailto:Brent_Newell)
Subject: RE: C&T Adaptive Management Plan
Date: Wednesday, August 19, 2015 6:08:21 PM

Hi Brent – we don't release information about transactions within the C&T program because that information is considered market sensitive. There is information posted on our website about allowance allocation (<http://www.arb.ca.gov/cc/capandtrade/allowanceallocation/v2015allocation.pdf>) and auction participation (http://www.arb.ca.gov/cc/capandtrade/auction/may-2015/summary_results_report.pdf and http://www.arb.ca.gov/cc/capandtrade/auction/may-2015/ca_proceeds_report.pdf).

As I mentioned in my note, we're going to starting some outreach in the fall on AM. We've haven't taken actions on adaptive management to date.

Thanks,
Edie

From: Brent Newell [mailto:bnewell@crpe-ej.org]
Sent: Tuesday, August 18, 2015 5:28 AM
To: Chang, Edie@ARB
Subject: RE: C&T Adaptive Management Plan

Edie,

Please send me information (1) on where facilities obtained their allowances/offsets for the 2013 compliance event; and (2) any actions ARB has taken pursuant to the Adaptive Management Plan in response to the 2013 compliance event.

Thanks!

PLEASE NOTE OUR NEW ADDRESS

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From: Chang, Edie@ARB [<mailto:edie.chang@arb.ca.gov>]

Sent: Friday, August 14, 2015 10:26 AM

To: Brent Newell

Subject: RE: C&T Adaptive Management Plan

Hi Brent – I've attached links to the cap and trade data that is available.

Reported and verified GHG emissions data is available here. The latest data posted is 2013. We will be posting the 2014 data in November. We've been collecting data under the reporting reg since 2008 and I think it's available on that website. <http://www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/ghg-reports.htm>

We have had one compliance event so far - in November of 2014. At that time, entities were required to submit allowances to cover 30% of their 2013 emissions. This is the report from that compliance event. You can see how many compliance instruments (allowances and offset) each entity submitted and also what offsets were used. Our next compliance event is November 2015 at which time allowances to cover the remaining 70% of 2013 emissions and 100% of 2014 emissions will be due. We will post a similar report after that compliance event. <http://www.arb.ca.gov/cc/capandtrade/2013complianceeventreport.xlsx>

This is a report that shows the total compliance instruments that have been issued.

<http://www.arb.ca.gov/cc/capandtrade/complianceinstrumentreport.xlsx>

We're continuing to work on our adaptive management plan and will be starting some outreach in the fall. Let me know if you have any questions,

Edie

From: Brent Newell [<mailto:bnewell@crpe-ej.org>]

Sent: Thursday, August 13, 2015 3:39 PM

To: Chang, Edie@ARB

Subject: C&T Adaptive Management Plan

Edie,

I hope all is well. On the CAA 111(d) call in July you mentioned that ARB had analyzed cap and trade program data for 2013 as part of the Adaptive Management Plan. I would like to receive that data,

especially data that shows how each source met its compliance obligation (e.g. through surrendering allowances, buying offsets, etc.). I'd also like to receive source specific emissions data to understand how each source has increased or decreased its emissions under cap and trade.

Please advise.

Thanks,
Brent

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Exhibit 4

Tracking and Evaluation of Benefits and Impacts of
Greenhouse Gas Limits in Disadvantaged Communities:
Initial Report

Office of Environmental Health Hazard Assessment

California Environmental Protection Agency

February 2017



OEHHA
SCIENCE FOR A HEALTHY CALIFORNIA

Preface

This report has been prepared in response to a directive issued by Governor Brown for an analysis of the state's response to climate change under the Global Warming Solutions Act of 2006 (AB 32). Specifically, the directive calls for the Office of Environmental Health Hazard Assessment (OEHHA) to prepare a report analyzing the benefits and impacts of the greenhouse gas emissions limits adopted by the California Air Resources Board (ARB) within disadvantaged communities. OEHHA is to update the report at least every three years.

The state's climate policies (e.g., Cap-and-Trade, zero emissions vehicles, renewable energy, low carbon fuel standard) are reducing greenhouse gas emissions statewide as well as contributing to reductions in other pollutants. This report is the first step in an investigation of whether the design and implementation of these climate policies are facilitating decreases or increases in pollutants of concern in disadvantaged communities.

OEHHA's mission is to protect and enhance public health and the environment of California through the evaluation of risks posed by hazardous substances. To carry out that mission, OEHHA provides scientific assistance to the state's other environmental and health agencies on projects involving hazard identification, exposure and toxicity assessment, and health and ecological risk assessment. The mission of ARB is to promote and protect public health, welfare and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on the economy of the state.

The focus of this initial report is on large stationary sources in the Cap-and-Trade Program, one of the elements of the state's climate change programs that is aimed at gradually reducing greenhouse gas emissions from large industrial sources through a market-based mechanism. It is limited in scope, but aims to be a starting point for future analyses. Later reports will also address the benefits and impacts of other AB 32 programs to reduce greenhouse gas emissions. The report does not explore the benefits associated with investments of Cap-and-Trade auction revenue. Subsequent reports will investigate impacts such as changes in toxic air contaminants emitted by mobile sources.

This report is one of several efforts by researchers and government entities to address air-quality impacts on disadvantaged communities. Cushing *et al.* (2016) investigated the locations and pollution from large stationary sources of greenhouse gas emissions in California that are covered under the Cap-and-Trade Program. ARB continues to implement its adaptive management program to identify and track emissions increases, if any, that are attributable to implementing the Cap-and-Trade Program. AB 197 (Garcia, Statutes of 2016) directs ARB to prioritize programs to achieve direct emissions reductions from large stationary sources and

mobile sources. AB 197 also requires ARB to graphically display data on the emissions of greenhouse gases, criteria pollutants, and toxic air contaminants on its website. These efforts over time will improve our knowledge of how California's climate change programs and older, more established regulatory programs affect emissions levels of criteria and toxic pollutants, and improve our understanding of emissions changes attributable to actions taken pursuant to AB 32.

In summary, OEHHA's work here complements other efforts underway to understand potential impacts from the state's various programs to reduce greenhouse gas emissions. There are also efforts to increase access to information on stationary-source emissions for a range of pollutants. This information is expected to inform future proposals to require further reductions in emissions of criteria, toxic, and greenhouse gases from industrial sources.

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Executive Summary

In the ten years since the enactment of the California Global Warming Solutions Act of 2006 (also known as AB 32), concerns have been expressed that the state's trailblazing efforts to reduce greenhouse gas (GHG) emissions may unintentionally impact low-income communities that are already burdened by pollution from multiple sources. More specifically, the concerns are that the state's GHG-reduction programs could prompt regulated businesses to make decisions resulting in more air pollution from facilities in those communities than would otherwise be the case even while statewide GHG emissions decrease.

Conversely, California's climate-change programs also offer the potential to benefit these low-income industrial communities, to the extent that the programs prompt investments by regulated businesses that reduce emissions of both GHGs and conventional air pollutants in the communities where they operate.

In December 2015, Governor Brown directed the Office of Environmental Health Hazard Assessment (OEHHA) to analyze possible benefits and impacts to communities identified as disadvantaged under SB 535 (De León, Chapter 830, Statutes of 2012) from the GHG-emissions limit adopted by the California Air Resources Board. These benefits and impacts include changes in emissions of GHGs, toxic air contaminants, and criteria air pollutants.

This is an initial report that provides the starting point for future, more comprehensive analyses of the impacts on disadvantaged communities of GHG-emission limits. As discussed below and in the body of the report, the emissions data available at this time do not allow for a conclusive analysis. This report makes some preliminary findings that OEHHA expects to build upon in future analyses as it acquires and evaluates more data. It does not provide definitive findings regarding the effects of the GHG limit on any individual community, or disadvantaged communities in general.

The focus of this first report is on one specific AB 32 program, the state's Cap-and-Trade Program. This program regulates facilities that produce a significant fraction of the state's GHG emissions, as well as toxic co-pollutants. There are adequate data available from the Cap-and-Trade Program to begin an evaluation of potential benefits and impacts from changes in emissions. Other GHG reduction programs will be covered in later report as more data related to these programs become available.

In time, the analysis of the Cap-and-Trade Program aims to address the following key questions:

- *How do emissions of GHGs relate to emissions of toxic air contaminants and criteria air pollutants from the same facility?*

- *Are emissions disproportionately occurring in SB 535 disadvantaged communities? Do disadvantaged communities benefit from or are they negatively impacted by changes in GHG emissions from facilities subject to Cap-and-Trade?*
- *Are the benefits and impacts due to the design of the Cap-and-Trade Program?*

While challenges described in this report preclude definitive answers to these questions, OEHHA’s initial analysis in this report makes the following findings:

1. A disproportionate number of facilities subject to the Cap-and-Trade Program are located in SB 535 disadvantaged communities. The Cap-and-Trade Program covers several hundred facilities from different industrial sectors that are located across the state. Of the 281 facilities with street addresses that could be geocoded, more than half (57 percent) are located in or within one-half mile of an SB 535 disadvantaged community¹. More specifically, 15 of 20 refineries (75 percent), 5 of 7 hydrogen plants (71 percent) and 72 of the 110 facilities classified by ARB as “other combustion source” facilities (65 percent) are located in or within one-half mile of a disadvantaged community. While people’s actual exposures to toxic co-pollutants emitted from these facilities would depend on various factors such as meteorological conditions and smokestack heights, changes in co-pollutant emissions resulting from the Cap-and-Trade Program would nonetheless tend to have disproportionate benefits (if emissions decrease) or adverse impacts (if emissions increase) on disadvantaged communities because of their proximity to these facilities.
2. There were moderate correlations between GHG emissions and the emissions of criteria air pollutants. The strongest correlation was with fine particulate matter emissions (PM_{2.5}). There was also moderate correlation between GHG and toxic chemical emissions across the entire set of Cap-and-Trade facilities with covered emissions. Some individual industrial sectors showed greater correlations between emissions of GHGs and toxic co-pollutants. Refineries overall showed a strong correlation, while cement plants showed a moderate correlation. Oil and gas production facilities also showed a moderate correlation, depending on the statistical measure used. Facilities in certain sectors with broad ranges in emissions levels (e.g. electricity generation facilities) showed increased correlation with a specific statistical analysis (logarithmic transformation). This report only looked at emissions from one recent year (2014), however, because this was the only year for which air toxics data could be obtained in time for this analysis.

¹ Identified in 2014. More on the identification of these communities can be found on CalEPA’s website at the following URL: <http://calepa.ca.gov/EnvJustice/GHGInvest/>.

3. OEHHA also conducted a more detailed case study of nine cement plants and 19 refineries. These facilities have relatively high toxicity-weighted emissions, and data for the years 2011-2014 were available. The different plants showed varying levels of correlation among GHG, toxicity-weighted emissions, and PM2.5 emissions during the four-year period. Several cement facilities showed modest positive correlations between GHG and toxicity-weighted emissions, while two cement facilities showed poorer correlations. For refineries, there generally was a positive correlation between GHG and toxicity-weighted air emissions. Facilities with high levels of GHG emissions generally had higher PM2.5 and toxicity-weighted emissions. There were some differences among individual refineries in the relationships between GHGs, toxicity-weighted and PM2.5 emissions, perhaps reflecting differences in the kinds of products made at each of the refineries.
4. These results indicate that the relationship between GHGs and other pollutant emissions is complex. GHG facilities that emit higher levels of GHGs tend to have higher emissions of toxic air contaminants and criteria air pollutants. There is a need for additional investigation into the factors that drive emission changes, how GHG emission reductions are likely to be achieved in different industrial sectors, and what that may mean for concomitant changes in emissions of toxic air pollutants. Nonetheless, these analyses suggest that reductions in greenhouse gas emissions are likely to result in lower pollutant exposures in disadvantaged communities, based overall on the positive correlations observed for the 2014 data.

Limited data availability prevented OEHHA from conducting a more comprehensive analysis in time for this report. The Cap-and-Trade Program is a relatively new program, with the first auction of emissions instruments occurring in 2012. In 2013-2014, the program covered large industrial sources and electricity generation. In 2015, the program expanded to cover emissions from combustion of gasoline and diesel, as well as natural gas use in commercial and residential applications. In these early days of the program, it is hard to discern trends and make firm conclusions regarding patterns of changes in GHG emissions resulting from the program.

Further, data are not yet available to broadly cover emissions of toxic air pollutants from all facilities subject to the Cap-and-Trade Program. Data on emissions of GHGs, criteria air pollutants and toxic air pollutants are collected by multiple entities under different programs and statutory mandates. To date, there is no co-reporting of GHG and toxic emissions, and differences in reporting requirements across regulatory programs complicates data analysis. OEHHA will continue to acquire and analyze data for future reports, which will build upon the initial findings presented in this report.

In addition, toxic emissions data for many facilities are only updated every four years, further limiting conclusions that can be reached. OEHHA currently only has a limited set of data to examine changes in emissions that would illuminate statewide patterns, especially with respect to disadvantaged communities. A further complexity for the analysis is that the relationships between GHG and co-pollutant emissions vary across different industrial sectors (and even within facilities within a sector) with the differences in fuel types and sources, industrial processes and chemical feedstocks.

Therefore, at this point in time, when the program is still new, OEHHA cannot make definitive conclusions regarding changes in emissions due to the Cap-and-Trade Program that may disproportionately affect disadvantaged communities. OEHHA expects with time the picture will become clearer. As the program continues to generate data over the next several years, it will be easier to detect and evaluate emissions trends. OEHHA intends to update the analysis in subsequent reports as additional types of data and years of data emerge. Co-reporting of high quality data on criteria, air-toxic and GHG emissions for the facilities subject to the Cap-and-Trade Program would substantially aid the investigation of emissions impacts.

In future reports, OEHHA also plans to expand the analysis to cover AB 32 programs in addition to the Cap-and-Trade Program. It will be important to evaluate the Cap-and-Trade Program in concert with other climate policies to gauge how the entire climate change program in aggregate may impact or benefit individual disadvantaged communities and as a whole. Examination of emissions changes in the transportation sector resulting from the large and varied AB 32 programs affecting it will be an important part of this more comprehensive evaluation.

I Introduction

In the ten years since the enactment of the California Global Warming Solutions Act of 2006 (also known as AB 32), concerns have been expressed that the state's trailblazing efforts to reduce greenhouse gas (GHG) emissions may unintentionally impact low-income communities that are already burdened by pollution from multiple sources. A concern is that the state's GHG-reduction programs could prompt regulated businesses to make decisions resulting in higher emissions of conventional air pollutants at facilities in those communities than would otherwise be the case even while statewide GHG emissions decrease.

Conversely, California's climate-change programs also offer the potential to benefit these low-income industrial communities, to the extent that the programs prompt investments by regulated businesses that reduce emissions of both GHGs and conventional air pollutants in the communities where they operate.

In December 2015, Governor Brown directed the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA) to analyze and periodically report on the impacts and benefits on disadvantaged communities related to the state's emission controls to mitigate climate change:

"I am directing that the Office of Environmental Health Hazard Assessment (OEHHA) prepare by December 1, 2016, a report analyzing the benefits and impacts of the greenhouse gas emissions limits adopted by the State Air Resources Board pursuant to Division 25.5 (commencing with Section 38500) of the Health and Safety Code within disadvantaged communities described in Health and Safety Code Section 39711. The report shall be made available to the public and the Legislature. OEHHA shall update the report at least every three years.

The report, at a minimum, shall track and evaluate (a) greenhouse gas emissions, criteria air pollutants, toxic air contaminants, short-lived climate pollutants, and other pollutant emission levels in disadvantaged communities; and (b) public health and other environmental health exposure indicators related to air pollutants in disadvantaged communities."

This report is the initial response to this directive. OEHHA has examined readily available information to evaluate possible analytical approaches, and has conducted an initial analysis of one major activity to reduce greenhouse gas (GHG) emissions – the Cap-and-Trade Program. The California Air Resources Board (ARB) established this program in regulation² pursuant to

² Originally adopted in 2011. The current Cap-and-Trade regulation can be found at the following URL: <https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm>.

Health and Safety Code Section 38500 enacted by Assembly Bill (AB) 32 (Núñez, Statutes of 2006), also known as the Global Warming Solutions Act of 2006).

Under the Cap-and-Trade Program, ARB applies a statewide cap on GHG emissions from a number of entities that are responsible for emissions of GHGs. The covered entities represent a variety of industrial sectors. These include electricity generators, food processors, other industrial facilities that burn large quantities of fossil fuels, as well as mobile sources. Facilities are required to surrender state-issued emission allowances and emission offset credits equal to their reported and verified GHG emissions. Over time, the aggregate cap (the total amount of GHG emissions allowed from all covered facilities declines). The regulation provides flexibility in how covered GHG emitters may comply with the overall emissions cap, allowing them to seek the least costly options. Reductions of GHGs may have the added benefit of reducing emissions of toxic air contaminants, ozone-producing gases and criteria air pollutants. The varied distribution on where facilities are located across California and the flexibility of the program can mean that changes in emissions of GHGs do not occur evenly across communities.

A variety of factors in addition to the Cap-and-Trade Program can affect the amount of GHG emitted by a facility including regional or global economic trends and consumer demand, drought, facility shutdowns (e.g., the shutdown of the San Onofre Generating Station) and responses to other policies (e.g., the renewable portfolio standard for electricity generation).

While this initial report focuses on the Cap-and-Trade Program, future reports will also include assessment of other GHG emission reductions programs set in place to meet AB 32 requirements. Some of these other programs are expected to significantly benefit and possibly impact communities' exposures to co-pollutants. These analyses should prove useful for informing future decisions by the state's climate change programs, including mitigating unintended impacts and maximizing benefits from reductions of co-pollutant emissions in disadvantaged communities. However, the Cap-and-Trade Program is still relatively new, with the first auction of emissions instruments occurring in 2013. In these early days of the program, it is hard to discern trends and make firm conclusions regarding patterns of emissions resulting from the program.

This report also highlights the need for data collection practices that would be helpful in enabling ongoing tracking of changes that may be occurring across California communities from the state's efforts to address climate change.

Finally, as described later in this report, GHG, criteria and air-toxic emissions are regulated under different programs. ARB regulates GHG emissions pursuant to AB 32, while local air districts regulate criteria and air-toxic emissions from facilities through their permitting processes. Each of these programs can affect emissions levels of these three classes of

pollutants, and make evaluation of emissions of air toxic contaminants and criteria air pollutants that are attributable to the cap-and-trade program challenging.

II Scope of Analysis

This report is directed at the question of whether certain communities, especially disadvantaged communities, are positively or negatively impacted from changes in exposures to environmental pollutants as a result of regulatory responses to the statewide GHG emissions limit adopted pursuant to AB 32. The scope of the analysis is necessarily limited in this initial report because of the limited data currently available, and the relatively short period of time since the implementation of the Cap-and-Trade Program. This section describes some methods that will be used to characterize benefits and impacts of the GHG reduction program, the definition of disadvantaged communities for the analysis, and the GHG reduction program of initial focus.

Benefits and Impacts

For this report, “benefits and impacts” are changes in pollutant exposures in communities resulting from changes in response to the Cap-and-Trade Program. The directive requires that the report, at a minimum, track and evaluate “greenhouse gas emissions, criteria air pollutants, toxic air contaminants, short-lived climate pollutants, and other pollutant emission levels” in disadvantaged communities, and also track and evaluate “public health and other environmental health exposure indicators related to air pollutants” in disadvantaged communities. This report provides information on levels of GHG emissions in communities, while using indicators of levels of criteria air pollutants, toxic air contaminants and other pollutants. Later reports will also identify and track public and environmental exposures indicators as measures of benefits and impacts, and will examine the effects of other GHG reduction programs in addition to the Cap-and-Trade Program. For example, the transportation sector, which is the largest source of GHG, criteria pollutant, and toxic emissions, will be addressed in later reports.

For this first report, we investigate the following emissions in communities:

- Greenhouse gases, including non-CO₂ compounds with global warming potential
- Criteria air pollutants
- Toxic air contaminants

Disadvantaged Communities

The directive requires that benefits and impacts be analyzed within “disadvantaged communities” as described in H&SC Section 39711, established by Senate Bill (SB) 535 in 2012. SB 535 requires the California Environmental Protection Agency (CalEPA) to identify

disadvantaged communities for investment of Cap-and-Trade proceeds. These communities are to be identified based on geographic, socioeconomic, public health and environmental hazard criteria, and may include, but are not limited to, either of the following:

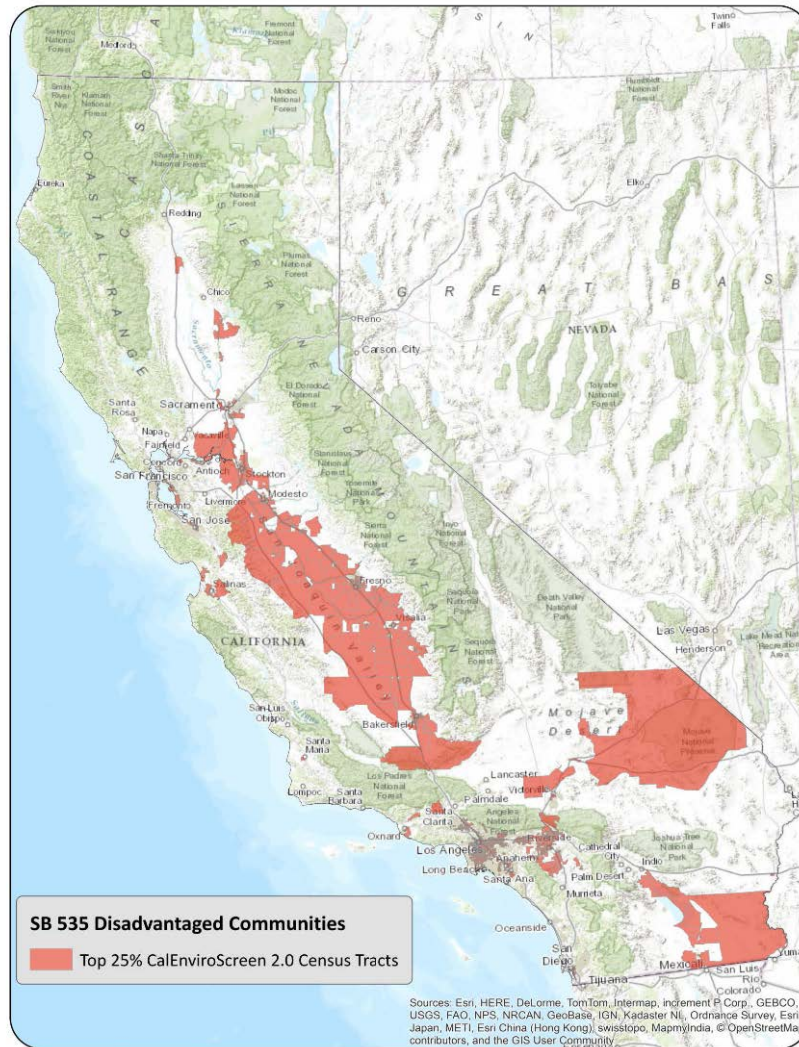
- (1) Areas disproportionately affected by environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation.
- (2) Areas with concentrations of people that are of low income, high unemployment, low levels of homeownership, high rent burden, sensitive populations, or low levels of educational attainment.

In October 2014, following a series of public workshops to gather public input, CalEPA released its list of disadvantaged communities for the purpose of SB 535. CalEPA based its list on the most disadvantaged communities identified by the California Communities Environmental Health Screening Tool (CalEnviroScreen), a tool developed by OEHHA that assesses all census tracts in California to identify areas disproportionately burdened by and vulnerable to multiple sources of pollution.

The analyses described and presented here focus on those California communities (census tracts) identified in 2014 by CalEPA as disadvantaged using Version 2.0 of the CalEnviroScreen tool.³ These communities are the highest-scoring census tracts in the state using the results of the tool, and represent about 25% of the state's population (see Figure 1 below).

³ Information on the specific communities/census tracts identified as “disadvantaged” for purposes of SB 535 can be found on CalEPA’s website at the following URL: <http://calepa.ca.gov/EnvJustice/GHGInvest/>.

Figure 1. Communities Identified as “Disadvantaged” under SB 535 (in Red) Using CalEnviroScreen Version 2.0 Results (October 2014).



OEHHA updated its statewide analysis of communities with the public release of Version 3.0 of CalEnviroScreen in January 2017. Later in the year CalEPA will make a new identification of “disadvantaged communities” that is expected to rely at least in part on the CalEnviroScreen 3.0 results. Since that new designation has yet to be made, this evaluation of the Cap-and-Trade Program utilizes CalEPA’s 2014 designation of disadvantaged communities.

Greenhouse Gas Emissions Limits Adopted by the State Air Resources Board

The directive specifically calls for OEHHA to analyze the benefits and impacts of the greenhouse gas emissions limits adopted by ARB pursuant to AB 32.

AB 32 requires California to reduce its GHG emissions to 1990 levels by 2020. This has been estimated to require a reduction of approximately 15 percent below emissions expected under a “business as usual” scenario. More recently, Senate Bill (SB) 32 (Pavley, Chapter 249, Statutes of 2016) requires ARB to ensure that GHG emissions are reduced to at least 40 percent below the 1990 statewide GHG emissions limit no later than December 31, 2030.

AB 32 requires ARB and other state agencies to adopt regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions. The goals of AB 32 are also being accomplished through a combination of policies, planning, direct regulations, market approaches, incentives, and voluntary efforts. The full implementation of AB 32 and SB 32 is expected to improve energy efficiency, expand the use of renewable energy resources, and result in cleaner transportation and reduced waste.

ARB’s *Climate Change Scoping Plan*, which is required to be updated at least once every five years, describes its strategy for meeting the GHG limits. Its 2014 *Update* described the status of the various measures to reduce GHG emissions.⁴ Table 1 below shows a number of the programs that are in place or under development.

Table 1. AB 32-Related Programs and Initiatives to Reduce GHG Emissions.

Economic Activity	Program
<i>Large Industry, Electricity Generators, Fuel Distributors</i>	<ul style="list-style-type: none"> • Cap-and-Trade Regulation • Energy Efficiency and Co-Benefits Audits for Large Industrial Sectors
<i>Transportation</i>	<ul style="list-style-type: none"> • Advanced Clean Cars • Low Carbon Fuel Standard • Regional Transportation-Related Greenhouse Gas Targets • Vehicle Efficiency Measures • Ship Electrification at Ports • Cap-and-Trade • Goods Movement Efficiency Measures • Heavy-Duty Vehicle Emission Reduction • Medium- and Heavy-Duty Vehicle Hybridization Voucher Incentive Project • High Speed Rail
<i>Electricity and Natural Gas Use</i>	<ul style="list-style-type: none"> • Building Energy Efficiency • Appliance Energy Efficiency • Utility Energy Efficiency • Solar Water Heating • Combined Heat and Power Systems • 33 Percent Renewable Portfolio Standard • Senate Bill 1, Million Solar Roofs • Cap-and-Trade

⁴ The 2014 First Update to the AB 32 Scoping Plan, including Appendix B, can be found at the following URL: <https://www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm>.

Economic Activity	Program	
<i>Water Production, Distribution, and Use</i>	<ul style="list-style-type: none"> • Water Use Efficiency • Water Recycling • Water System Energy Efficiency 	<ul style="list-style-type: none"> • Reuse Urban Runoff • Renewable Energy Production
<i>Green Buildings</i>	<ul style="list-style-type: none"> • State Green Building Initiative • Green Building Standards Code 	<ul style="list-style-type: none"> • “Beyond Code: Voluntary Programs at the Local Level” • Greening Existing Buildings
<i>Oil and Gas Extraction, Distribution, and Refining</i>	<ul style="list-style-type: none"> • Oil and Gas Extraction GHG Emission Reduction • GHG Emissions Reduction from Natural Gas Transmission and Distribution • Cap-and-Trade 	<ul style="list-style-type: none"> • Refinery Flare Recovery Process measures, consultation with air districts on amendments to rules for existing leak detection and repair at industrial facilities, including methane leaks
<i>Recycling and Waste Management</i>	<ul style="list-style-type: none"> • Landfill Methane Control Measure • Increase the Efficiency of Landfill Methane Capture • Mandatory Commercial Recycling 	<ul style="list-style-type: none"> • Increase Production and Markets for Compost and Other Organics, Anaerobic/Aerobic Digestion • Extended Producer Responsibility • Environmentally Preferable Purchasing
<i>Forestry</i>	<ul style="list-style-type: none"> • Sustainable Forest Target 	
<i>Controls on High Global Warming Potential Gases</i>	<ul style="list-style-type: none"> • Motor Vehicle Air-Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing • SF₆ Limits in Non-Utility and Non-Semiconductor Applications • Reduction of Perfluorocarbons in Semiconductor Manufacturing 	<ul style="list-style-type: none"> • Limit Use of Compounds with High Global Warming Potentials in Consumer Products • Stationary Equipment Refrigerant Management Program • SF₆ Lead Reduction Gas Insulated Switchgear

Initial Focus of AB 32 Impact and Benefit Analysis: Cap-and-Trade Program

Many of the AB 32-related GHG emission reduction programs should carry the benefit of reduced exposures to co-pollutants in affected neighborhoods. For example, energy efficiency in electrical power generation and other sectors brings reduced releases of combustion by-products; reduced gasoline use from vehicle efficiency brings lower exposure to a number of gasoline-related toxicants; and improved control of fugitive emissions from natural gas transmission and distribution can reduce benzene releases.

The breadth of activities being undertaken to reduce GHG emissions in California makes a full analysis in this first report of the overall AB 32 program infeasible given the one-year timeframe for conducting the analysis. OEHHA is therefore placing an initial focus on California’s Cap-and-Trade Program. This program has been chosen as the initial focus for the following reasons:

- GHG emissions from facilities and sources that are regulated under the Cap-and-Trade Program constitute about 85 percent of the state’s GHG emissions.⁵
- Facilities regulated under the Cap-and-Trade Program commonly emit toxic air pollutants in addition to GHGs, and the emissions of GHGs may correlate with toxic co-pollutants. Thus reductions or increases in GHGs may be accompanied by corresponding changes in toxicant emissions.
- Many of the facilities are also located in low-income communities with high non-white populations. An evaluation of this program is consistent with the directive’s intent to examine impacts in disadvantaged communities.
- Substantial data describing emissions of GHGs and toxic air contaminants by the covered entities are available.

This initial analysis will become part of a larger ongoing effort to understand the co-benefits and impacts of California’s GHG reduction programs. In future reports, OEHHA plans to expand the analysis to cover AB 32 programs in addition to the Cap-and-Trade Program.

The Cap-and-Trade Program

Upon initial implementation in 2012, the Cap-and-Trade Program covered large industrial facilities and electricity generators each annually emitting more than 25,000 metric tons of carbon dioxide equivalent (MTCO_{2e}).⁶ Distributors of transportation, natural gas, and other fuels were added to the program beginning in 2015. Presently the program covers about 450 entities.

Facilities in industrial sectors are annually allocated some free allowances to emit a portion of their GHG emissions. An allowance is a tradable permit to emit one metric ton of a CO₂-equivalent greenhouse gas emission (one MTCO_{2e}). Each allowance has a unique serial number to enable its tracking. The initial allocation of allowances for most industrial sectors was set at about 90 percent of average emissions, and was based on benchmarks that reward efficient facilities.⁷ A facility’s allocation is generally based on its production levels and is updated annually. Utilities that distribute electricity and natural gas are given free allowances whose

⁵ Overview of ARB Emissions Trading Program available at URL: https://www.arb.ca.gov/cc/capandtrade/guidance/cap_trade_overview.pdf.

⁶ Carbon dioxide (CO₂) is the primary GHG, but other chemical emissions have global warming potential, including methane (CH₄), black carbon, nitrous oxide (N₂O), and hydrofluorocarbons. Emissions of GHGs are reported as CO₂ equivalents, where emissions rates for GHGs other than CO₂ are adjusted by a multiplier. For example, the multipliers for methane and nitrous oxide are 21 and 310, respectively, indicating higher global warming potential on a mass basis (CO₂ = 1).

⁷ Overview of ARB Emissions Trading Program. Available at URL: https://www.arb.ca.gov/cc/capandtrade/guidance/cap_trade_overview.pdf.

value must be used to benefit ratepayers and reduce GHG emissions. Electrical distribution utilities also receive an allocation of about 90 percent of average emissions. The allocation for natural gas utilities is based on 2011 levels of natural gas supplied to non-covered entities.

The Cap-and-Trade Program regulations enable trading and limited banking of allowances, as well as obtaining a limited number of “offset” credits. An offset credit is equivalent to a reduction or increase in the removal of one MTCO₂e. Offset projects are developed by third parties and have included projects to remove CO₂ from the atmosphere through forestry projects, control of livestock-related biogas emissions, and projects to reduce use of refrigerants. These projects may occur out-of-state.

Allowances and offset credits are together referred to as “compliance instruments.” Regulated entities surrender compliance instruments equivalent to their total GHG emissions by established deadlines within specific compliance periods.⁸ Compliance instruments can be obtained from the entity’s free allocation, purchase of allowances at auctions or reserve sales, purchase of offset credits, and transfer of allowances or offset credits between entities. Use of offset credits is limited to up to eight percent of a facility’s compliance obligation. Every year, covered entities turn in allowances and offsets for at least 30 percent of previous year’s emissions.⁹

Under the program, the annual emissions budgets decline 2-3% annually, but emissions in any year can fluctuate somewhat due to banking of allowances and offsets. The “cap” is the sum of the emissions allowances plus the allowable offset in aggregate for the compliance period.

California’s program is designed to be linked to other similar programs outside of the state. This linkage allows covered California entities to use compliance instruments from GHG trading systems outside of California (and vice versa). This linkage creates a larger program and increases the total emission reduction achieved. Since 2014, the state’s program has been linked to the program in Québec, Canada.

The first auction of allowances occurred in November 2012. Compliance obligation began in January 2013. In 2015, the compliance obligation began for distributors of transportation fuels, natural gas, and other fuels.

⁸ The first compliance period was the years 2013 and 2014; the second and third compliance periods are 2015-2017 and 2018-2020, respectively.

⁹ At the end of the compliance period, covered facilities must surrender all instruments to cover the remaining emissions, that is 100% of final year and 70% of earlier years.

III Facilities Subject to the Cap-and-Trade Program: Description and Proximity to Disadvantaged Communities

What Are the GHG Facilities?

The Cap-and-Trade Program has required compliance by sources of GHGs that emit more than 25,000 MTCO₂e per year since it began in 2012. These include facilities associated with electricity generation as well as large stationary sources of GHG emissions. Based on industrial classification, ARB has grouped the facilities into broad sectors for reporting purposes. These are: cement plants, cogeneration facilities, electricity generators, hydrogen plants, oil and gas production facilities, refineries, and “other combustion sources.”

For the initial analysis here, OEHHA will continue to use these broad sectors to characterize possible differences in emissions of GHGs and air toxics.

In 2015, the Cap-and-Trade Program incorporated fuel suppliers. These are suppliers of petroleum products (including gasoline and diesel fuel), biomass-derived transportation fuels, natural gas (including operators of interstate and intrastate pipelines), liquefied natural gas, and liquefied petroleum gas. These entities are not included in the current analysis, in part because of how recently they have been included, but also because the emissions of GHGs and air toxics from these entities are distributed too widely to be included in the facility-based analysis conducted for this report. (However, refineries are a point source of emissions and the facility emissions resulting from the production of fuels are included in the analysis.) The current analysis focuses on facilities that produce more localized emissions. Furthermore, the sector representing electricity importers was also excluded from the present analysis.

Table 2 below shows industrial sectors included in the Cap-and-Trade Program, and the amount of GHGs emitted in 2014.¹⁰ The largest contributors are from electricity generation and petroleum and gas refining, which together account for over half of the localized GHG generation covered by the Program (emitter covered emissions). On a facility basis, refineries also dominate, with average facility levels of 1.7 million MTCO₂e. However, within all but one sector, there is at least one facility producing more than 1 million MTCO₂e.

¹⁰ Data available pursuant to California’s Regulation for the Mandatory Reporting of Greenhouse Gas Emissions at URL: <https://www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/ghg-reports.htm>.

Table 2. GHG Emissions in 2014 by Cap-and-Trade Program Industry Sector for Facilities Reporting Emissions (Emitter-Covered Emissions in MTCO₂e).

Sector	No. Facilities / Entities	Total MTCO₂e by Sector	Range of MTCO₂e per Facility	Median MTCO₂e per Facility	Mean MTCO₂e per Facility
<i>Cement Plant</i>	9	7,653,163	123 – 1,968,656	935,061	850,351
<i>Cogeneration</i>	48	10,510,133	14,515 – 1,397,718	118,818	218,961
<i>Electricity Generation</i>	81	34,523,656	16 – 2,501,899	133,550	426,218
<i>Hydrogen Plant</i>	7	3,291,235	38,815 – 839,224	615,058	470,176
<i>Oil and Gas Production^a</i>	50	16,256,368	13,155 – 3,246,254	44,572	325,127
<i>Refinery^b</i>	18	31,266,353	3 – 6,363,590	1,112,508	1,737,020
<i>Other Combustion Source^c</i>	116	8,326,559	747 – 1,412,648	44,534	71,781
Total	329	111,827,467			

^a Includes eight facilities that also supply natural gas, natural gas liquids, or liquefied petroleum gas.

^b Includes 15 facilities that also supply transportation fuel or CO₂, and/or operate a hydrogen plant.

^c Includes one facility that also supplies CO₂.

What Are the Sources of Emissions from GHG Facilities Covered by the Cap-and-Trade Program?

The Cap-and-Trade Program covers several hundred industrial facilities that represent a wide variety of processes and activities. As a result of these activities, GHGs as well as other pollutants are commonly released into the atmosphere.

Table 3 below describes the facility sectors that report GHG emissions under the Cap-and-Trade Program and some of the processes used within these sectors that generate both GHGs and emissions of air toxics. In most sectors, the combustion of fuel is an important contributor to both GHG and air toxics emissions. For some sectors, GHGs are generated from processes other than fuel combustion (for example, CO₂ generated from the production of clinker in the manufacture of cement or CO₂ released from the production of hydrogen gas in the steam reformation process). Nearly all processes also generate air toxics. Criteria air pollutants and toxic air contaminants can be generated by non-combustion processes that may not be related to GHG emissions.

Table 3. GHG- and Air Toxic-Generating Activities and Processes in Primary Sectors of GHG Facilities Covered by the Cap-and-Trade Program (based on 2014 Inventory of Facilities).

Sector	Activities	Processes	Main Processes Generating CO₂e and Air Toxics
Cement Plants	Production of cement from limestone, clay and sand.	<p>The mixture of limestone, clay, and sand is heated at high temperatures in a kiln to form clinker. Clinker is cooled and ground with various additives to produce cement. Key steps:</p> <ol style="list-style-type: none"> 1. Raw materials acquisition and handling 2. Kiln feed preparation 3. Pyro-processing (calcining) 4. Finished cement grinding <p>Most cement plants use short kilns with preheaters and pre-calciners for pyro-processing in clinker production. Some use long dry kilns without preheaters.</p>	<p>Pyro-processing (calcining) Fuel combustion (frequently coal)</p>
Cogeneration Facilities	Generation of electrical power and useful heat, including waste heat recovery, from the same original fuel energy. Also known as combined heat and power.	<p>Electricity and thermal energy are generated onsite at cogeneration facilities, where waste heat recovery also occurs. Some examples of cogeneration include:</p> <ol style="list-style-type: none"> 1. Gas or other fuel combustion, sometimes to heat water to produce steam. 2. Gas or steam turbine to generate electricity 3. Exhaust energy convert to steam, exported to a host facility 	<p>Fuel combustion (fossil fuels or biomass)</p>
Electricity Generation Facilities	Generating electrical power	<ol style="list-style-type: none"> 1. Gas turbine: fuel combustion to generate electricity 2. Boiler: to capture exhaust heat to make steam 3. Steam turbine: to produce additional electricity 	<p>Fuel combustion (fossil fuels or biomass) Fugitive emissions</p>
Hydrogen Plants	Producing hydrogen from feedstock for refineries, food industries, and fertilizer production	<p>Steam methane reforming (SMR) method (for example):</p> <ol style="list-style-type: none"> 1. Feedstock hydrogenation and sulfur removal 2. Reforming in the SMR 3. Shift conversion 4. Hydrogen purification 	<p>Fuel combustion Feedstock consumption¹¹ All steps</p>

¹¹ Produces mainly CO₂.

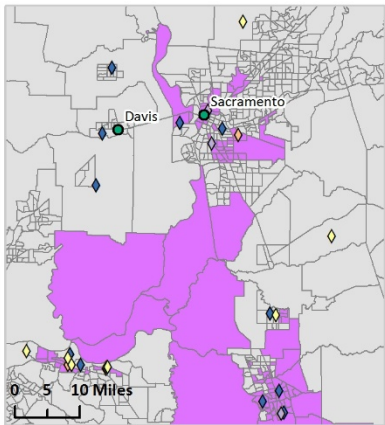
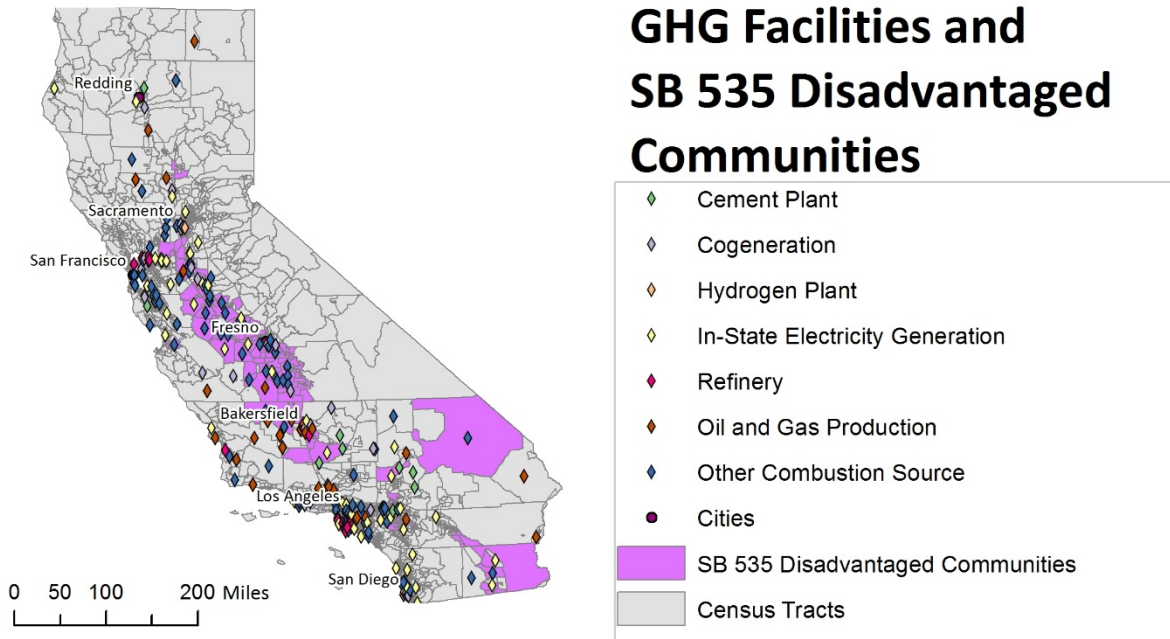
Sector	Activities	Processes	Main Processes Generating CO₂e and Air Toxics
Oil and Gas Production Facilities	Extraction of crude petroleum and natural gas from geological formations. May include well stimulation such as thermal (steam), waterflood, or gas injection techniques	<ol style="list-style-type: none"> 1. Extraction of oil/water emulsion from the geological formation via a mechanical or submergible pump 2. Separation of emulsion into water, oil, and gas 3. Storage and transfer of oil and water; processing of natural gas for sale or use 	Fuel combustion (frequently natural gas for steam generation) Fugitive emissions Flaring Dehydration processes
Refineries	Production of petroleum products, including transportation fuels (gasoline diesel), asphalt, and other products (kerosene, liquefied petroleum gas, feedstock for production of other materials)	Refineries can vary in the complexity of their processes. Topping refineries have small throughput, primarily separating crude oil into intermediates or simple products (e.g., asphalt). Hydro-skimming facilities include reforming and desulfurization process units as well as topping activity. More complex facilities produce transportation fuels and other products, and tend to use more energy, using processes including distillation, reforming, hydrocracking, catalytic cracking, coking, alkylation, blending, isomerization, amine treating, mercaptan oxidation. Many refineries have on-site hydrogen production, calciners, and sulfuric acid plants. Heavy crude oil inputs and production of lighter/cleaner products require more energy.	Combustion of refinery gas, syngas, and petroleum coke Fuel combustion for distillation Hydro-treating Catalytic reforming Sulfur removal Hydrogen generation
Other Combustion Sources	Multiple	Numerous industries are represented by facilities identified under the “other combustion source” sector. Facilities include those that manufacture nitrogenous fertilizer, alcoholic beverages, food and dairy products, paper and paperboard, gypsum products, soda ash, glass and glass containers, milling of iron and steel and rolled steel shapes, forging, lime, and mineral wool. Industrial activities can include canning, secondary smelting, and poultry processing. GHG emissions from colleges, universities, and professional schools are also included in this category.	Industry-dependent

Where Are GHG Facilities?

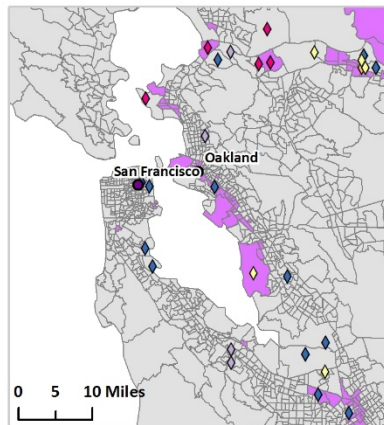
OEHHA has analyzed the location of 281 GHG facilities covered by the Cap-and-Trade Program for which street addresses could be geocoded from a 2014 inventory of facilities¹². In this case, the distance from each GHG facility to the nearest SB 535 disadvantaged community was evaluated. Facilities were grouped by industrial sector to determine whether some sectors were more likely to be in or near disadvantaged communities. Facility locations are shown in Figure 2 below. The analysis of the percent of each sector's facilities in or within specific distances of disadvantaged communities is presented in Table 4 below. Since disadvantaged communities represent 25% of the census tracts in the state, Table 4 shows that GHG facilities are disproportionately located within disadvantaged communities for all sectors. Over 50% of facilities for all but the cogeneration sector fall within one-half mile of a disadvantaged community.

¹² Because oil and gas production facilities can cover large geographic areas, the proximity analysis to disadvantaged communities will require more in-depth spatial analysis. For this reason, 48 oil and gas production facilities with geocoded street addresses are not included in this analysis.

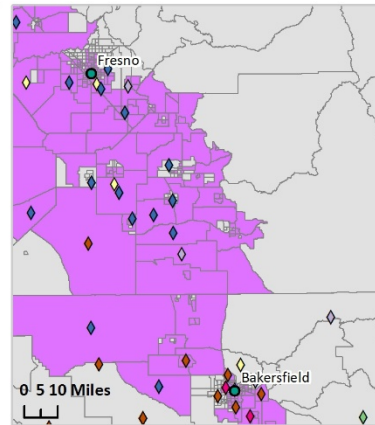
Figure 2. California Map Showing the Locations of GHG Facilities and SB 535 Disadvantaged Communities.



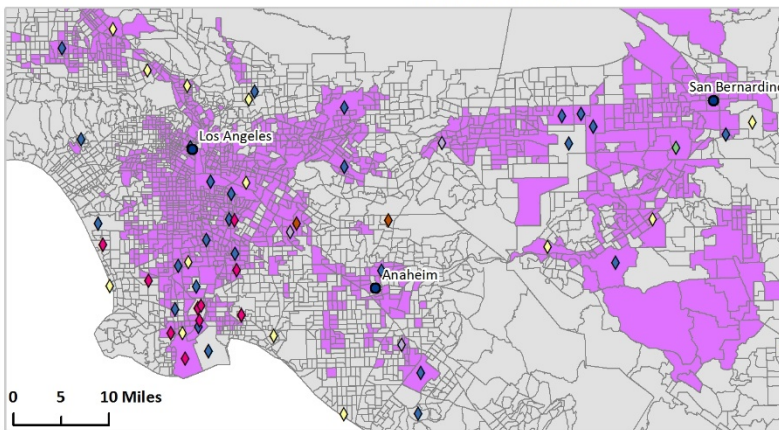
Sacramento Area



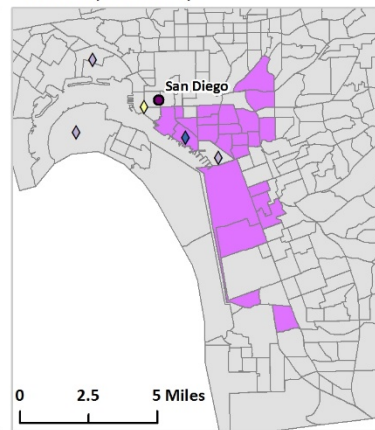
San Francisco Area



San Joaquin Valley



Greater Los Angeles Area



San Diego Area

Table 4. Analysis of Proximity of GHG Facilities to SB 535 Disadvantaged Communities (Based on Geocoding by Facility Street Addresses).

Sector	No. Facilities	% of Facilities in or near SB 535 DACs ^a		
		Within	<0.5 mi	<1.0 mi
<i>Cement Plant</i>	9	33	56	56
<i>Cogeneration</i>	59	29	41	42
<i>Electricity Generation</i>	76	41	51	58
<i>Hydrogen Plant</i>	7	43	71	86
<i>Refinery</i>	20	65	75	85
<i>Other Combustion Source</i>	110	56	65	66
<i>Total</i>	281	46	57	60

^a The SB 535 disadvantaged communities include about 15.5% of California’s land area. With the additional 0.5 and 1.0 mile buffers, the land area represents 16.9 and 18.1% of California’s land area, respectively. The total land area in California is estimated at 155,779 square miles. Greater buffer distances represent cumulative percent of facilities within a given distance. Facilities are treated here as points. Since many facilities cover large areas (footprint), the proximity to disadvantaged communities may be underestimated in this analysis.

In total, 46 percent of the GHG facilities covered by the Cap-and-Trade Program were located within SB 535 disadvantaged communities, 57 percent were in or within 0.5 miles of one, and 60 percent were in or within one mile of an SB 535 community. Generally, the sectors with the greatest likelihood of having a facility in or near an SB 535 disadvantaged community were from the sectors for refineries, hydrogen plants, and “other combustion source” sectors. Since the majority of GHG facilities are in close proximity to SB 535 disadvantaged communities, changes in emissions generally represent potential for differential increases or decreases in exposure in these communities.

These results are consistent with a recent report from academic researchers that examined the locations of many of the GHG facilities covered under the Cap-and-Trade Program. Cushing *et al.* (2016)¹³ describe a geographic analysis of 321 facilities that reported GHG emissions that were covered by the Cap-and-Trade Program during the 2013-2014 compliance period. And of these, 255 were within 2.5 miles of a resident population. Areas in proximity to these facilities

¹³ Cushing LJ, Wander M, Morello-Frosch R, Pastor M, Zhu A, Sadd J (2016). A Preliminary Environmental Equity Assessment of California’s Cap-and-Trade Program. Research Brief – September 2016. UC, Berkeley, University of Southern California, San Francisco State University, and Occidental College. Available at URL: <http://dornsife.usc.edu/PERE/enviro-equity-CA-cap-trade>.

were examined with respect to CalEnviroScreen 2.0 scores (highest 10 and 20% of scores) as well as the percentages of people of color and living in poverty.

The analysis found that census block groups within 2.5 miles of the GHG facilities had higher mean non-white populations, higher mean poverty levels, and a higher likelihood of being in a high-scoring CalEnviroScreen 2.0 census tract compared to block groups farther from GHG facilities. Many block groups are also within 2.5 miles of more than one facility. As the number of facilities near block groups increases, communities tend to have higher populations of color and higher rates of poverty.

IV Proposed Analytic Approach to Characterize Benefits and Impacts

Key Questions

The overall analysis of Cap-and-Trade facilities aims to answer the following key questions, in due course:

- *How do emissions of GHGs relate to emissions of toxic air contaminants and criteria air pollutants from the same GHG facilities?* Since the Cap-and-Trade Program aims to reduce aggregate GHG emissions, understanding how reductions or increases in GHG emissions may relate to changes in emissions of toxic air pollutants that could result in human exposure is critical to analyzing potential benefits and impacts.
- *Are emissions disproportionately occurring in SB 535 disadvantaged communities? Do disadvantaged communities benefit from or are they negatively impacted by changes in emissions from GHG facilities subject to Cap-and-Trade?* The SB 535 communities face burdens from multiple sources of pollution and population vulnerability factors. Equity analyses will address whether changes are occurring that may disproportionately affect these communities.
- *Are the benefits and impacts due to the design of the Cap-and-Trade Program?* The directive seeks to analyze benefits and impacts attributable to the AB 32 program. Therefore, an ultimate goal of the analyses will be to understand what changes in emissions can be attributed to responses to the program rather than external factors, such as economic conditions and drought.

Challenges in Evaluating the Benefits and Impacts of the Cap-and-Trade Program

The ability to examine relationships between Cap-and-Trade Program activities, outputs, and outcomes/impacts is complicated by a number of factors. These include:

- *The diversity of industries and facilities covered by the program.* Uniformity is not expected in how industries are able or likely to achieve compliance with the Cap-and-

Trade Program. The types and amounts of GHG and air toxics emissions that result from changes in industrial activities to comply with Cap-and-Trade are also expected to vary. Thus, the relationships between GHG and co-pollutant emissions vary across different industrial sectors (and even within facilities within a sector) with the differences in fuel types and sources, industrial processes and chemical feedstocks. For example, certain industrial processes may require fuels that burn at high temperatures. The emissions profile (specific chemicals emitted and levels at which they are emitted) typically varies with the temperature of combustion. Alternative fuels can also have different emissions profiles from conventional fuels.

- *The limited availability of data about GHG program activities, associated emissions, and health and other outcomes.* Some information regarding program activities is limited due to the need to protect confidential business information and market sensitivity of the information. This information could inform analyses of the relationship between GHG and co-pollutant emissions and facilities. Possible examples of such information include the mix and quantity of products made at specific facilities, and emissions produced per unit of product manufactured at a facility. However, such information may potentially provide economic advantage to competitors if made publicly available.

Other limitations in data are that information relevant to the analysis of outcomes – especially co-pollutants – has not to date been required to be co-reported with GHG emissions. As a result, these data must be obtained from sources resulting from other federal, state and local regulatory programs, such as permitting and reporting requirements and emissions monitoring by local air districts. Differences in reporting requirements across regulatory programs can complicate the analysis. Optimally, this analysis would have data reporting for co-pollutants and GHG emissions within the same time period, and over time. Changes in data collection practices can make it difficult to establish relationships between activities and outcomes over time.

- *The flexibility of the Cap-and-Trade Program.* The program has a number of components, including the aggregated nature of the GHG emissions cap and provisions to minimize “leakage” in which economic/industrial activity may move out of state. Facilities are also provided with numerous options for how compliance can be achieved, including “banking” of compliance instruments to provide flexibility while the program overall still meets the goals of GHG emission reductions. Also, the phase-in of different industrial sectors has occurred in different years.
- *Confounding factors that affect emissions and related outcomes that are unrelated to the Cap-and-Trade Program.* As one important example, industrial activity in California is affected by the overall economy and market factors, and may also be affected by other state, regional, or local regulatory activity. This can influence levels of GHG and air toxics

emissions. For example, the US and California experienced a severe economic recession from the late 2000s into the early 2010s, followed by an economic recovery, which occurred in the same period over which the Cap-and-Trade Program was launched and has developed. Another example includes the recent and persistent California drought. Because a large fraction of the state's electricity supply is derived from hydropower, the recent drought has necessitated additional generation of electricity from thermal power plants. Further, during the analysis period, the San Onofre Generating Station (a large nuclear power plant) was decommissioned. This resulted in more in-state emissions than would otherwise have occurred due to electricity generation from thermal power plants.

Practical Steps for Initial Analysis

Limitations to the readily available data place some constraints on the initial analysis described here. More public data are available to describe potential overall changes in pollutant emissions in disadvantaged communities than are available to specifically characterize Cap-and-Trade Program activities that may be influencing those emissions changes (see Section V below). For this reason, OEHHA is first examining the emissions data, and later intends to identify potential regulatory activities that may be contributing to changes in emissions, especially in disadvantaged communities. This report focuses on identifying and describing relevant data sources and how they can be used, gathers readily available data, and presents initial findings regarding those data.

V Data Used to Characterize Emissions of GHG and Air Toxics Emissions from GHG Facilities

Various types of information are collected by state and federal agencies on emissions of GHGs and toxic air pollutants from facilities and other entities covered by the Cap-and-Trade Program. Below are the sources of information that provided emissions data for the analysis of impacts and benefits of California's Cap-and-Trade Program described in this report.

Mandatory Reporting of Greenhouse Gas Emissions

GHG emissions must be reported to ARB annually by many industrial sources, fuel suppliers, and electricity importers under the Mandatory Reporting Rule (MRR).¹⁴ Of these

¹⁴ More detailed information on Mandatory Greenhouse Gas Emissions Reporting is available from ARB's website at URL: <https://www.arb.ca.gov/cc/reporting/ghg-rep/ghg-rep.htm>.

facilities/entities, many are also subject to the Cap-and-Trade Program. For such facilities, the submitted emissions data are verified by an accredited third party. The table below describes some of the publicly available data through the MRR.

Table 5. Partial List of Information Available from Mandatory Greenhouse Gas Emissions Reporting.

Source of Information	Description of Available Data
<i>Facility Data</i>	<ul style="list-style-type: none"> • Facility name, ARB identification code, ZIP Code/city, industrial sector, industrial classification code (NAICS)
<i>Total Emissions</i>	<ul style="list-style-type: none"> • Total CO₂e from combustion, process, vented, and supplier (in MTCO₂e); includes both fossil and biomass-derived fuels
<i>Facility Reported GHG Data (in MTCO₂e)</i>	<ul style="list-style-type: none"> • CO₂e from non-biogenic sources and CH₄ and N₂O from biogenic fuels¹⁵ as emitters and fuel suppliers • CO₂e from biogenic fuels as emitters and fuel suppliers • Electricity importer CO₂e
<i>ARB Calculated Covered Emissions (in MTCO₂e)</i>	<ul style="list-style-type: none"> • Covered emissions as emitters, fuel suppliers, and electricity importers • Total covered emissions (combined for entities with multiple) • Total non-covered emissions

ARB has publicly provided information on GHG emissions for each year since 2008. However, emissions data for the years 2008 to 2010 are not directly comparable to later years. This is a result of changes in methodology to harmonize with U.S. EPA’s GHG reporting regulation. An additional industrial sector has also been brought into the program since GHG reporting began, namely fuel distributors.

In 2015, GHG emissions data were reported for over 800 facilities, 724 of which reported GHG emissions greater than zero. The number of facilities in sectors expected to have on-site emissions was 589 (excluding electricity importers and suppliers of natural gas and transportation fuel). Not all facilities that report GHG emissions under the MRR are required to participate in the Cap-and-Trade Program.

¹⁵ Biomass fuels are derived from biomass products and byproducts, wastes, and residues from plants, animals, and microorganisms. Emissions from combustion of biomass fuels that meet certain criteria are considered biogenic and are exempt from a compliance obligation in the Cap-and-Trade regulations.

ARB also provides data related to how each entity covered by the Cap-and-Trade regulation meets its compliance obligation in terms of the total number of allowances and offsets surrendered each year.¹⁶

Table 6. Information Available in the Annual Compliance Report for the Cap-and-Trade Program (ARB).

Type of Information	Description of Available Data
<i>Facility information</i>	Facility name and ARB identification number
<i>Compliance Instrument Data</i>	<ul style="list-style-type: none"> • 2013-2014 triennial surrender obligation • Total instruments surrendered • Total allowances surrendered • Offsets surrendered and the types of offset credits and specific offset projects those credits are from • Compliance status (“fulfilled” or “unfulfilled”)

The Cap-and-Trade Program has established definitions of “facility” that clarify the extent of facilities operations that are required to report as a single entity. These definitions are provided in Appendix A.

Air Toxics “Hot Spots” Emission Inventory

Information on emissions of toxic substances from facilities in California is available from the Air Toxics “Hot Spots” Emissions Inventory. Emissions inventory plans are intended to provide “a comprehensive characterization of the full range of hazardous materials that are released, or that may be released, to the surrounding air from the facility” and includes all continuous, intermittent, and predictable air releases (Health and Safety Code section 44340(c)(2)). The Air Toxics “Hot Spots” Information and Assessment Act of 1987 (Health and Safety Code section 44300-44394, as amended) requires reporting of site-specific emissions of toxic substances based on criteria and guidelines adopted by ARB.¹⁷ These guidelines outline:

- *The facilities that are subject to reporting.* Generally, any facility¹⁸ or business in California that emits more than 10 tons per year of organic gases, particulate pollution, nitrogen oxides, or sulfur oxides, is subject to “Hot Spots” requirements. Certain smaller

¹⁶ This information is made available through ARB’s website at URL:

<https://www.arb.ca.gov/cc/capandtrade/capandtrade.htm> (see Publicly Available Market Information).

¹⁷ AB 2588 Air Toxics “Hot Spots” Emission Inventory Criteria and Guidelines Regulation (Guidelines). The current regulation and a detailed description of the guidelines are available on ARB’s website at

<https://www.arb.ca.gov/ab2588/2588guid.htm#current>.

¹⁸ See Appendix A for definition of “facility” under this program.

facilities like gas stations, dry cleaners, and chrome platers are also subject to the requirements. Some “low level” facilities are exempt from further update reporting unless specified reinstatement criteria are met. Reductions in emissions from changes in activities or operations may also exempt some facilities from further reporting requirements. Facilities that have been exempted from compliance with this program may also be reinstated under certain conditions (for example, emissions of a newly listed substance, the establishment of a nearby sensitive receptor such as a school, or an increase in the potency of a substance that it emits).

- *The groups of substances to be inventoried.* Different chemical substances have different reporting requirements. Emissions must be quantified for over 500 specific substances. Production, use, or other presence must be reported for an additional ~200 substances. Facilities must report whether they manufacture an additional ~120 substances.
- *When facilities are required to report.* This is based on prioritization scores, risk assessment results, or *de minimis* thresholds. Emissions inventories developed under the “Hot Spots” Program are updated every four years.
- *The information a facility operator must include in a facility's update to their emission inventory.*
- *Criteria by which “Hot Spots” reporting is integrated with other air district programs.*
- *The information that must be included in the air toxics emission inventory plan and report by a facility operator.*
- *The source testing requirements, acceptable emission estimation methods, and reporting formats.*

Criteria Air Pollutant Emissions

Emissions data for criteria air pollutants from California facilities are collected by county or regional air districts as a result of both state and federal laws. The district data are then reported to ARB. Generally, large facilities report these emissions annually, though facilities with lower rates of emissions may only be required to report every three years.

Data on the emissions of criteria air pollutants for some facilities that are subject to the Cap-and-Trade regulation have recently been made available on ARB’s Integrated Emissions Visualization Tool.¹⁹ This includes data by facility for the years 2008 to 2014 on emissions of

¹⁹ Available at URL: <https://www.arb.ca.gov/ei/tools/ievt/>. For additional information comparing the reporting of GHG and criteria air pollutant emissions, see also URL: https://www.arb.ca.gov/ei/tools/ievt/doc/ievt_notes.pdf.

ozone-producing volatile organic compounds (VOCs), nitrogen oxides (NO_x), sulfur oxides (SO_x), particulate matter (PM 2.5 and PM10), and ammonia (NH₃).

Toxic Release Inventory (TRI; US Environmental Protection Agency)

Another source of emissions data for toxic substances is the US Environmental Protection Agency's (US EPA) Toxic Release Inventory (TRI).²⁰ Under this program, facilities²¹ in certain industrial categories with more than 10 full-time equivalent employees that manufacture, process, or otherwise use chemicals are required to report chemical emissions. Industries covered include certain electric power utilities, chemical manufacturing, mining, hazardous waste treatment, and federal facilities.

The list of chemicals for which reporting is required currently contains almost 600 individual chemicals, plus 31 chemical categories. Facilities are required to report emissions that manufacture or process more than 25,000 pounds, or otherwise use more than 10,000 pounds of any listed chemical in the course of a calendar year. Lower thresholds are in place for facilities that manufacture, process, or use certain persistent bioaccumulative toxic (PBT) chemicals.

For industries and facilities required to report, the minimum amounts that must be reported are on the order of 0.1 to 1 pounds per year. Reporting levels for PBT chemicals have no minimum levels. For qualifying facilities, reporting occurs annually.

General Limitations to the Use of Emissions Data as an Indicator of Benefits and Impacts

Emissions data are being used in this report as a proxy for potential exposures to air pollutants that arise from industrial sources, and do not directly correspond to health risks to individuals in communities near facilities. Health risks are typically estimated through health risk assessments of the facilities themselves. Such assessments can take into account a large number of factors, such as: the specific location of the emissions, the fate and transport of the substances emitted (in consideration of stack height, meteorology and terrain), the estimated concentrations of chemicals where people are, the duration of exposures, and the toxicity characteristics of the substances informed by health guidance values (such as cancer potencies and reference exposure levels). However, for an initial screen of potential concerns related to emissions of toxic air pollutants, emissions data provides information to use as a basis for

²⁰ Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA, or Title III of the Superfund Amendments and Reauthorization Act of 1986, Public Law 99-499). Additional information available through U.S. EPA's website at URL: <https://www.epa.gov/toxics-release-inventory-tri-program>.

²¹ See Appendix A for definition of "facility" under this program.

relative comparison (changes in emissions) and can illuminate the nature of potential hazards arising from facilities.

To address variations in the toxicity of the emitted chemicals, this report performs a toxicity weighting of the emitted chemicals. This weighting puts a greater emphasis on the more highly toxic emitted chemicals than on emitted chemicals with relatively low toxicity.

There are uncertainties associated with emissions data themselves. While the emissions reporting described below is required by law under different statutes, the amounts and types of emissions are self-reported by the regulated industries. This means they may be subject to some reporting errors. Different regulatory programs have different practices in place to verify submitted data, though there may be inaccuracies that are difficult to identify. Reporting requirements can change over time to include additional types of emissions and emission processes. Factors that are used to estimate emissions from specific processes can also be revised over time, leading to changes in the estimates.

VI Toxicity of GHGs and other Air Pollutants

Greenhouse Gases

There is generally low concern for human health from localized emissions of carbon dioxide (CO₂), the primary GHG that is driving climate change. Only at very high concentrations does CO₂ affect human health. For this reason, emissions of CO₂ itself are not considered to be contributing to localized impacts from facilities where it is emitted.

Other GHGs are the “short-lived climate pollutants” including methane, fluorinated gases, and black carbon. Methane is more potent than CO₂ as a GHG, but is generally emitted at lower rates than CO₂. Sources of methane include agriculture, the oil and gas industry, and from the treatment of waste. Methane is generally not expected to have health effects from localized emissions due to its low toxicity.

Fluorinated gases include chlorofluorocarbons, hydrochlorofluorocarbons, and hydrofluorocarbons, many of which are being phased out of use because of their ozone-depleting potential. Most of the emissions of this class of compound arise from leakage of refrigeration systems. As such, they provide a relatively limited contribution to emissions from facilities regulated under the Cap-and-Trade Program. Similarly, sulfur hexafluoride has numerous uses, but is regulated from early actions outside of the Cap-and-Trade Program due to its very high global warming potential and increasing levels in recent years.

Black carbon is generally created as a product of incomplete combustion of organic fuels, including diesel fuels. Black carbon is a component of particulate pollution (including PM_{2.5},

see below) and diesel particulate matter, both of which have well-described human health toxicity concerns, including increasing risk of premature death and cancer. California has substantially reduced black carbon from diesel exhaust from many sources over the past 20 years, corresponding to a 13% reduction in the total annual CO₂ emissions in California.

Criteria Air Pollutants

The criteria air pollutants are common air pollutants for which federal standards are established under the Clean Air Act (42 U.S. Code Chapter 85). The six criteria air pollutants are ozone, particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead. California has established more protective standards in some cases. The standards are established to protect even the most sensitive individuals, such as children and elderly. Some of the common sources of exposure and key health effects are described in Table 7 below.

Table 7. Sources of Exposure and Health Effects of Criteria Air Pollutants.

Criteria Air Pollutant	Sources of Exposure	Health Effects
<i>Ozone</i>	Generated from interaction of sunlight with volatile organic compounds (reactive organic gases), especially hydrocarbons, and nitrogen oxides; ozone formation may be distant from the source of these emissions. Sources include vehicles, industrial facilities, and consumer products, among others.	Damage to the respiratory tract; worsening of symptoms for respiratory diseases like asthma, bronchitis, and emphysema; reduction in lung function; increased susceptibility to infections. People who spend more time outdoors may be especially susceptible.
<i>Particulate matter (PM)</i>	Many sources of PM; generated by the combustion of most fuels, which produces most of fine PM (particles less than 2.5 microns in diameter, PM _{2.5}); larger particles (PM ₁₀) can be generated by blowing dusts. Particles can vary greatly in their composition.	Worsening of heart and lung disease; decreases in lung function and respiratory symptoms, such as coughing or shortness of breath; increases in hospitalizations and deaths. People with heart and lung disease, as well as children and elderly, may be especially susceptible to the effects.

Criteria Air Pollutant	Sources of Exposure	Health Effects
<i>Sulfur dioxide</i>	Combustion of fuel containing sulfur. Industrial sources include certain petroleum refining processes. Other sources are locomotives, ships, and certain diesel equipment.	Respiratory effects include shortness of breath and wheezing. Increases in mortality have been observed from sulfur dioxide exposure. Children, elderly, asthmatics, and people with existing heart disease may be especially sensitive to the effects.
<i>Nitrogen dioxide</i>	Combustion of fuel by cars, trucks, and at power plants.	Damage to the respiratory tract. Asthmatics may be especially susceptible to the harmful effects of nitrogen dioxide exposures.
<i>Carbon monoxide</i>	Produced from the incomplete combustion of fuels from a variety of sources.	Dizziness and confusion at high levels of exposure, though unlikely outdoors. Individuals with heart or lung disease may be especially susceptible.
<i>Lead</i>	Multiple sources, especially processing of metals, waste incineration, battery manufacturing, and aircraft burning leaded aviation fuel.	Harmful to the nervous, cardiovascular, immune, reproductive and developmental systems. Children are especially sensitive to the effects of lead.

Toxic Air Contaminants

“Toxic air contaminants” are defined in California law as air pollutants which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health (Health and Safety Code section 39655). There are currently almost 200 substances or groups of substances identified as toxic air contaminants by ARB.²² These substances show a wide range of toxicity characteristics and physical properties that could influence the likelihood of health effects if they are emitted to air.²³

²² The current list can be found on the ARB website at URL:
<https://www.arb.ca.gov/toxics/quickref.htm#TAC>.

²³ Information on the types of hazards for many identified toxic air contaminants is available at URL:
<https://www.arb.ca.gov/toxics/cattable.htm>.

Some toxic air contaminants were listed because they were federally designated hazardous air pollutant (pursuant to subsection (b) of Section 112 of the federal act (42 U.S.C. Sec. 7412(b)). ARB designated others based on evaluations performed by OEHHA that meets specific criteria described in California law (Health and Safety Code section 39660).

VII Results

Toxicity-Weighted Emissions to Air

Most GHG facilities covered by the Cap-and-Trade Program emit a combination of GHGs, criteria air pollutants, and toxic air contaminants. While GHGs themselves tend to be relatively less toxic, co-pollutants that are emitted can vary significantly by facility with respect to their composition and potential toxicity. To provide additional information on how these facilities vary with respect to overall toxicity of emissions, OEHHA derived a “toxicity-weighted” emissions score for each of the facilities for which emissions data were available. The purpose of this analysis was to screen for higher-concern facilities with respect to emission levels and potential chemical toxicity.

The data were derived from the California Air Toxics “Hot Spots” Emissions Inventory for GHG facilities that could be matched across both the “Hot Spots” and Cap-and-Trade Programs. This matching was performed by investigators from UC Berkeley and San Francisco State University. The facility matching involved geocoding facility addresses that were available for each Cap-and-Trade Program GHG facility. The location information was then matched to location information for “Hot Spots” facilities that was made available by ARB. Facilities with close proximity to a listed address and similar facility names were presumed to match. Comparable identities were confirmed by visual inspection of satellite imagery and internet research. In developing this facility data set, some facility locations were adjusted so that they more closely spatially aligned with likely point sources of emissions.

There are several uncertainties associated with the matching of Cap-and-Trade and “Hot Spots” facilities due to the differences between the two regulatory programs. These uncertainties come from differences in how facilities are defined under each program. In some cases, facilities may have multiple operations that are combined for the purpose of reporting GHG emissions. However, these operations may be reported separately for air toxics and criteria air pollutant emissions.

Of the full set of Cap-and-Trade covered facilities from sectors that were expected to produce localized emissions, a subset of 374 facilities were tentatively identified as likely matches to “Hot Spots” facilities. Emissions information for 365 of these facilities was provided to OEHHA by ARB for the 2014 reporting year. These data included annual emissions amounts for

individual criteria air pollutants (or their precursors for those with ozone-forming potential) and individual chemicals for which reporting is required under the “Hot Spots” Program. A smaller subset of 77 facilities had risk assessments prepared under the “Hot Spots” Program. In these cases, emissions were modeled to identify potential risks in neighboring communities. Since these data were somewhat limited in availability across Cap-and-Trade Program covered facilities, they are not currently being used in the analysis described here.

Because facilities emit multiple chemicals and not all chemicals are equally toxic, OEHHA applied weighting factors to the air toxics emissions data for each facility. OEHHA calculated a toxicity-weighted emissions score for each of the 365 facilities using an approach comparable to that used to calculate toxicity-weighted emissions under US EPA’s Toxic Release Inventory Program. To apply a comparable methodology here, US EPA’s Inhalation Toxicity Scores for individual chemicals were matched and applied to the chemical emissions levels for air toxics (pounds emitted per year) from each facility.²⁴ Some chemicals whose emissions are required to be reported in the “Hot Spots” Program did not have US EPA toxicity weights available. These compounds are currently excluded from the analysis. Toxicity weights may be established for these compounds in the future.

Toxicity weight is described by US EPA as follows:²⁵

“This weight is a proportional numerical weight applied to a chemical based on its toxicity. The toxicity of a chemical is assessed using EPA-established standard methodologies. For each exposure route, chemicals are weighted based on their single, most sensitive adverse chronic human health effects (cancer or the most sensitive noncancer effect). In the absence of data, the toxicity weight for one pathway is adopted for the other pathway. The range of toxicity weights is approximately 0.02 to 1,400,000,000.”

This type of weighting was also used in characterizing air toxics emissions in the California Communities Environmental Health Screening Tool (CalEnviroScreen). Toxicity weights do not include the criteria air pollutants (NO_x, PM_{2.5}, etc.). Those pollutants are evaluated separately below.

²⁴ OEHHA used US EPA values here because they were readily available. Since California-specific risk and toxicity data may be available for many chemicals, these values will be updated for future analyses. As an example, US EPA does not include a toxicity weight for diesel exhaust, which can be an important contributor to cancer risk from facilities.

²⁵ Further information is available on U.S. EPA’s website at URL:

<https://www.epa.gov/trinationalanalysis/hazard-and-risk-tri-chemicals-2014-tri-national-analysis>.

As discussed above, the toxicity weights themselves for each compound are not a measure of risk or likelihood of harm, but provide a way to screen overall emissions from facilities that allows comparisons and the identification of those emissions of highest overall concern.

The emissions characteristics of facilities differ by industry. Using the information on emissions reported by facilities, the most frequently reported specific chemical emissions are described in Table 8 below. Across sectors, numerous air toxics are reported to be emitted that are commonly created by fuel combustion. These include formaldehyde, benzene, toluene, xylenes, 1,3-butadiene, diesel particulate matter, and polycyclic aromatic hydrocarbons (PAHs). The composition of chemicals emitted from fuel combustion depends on the type of fuel burned (oil, coal, natural gas, biomass). Other emissions are likely to be associated with a type of industry. For example, nearly all cement plants report emissions of nickel, naphthalene, lead, formaldehyde, hexavalent chromium, cadmium, beryllium, benzene, and arsenic. (One cement plant in this data set reported very low activity in 2014 with respect to both GHG and air toxics emissions.) Oil and gas production facilities emit numerous organic chemicals: benzene, formaldehyde, naphthalene, toluene, xylenes, acetaldehyde, PAHs, acrolein, ethylbenzene, and 1,3-butadiene.

Toxicity-weighted emissions values were calculated for each of the facilities for which air toxics emissions data were available, as described above. The highest-scoring 25 facilities are presented in Table 9 below. While multiple sectors are represented in this group, some sectors appear more frequently among those with the highest toxicity-weighted emissions. The highest-scoring 25 facilities in the state include several cement plants (6), refineries (6), and facilities associated with oil and gas production (6).

Table 8. Frequency of Specific Chemical Emissions for Facilities with Reported Air Toxics Emissions by Cap-and-Trade Sector (Criteria Air Pollutants Excluded).

Sector	Facilities*	Chemicals most frequently reported emitted (number of occurrences) *		
<i>Cement Plants</i>	9	Nickel (8) Naphthalene (8) Lead (8) Formaldehyde (8) Hexavalent chromium & compounds (8) Cadmium (8) Beryllium (8) Benzene (8) Arsenic (8) Selenium (7) Mercury (7) Manganese (7)	Copper (7) Zinc (6) Xylenes (mixed) (6) Toluene (6) Hydrochloric acid (6) Chromium (6) Benzo(a)pyrene (6) Acetaldehyde (6) 2,3,7,8-Tetrachlorodibenzo-p-dioxin (6) 1,3-Butadiene (6) Silica, crystalline (respirable) (5) Indeno(1,2,3-cd)pyrene (5)	Ethyl benzene (5) Dibenz(a,h)anthracene (5) Benzo(k)fluoranthene (5) Benzo(b)fluoranthene (5) Benz(a)anthracene (5) 2,3,7,8-Tetrachlorodibenzofuran (5) 2,3,4,7,8-Pentachlorodibenzofuran (5) 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (5) 1,2,3,4,6,7,8-Heptachlorodibenzofuran (5)

Sector	Facilities*	Chemicals most frequently reported emitted (number of occurrences) *		
<i>Cogeneration Facilities</i>	48	Formaldehyde (43) Benzene (43) Toluene (35)	Ammonia (34) Naphthalene (31) Acetaldehyde (29)	Xylenes (mixed) (27) Acrolein (26) 1,3-Butadiene (26)
<i>Electricity Generation Facilities</i>	90	Formaldehyde (80) Benzene (80) Ammonia (71) Naphthalene (60)	1,3-Butadiene (50) Toluene (47) Arsenic (46) Nickel (45)	Lead (45) Cadmium (45) Hexavalent chromium & compounds (40) Xylenes (mixed) (39)
<i>Hydrogen Plants</i>	6	Formaldehyde (6) Benzene (6)	Ammonia (5) PAHs, total (4)	Naphthalene (4)
<i>Oil and Gas Production Facilities</i>	47	Benzene (40) Formaldehyde (38) Naphthalene (32)	Toluene (28) Xylenes (mixed) (25) Acetaldehyde (25)	PAHs, total (24) Acrolein (24)
<i>Refineries</i>	20	Ammonia (19) Benzene (18) Formaldehyde (17) Nickel (16)	Lead (16) Hexavalent chromium & compounds (16) Cadmium (16) Naphthalene (15)	Arsenic (14) Beryllium (13) 1,3-Butadiene (13) PAHs, total (12)

Sector	Facilities*	Chemicals most frequently reported emitted (number of occurrences) *																																																																					
<i>Other Combustion Sources</i>	114	<p>Numerous industrial activities are represented in the “Other Combustion Sources” category. A few examples are presented below.</p> <table border="0"> <tr> <td data-bbox="573 380 852 436">Fruit and Vegetable Canning</td> <td data-bbox="852 380 1131 436">Propylene (4)</td> <td data-bbox="1131 380 1445 436">Arsenic (2)</td> </tr> <tr> <td data-bbox="573 436 852 464">Toluene (8)</td> <td data-bbox="852 436 1131 464">PAHs, total (4)</td> <td data-bbox="1131 436 1445 464">Ammonia (2)</td> </tr> <tr> <td data-bbox="573 464 852 491">Formaldehyde (8)</td> <td data-bbox="852 464 1131 491">Nitrous oxide (4)</td> <td data-bbox="1131 464 1445 491">Acetaldehyde (2)</td> </tr> <tr> <td data-bbox="573 491 852 518">Benzene (8)</td> <td data-bbox="852 491 1131 518">Naphthalene (4)</td> <td data-bbox="1131 491 1445 518"></td> </tr> <tr> <td data-bbox="573 518 852 546">Xylenes (mixed) (6)</td> <td data-bbox="852 518 1131 546">Methane (4)</td> <td data-bbox="1131 518 1445 546">Colleges, Universities, and Professional Schools</td> </tr> <tr> <td data-bbox="573 546 852 573">Propylene (6)</td> <td data-bbox="852 546 1131 573">Hexane (4)</td> <td data-bbox="1131 546 1445 573">Formaldehyde (8)</td> </tr> <tr> <td data-bbox="573 573 852 600">Nitrous oxide (6)</td> <td data-bbox="852 573 1131 600">Formaldehyde (4)</td> <td data-bbox="1131 573 1445 600">Benzene (8)</td> </tr> <tr> <td data-bbox="573 600 852 627">Naphthalene (6)</td> <td data-bbox="852 600 1131 627">Ethyl benzene (4)</td> <td data-bbox="1131 600 1445 627">Nickel (7)</td> </tr> <tr> <td data-bbox="573 627 852 655">Methane (6)</td> <td data-bbox="852 627 1131 655">Carbon dioxide (4)</td> <td data-bbox="1131 627 1445 655">Lead (7)</td> </tr> <tr> <td data-bbox="573 655 852 682">Hexane (6)</td> <td data-bbox="852 655 1131 682">Benzene (4)</td> <td data-bbox="1131 655 1445 682">Hexavalent chromium & compounds (7)</td> </tr> <tr> <td data-bbox="573 682 852 709">Ethyl benzene (6)</td> <td data-bbox="852 682 1131 709">Acrolein (4)</td> <td data-bbox="1131 682 1445 709">Cadmium (7)</td> </tr> <tr> <td data-bbox="573 709 852 737">Carbon dioxide (6)</td> <td data-bbox="852 709 1131 737">Acetaldehyde (4)</td> <td data-bbox="1131 709 1445 737">Arsenic (7)</td> </tr> <tr> <td data-bbox="573 737 852 764">Acrolein (6)</td> <td data-bbox="852 737 1131 764">Paperboard Mills</td> <td data-bbox="1131 737 1445 764">Naphthalene (6)</td> </tr> <tr> <td data-bbox="573 764 852 791">Acetaldehyde (6)</td> <td data-bbox="852 764 1131 791">Formaldehyde (3)</td> <td data-bbox="1131 764 1445 791">Mercury (6)</td> </tr> <tr> <td data-bbox="573 791 852 819">PAHs, total (5)</td> <td data-bbox="852 791 1131 819">Benzene (3)</td> <td data-bbox="1131 791 1445 819">Toluene (5)</td> </tr> <tr> <td data-bbox="573 819 852 846">Ammonia (5)</td> <td data-bbox="852 819 1131 846">Toluene (2)</td> <td data-bbox="1131 819 1445 846">Methylene chloride (5)</td> </tr> <tr> <td data-bbox="573 846 852 903">Diesel engine exhaust, particulate matter (Diesel PM) (4)</td> <td data-bbox="852 846 1131 903">Nickel (2)</td> <td data-bbox="1131 846 1445 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(4)</td> <td data-bbox="852 1098 1131 1125"></td> <td data-bbox="1131 1098 1445 1125"></td> </tr> </table>	Fruit and Vegetable Canning	Propylene (4)	Arsenic (2)	Toluene (8)	PAHs, total (4)	Ammonia (2)	Formaldehyde (8)	Nitrous oxide (4)	Acetaldehyde (2)	Benzene (8)	Naphthalene (4)		Xylenes (mixed) (6)	Methane (4)	Colleges, Universities, and Professional Schools	Propylene (6)	Hexane (4)	Formaldehyde (8)	Nitrous oxide (6)	Formaldehyde (4)	Benzene (8)	Naphthalene (6)	Ethyl benzene (4)	Nickel (7)	Methane (6)	Carbon dioxide (4)	Lead (7)	Hexane (6)	Benzene (4)	Hexavalent chromium & compounds (7)	Ethyl benzene (6)	Acrolein (4)	Cadmium (7)	Carbon dioxide (6)	Acetaldehyde (4)	Arsenic (7)	Acrolein (6)	Paperboard Mills	Naphthalene (6)	Acetaldehyde (6)	Formaldehyde (3)	Mercury (6)	PAHs, total (5)	Benzene (3)	Toluene (5)	Ammonia (5)	Toluene (2)	Methylene chloride (5)	Diesel engine exhaust, particulate matter (Diesel PM) (4)	Nickel (2)	Manganese (5)		Naphthalene (2)	1,3-Butadiene (5)		Lead (2)	Xylenes (mixed) (4)	Dry, Condensed, and Evaporated Dairy Product Manufacturing	Hexavalent chromium & compounds (2)	Acrolein (4)	Diesel engine exhaust, particulate matter (Diesel PM) (5)	Cadmium (2)	Acetaldehyde (4)	Xylenes (mixed) (4)			Toluene (4)		
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* Facility count is the number of facilities for which air toxics emissions data are available, but did not report emitter-covered GHG emissions in 2014.

Table 9. Twenty-Five Cap-and-Trade Facilities with the Highest Toxicity-Weighted Air Emissions.* Shaded Facilities Are In or Within ½ Mile of an SB 535 Census Tract.

Facility Name and Approximate Location	Sector	Tox-Weighted Air Emissions	CEIDARS ID	ARB ID
CalPortland Company, Mojave Plant, Mojave	Cement Plant	11,128,486,856	15_KER_9	101029
California Resources Elk Hills, LLC, 35R Gas Plant, Tupman	Oil & Gas Production, Supplier of NG/ NGL/ LPG	8,019,256,117	15_SJU_2234	104014
Riverside Cement Company, Oro Grande	Cement Plant	4,773,322,002	36_MOJ_1200003	100013
Cemex Construction Materials Pacific LLC, Victorville Plant	Cement Plant	3,981,635,547	36_MOJ_100005	101476
Lake Shore Mojave, LLC (Shutdown), Boron	Cogeneration	3,154,251,353	KER_593	100218
U.S. Borax, 93516, Boron	Other Combustion Source	3,154,251,353	15_KER_28	100300
PG&E Hinkley Compressor Station, Hinkley	Oil & Gas Production	2,695,090,703	36_MOJ_1500535	101290
Lehigh Southwest Cement Co., Tehachapi	Cement Plant	2,565,789,410	15_KER_20	101461
Mitsubishi Cement 2000, Lucerne Valley	Cement Plant	2,073,213,791	36_MOJ_11800001	101010
Shell Oil Products US, Martinez	Refinery, Hydrogen Plant	1,916,625,223	7_BA_11	100914
PG&E Topock Compressor Station, Needles	Oil & Gas Production	1,576,205,185	36_MOJ_1500039	101031
ExxonMobil Oil Corporation, Torrance Refinery Torrance	Refinery, Hydrogen Plant, CO ₂ Supplier	1,531,495,371	19_SC_800089	100217
Searles Valley Minerals Inc., Trona	Other Combustion Source	1,487,264,625	36_MOJ_900002	100011
Southern California Gas Co., South Needles Facility, Needles	Oil & Gas Production	1,401,623,408	36_MOJ_3100068	101346
Coso Power Developers (Navy II), Geothermal, Little Lake	In-State Electricity Generation	1,280,562,586	15_KER_328	101669
National Cement Company, Lebec	Cement Plant	1,151,169,990	15_KER_21	101314
Freeport-McMoRan Oil & Gas LLC, SJV Basin Facility, Fellows	Oil & Gas Production	1,090,450,784	15_SJU_1372	104081
Imerys Minerals California, Inc., Lompoc	Other Combustion Source	1,047,824,807	42_SB_12	101318
Grayson Power Plant, Glendale	In-State Electricity Generation	873,364,347	19_SC_800327	100181
Valero Refining Company, Refinery and Asphalt Plant, Benicia	Refinery, Hydrogen Plant, CO ₂ Supplier	830,573,455	48_BA_12626	100372
Tesoro Refining and Marketing Co., Martinez	Refinery, Hydrogen Plant, CO ₂ Supplier	786,966,781	7_BA_14628	101331
Southern California Gas Co - Aliso Canyon Facility, Northridge	Oil & Gas Production	716,224,953	19_SC_800128	101349
Spreckels Sugar Company, Inc., Brawley	Other Combustion Source	708,360,193	2014_13_IMP_10	101241
Chevron Products Company, El Segundo	Refinery, Hydrogen Plant, CO ₂ Supplier	697,864,142	2014_19_SC_800030	100138
Phillips 66 Company, Los Angeles Refinery, Wilmington	Refinery, Hydrogen Plant, CO ₂ Supplier	673,822,489	2014_19_SC_171107	100329

*Top 25 of the 297 facilities for which scores could be calculated using 2014 emissions data.

Air Toxics and GHGs Emissions

Plotting data graphically for visual inspection and calculation of correlation coefficients are approaches to the evaluation of data that may be informative with respect to relationships between greenhouse gas emissions and toxic air contaminants.

The Pearson correlation coefficient is a measure of the linear dependence between two variables, in this case between GHG emissions and a number of different pollutant emission measures. A Pearson correlation coefficient is high when the relationship between two measures increases linearly in proportion to each other. Generally, high positive correlation produces a coefficient r -value of greater than 0.8, with moderately high correlation above 0.5, moderate when the measures are between 0.3 and 0.5, and low when below 0.3 to zero but statistically significant. Inversely correlated values are negative. The Pearson correlation is vulnerable to outlier data, especially when there is a large range of values represented in the analysis. For this reason, an additional correlation analysis was conducted using the Spearman correlation coefficient. In this analysis, the rank order of each of two sets of measures is compared. This coefficient is better able to identify data sets that may be related, but the relationship may be more complex than linear. Another method to address data over a larger range is to make logarithmic transformations. For several of the data sets here, logarithmically transforming the data strengthened the correlations.

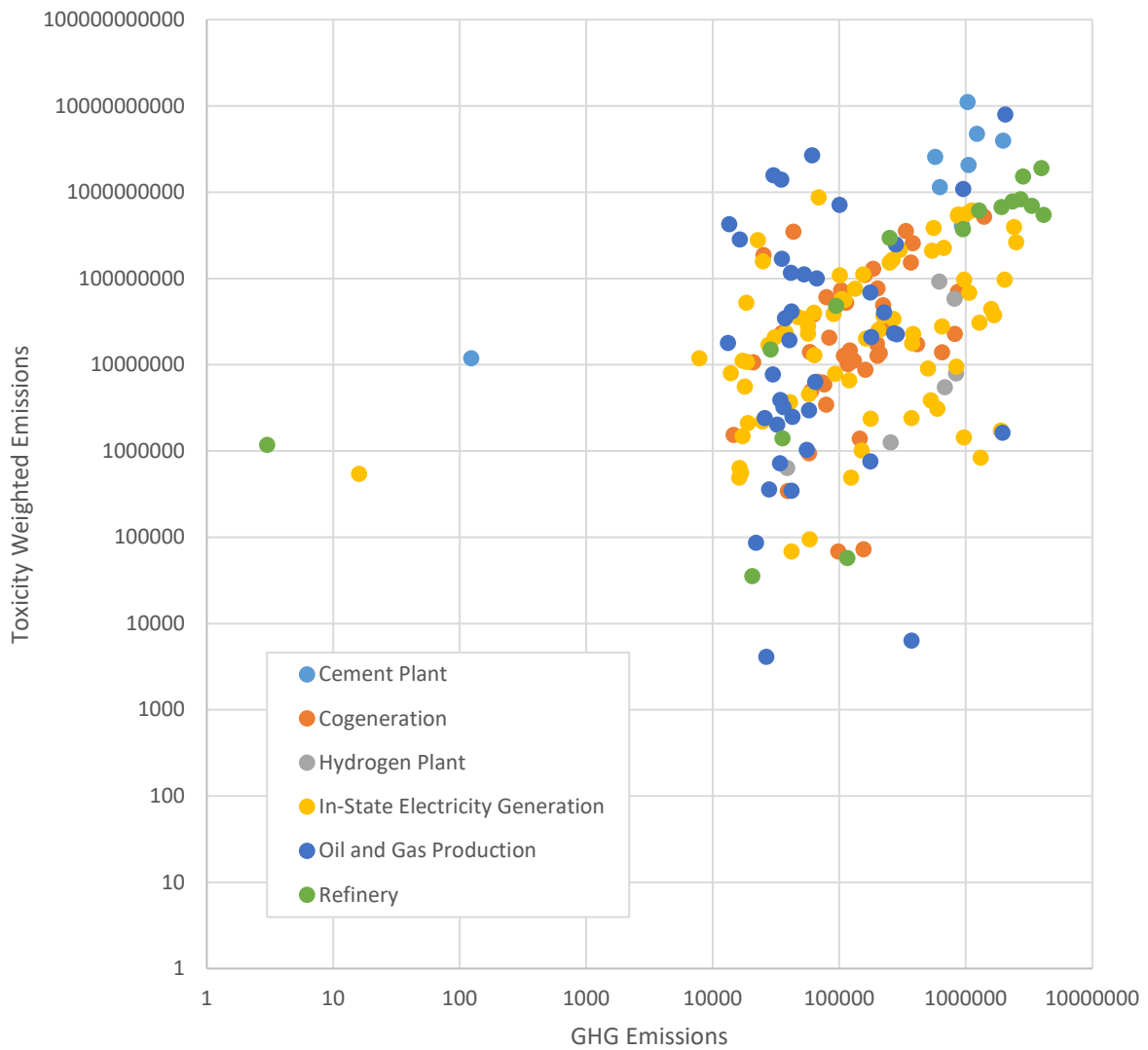
Figure 3 shows a scatterplot of GHG emissions versus toxicity-weighted emissions from facilities for which both types of data are available. The GHG emissions used are emitter-covered emissions for the year 2014, excluding emissions by facilities that were not covered by the program (e.g., biomass) and emissions related to electricity imports that were not local. This analysis only included facilities with emitter-covered emissions for which 2014 air toxics data were available ($n = 298$). Overall, this correlation was moderate, positive and highly significant by both measures (Pearson coefficient, $r = 0.32$; Spearman coefficient, $r = 0.44$; both statistically significant, $p < 0.0001$).

When facilities were subdivided by Cap-and-Trade Program industrial sectors, some sectors showed considerably higher positive relationships. The scatterplots and correlations are presented in Figure 4 and Table 10 below, respectively. Refineries overall showed high positive correlations ($r \cong 0.8$), followed by oil and gas production facilities, hydrogen plants, and cement plants, each of which were moderately correlated using the Pearson coefficient ($r \cong 0.5$). For refineries, GHG emissions were highly correlated with toxicity-weighted air toxics emissions, as indicated by both the Pearson (0.82) and Spearman (0.86) correlation coefficient ($p \leq 0.0001$ for both coefficients). The Pearson correlations for hydrogen and cement plants were also supported by positive correlations using the Spearman coefficient. For the oil and gas production facilities, both measures showed positive correlation, but only the Pearson was

statistically significant, suggesting that outliers or extreme values may have contributed to the Pearson correlation. It is also likely that the nature of the relationship between emissions of GHGs and air toxics varies substantially across these types of facilities. Also, how these facilities are defined differs across the different regulatory programs (see Appendix A for the definitions).²⁶ For electricity generation facilities, GHG emissions and toxicity-weighted emissions also showed low correlation; however, emissions levels across facilities varied broadly and logarithmic transformation resulted in a moderate (Pearson $r = 0.41$) and a highly significant correlation ($p < 0.001$).

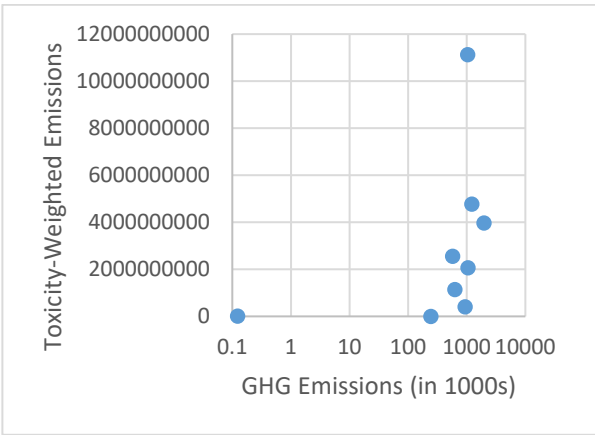
²⁶ ARB provides additional information on the differences between oil and gas facilities under different programs. See URL: https://www.arb.ca.gov/ei/tools/ievt/doc/ievt_oil_gas_crosswalk.pdf. The crosswalk table described in this document was not used for the initial analysis performed by OEHHA in this report.

Figure 3. Scatterplot of Toxicity-Weighted Emissions vs GHG Emissions from GHG Facilities with Emissions Data, by Cap-and-Trade Program Sectors (n=201)*

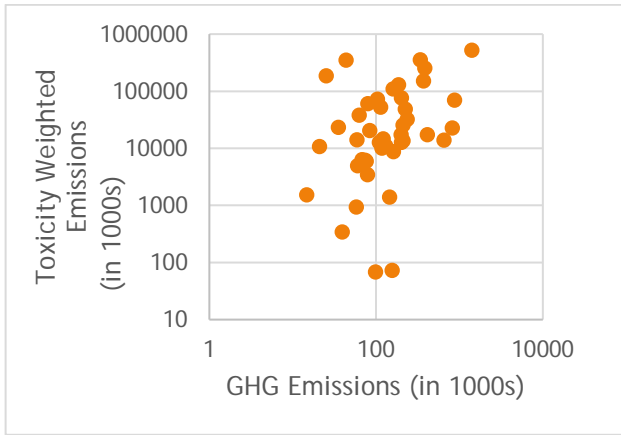


*The figure excludes “Other Combustion Sources” Category. GHG Emissions in MTCO₂e. Plotted on a Logarithmic Scale).

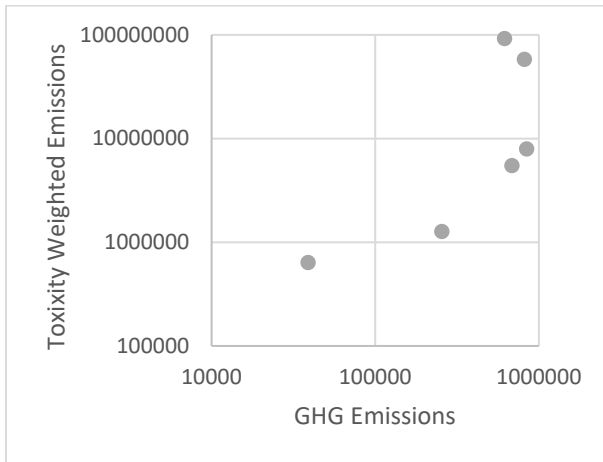
Figure 4. Scatterplots of Toxicity-Weighted Emissions vs GHG Emissions (MTCO_{2e}) by Cap-and-Trade Program Sectors (plotted on logarithmic scale).



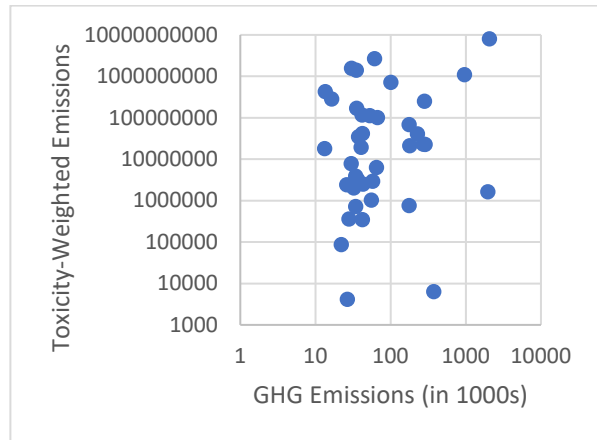
Cement Plants (n = 9)



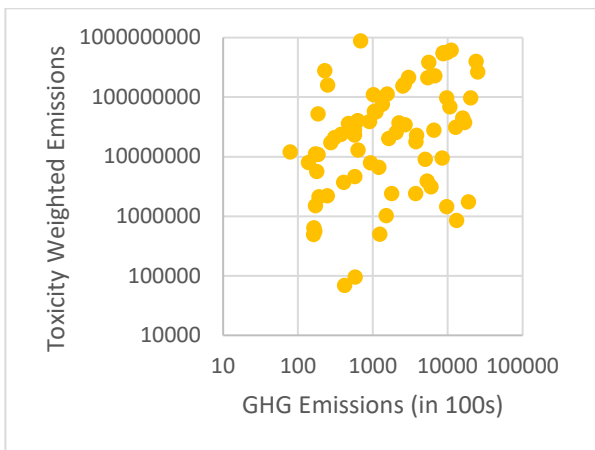
Cogeneration Facilities (n = 45)



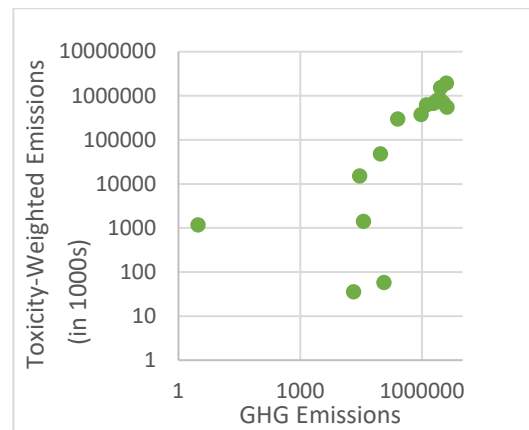
Hydrogen Plants (n = 7)



Oil and Gas Production Facilities (n = 41)



Electricity Generation Facilities (n = 83)



Refineries (n = 16)

Table 10. Correlation for GHG Emissions vs. Toxicity-Weighted Air Toxics Emissions for Cap-and-Trade Facility by Sector (2014 Emissions Data; Shaded r-Values Represent Statistically Significant Results, $p < 0.05$).

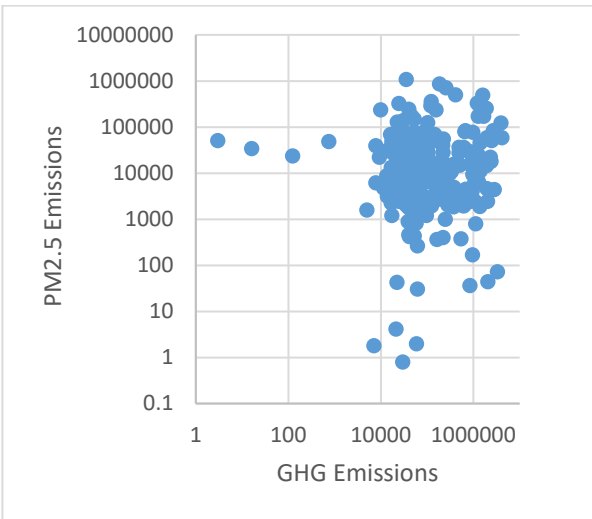
Sector	No.	Pearson (r-value)	Stat. Sig. (p-value)	Spearman (r-value)	Stat. Sig. (p-value)
<i>Cement Plants</i>	9	0.474	0.198	0.733	0.025
<i>Cogeneration</i>	45	-0.004	0.979	0.243	0.108
<i>Hydrogen Plants</i>	7	0.481	0.274	0.714	0.071
<i>Oil & Gas Production</i>	41	0.555	0.0002	0.100	0.533
<i>Electricity Generation</i>	83	0.173	0.119	0.282	0.0098
<i>Refineries</i>	16	0.818	0.0001	0.862	<0.0001

Criteria Air Pollutant and GHG Emissions

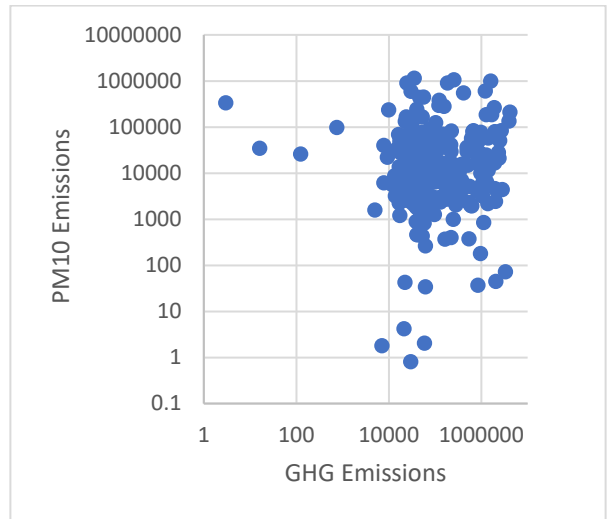
The relationships between GHG emissions and the emissions of specific criteria air pollutants from facilities were investigated in a manner similar to the analysis above using toxicity-weighted emissions. Figure 5 below show scatterplots of emissions of GHGs from facilities (as above) versus emissions of criteria air pollutants using data provided by ARB. Table 11 below shows the Pearson and Spearman correlation coefficients for each of the comparisons. This analysis includes facilities from all sectors for which data are available.

Because of the wide range of emissions of both GHGs and criteria air pollutants and the diverse nature of the industries analyzed here, the Spearman correlation likely provides more insight into probable relationships than the Pearson correlation. Here, Spearman correlations were moderately positive ($r \cong 0.5$) for total PM, PM10, PM2.5, SOx and NOx, individually. Correlations were poorer, though still positive, for organic and volatile gases (ozone-precursors), and carbon monoxide. Each of these correlations was statistically significant.

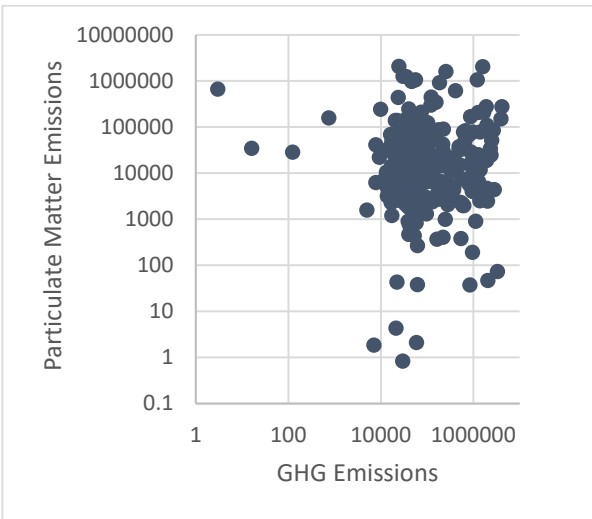
Figure 5. Scatterplots of Criteria Air Pollutant Emissions from All GHG Facilities with Emissions Data for the 2014 Reporting Year (n ≈ 316; Criteria Air Pollutant Emissions vs. GHG Emitter-Covered Emissions in MTCO₂e).



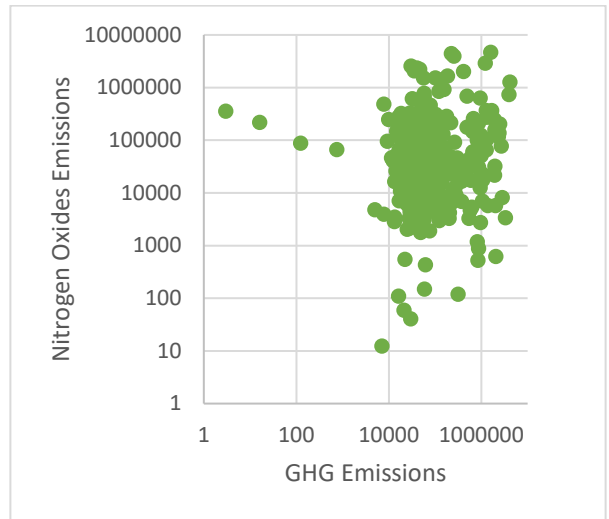
PM2.5



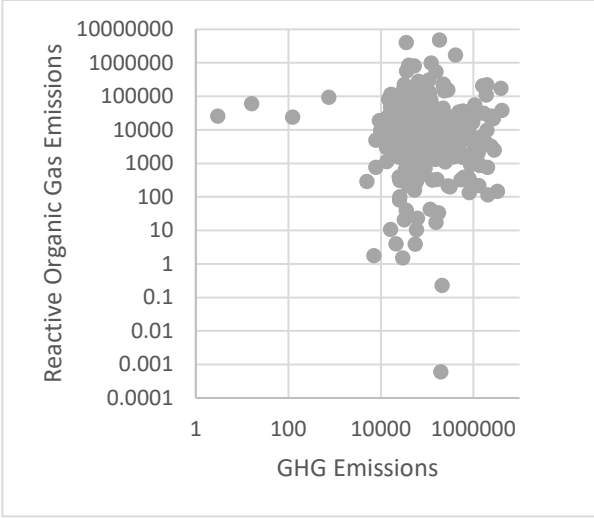
PM10



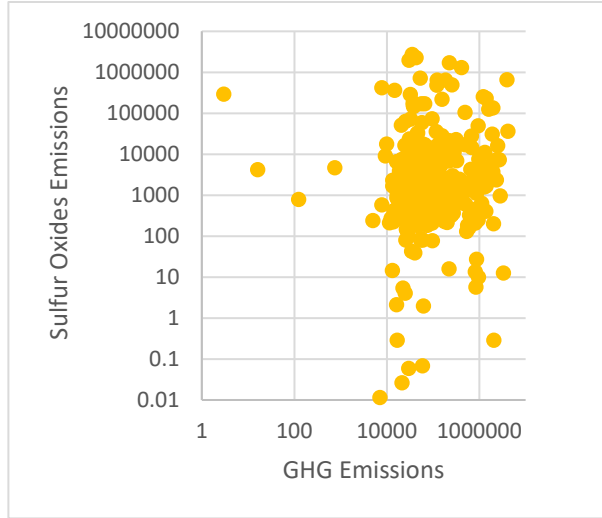
Total PM



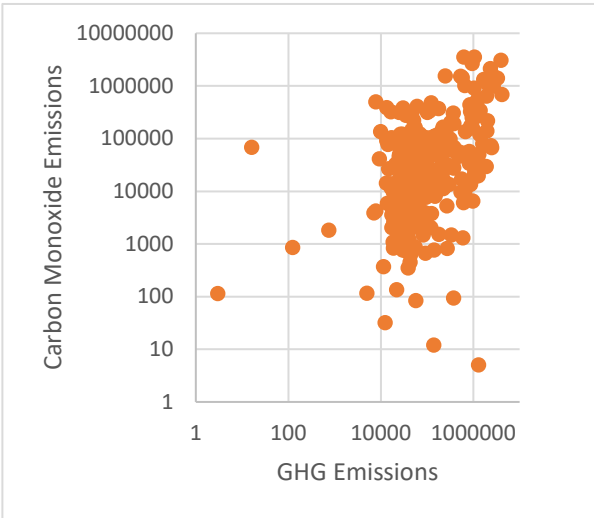
Oxides of Nitrogen (NOx)



**Ozone-Generating Compounds
(Reactive Organic Gases)**



Oxides of Sulfur (SOx)



Carbon Monoxide

Table 11. Correlations between Emitter Covered GHG Emissions (in MTCO₂e) and Criteria Air Pollutant Emissions (in pounds) for All Cap-and-Trade Facilities with Emissions Data (2014 Data).

Pollutant	Correlation (r-value)*	
	Pearson	Spearman
CO	0.451	0.394
NOx	0.515	0.508
SOx	0.460	0.564
PM	0.467	0.455
PM10	0.617	0.499
PM2.5	0.718	0.554
ROG	0.642	0.246
TOG	0.693	0.389
VOCs	0.652	0.246

* All correlation r-values for both tests were statistically significant ($p < 0.0001$).

OEHHA also examined relationships between individual criteria air pollutants and GHG emissions by industrial sector. These correlations are presented in a table in the Appendix (p. A-3). For refineries and in-state electricity generation facilities, correlations were moderate to high. All were statistically significant ($p < 0.05$). Other sectors with high correlations include cement plants (NOx, PM, PM10, and VOCs) and hydrogen plants (TOG, VOCs).

Case Study: Cement Plants

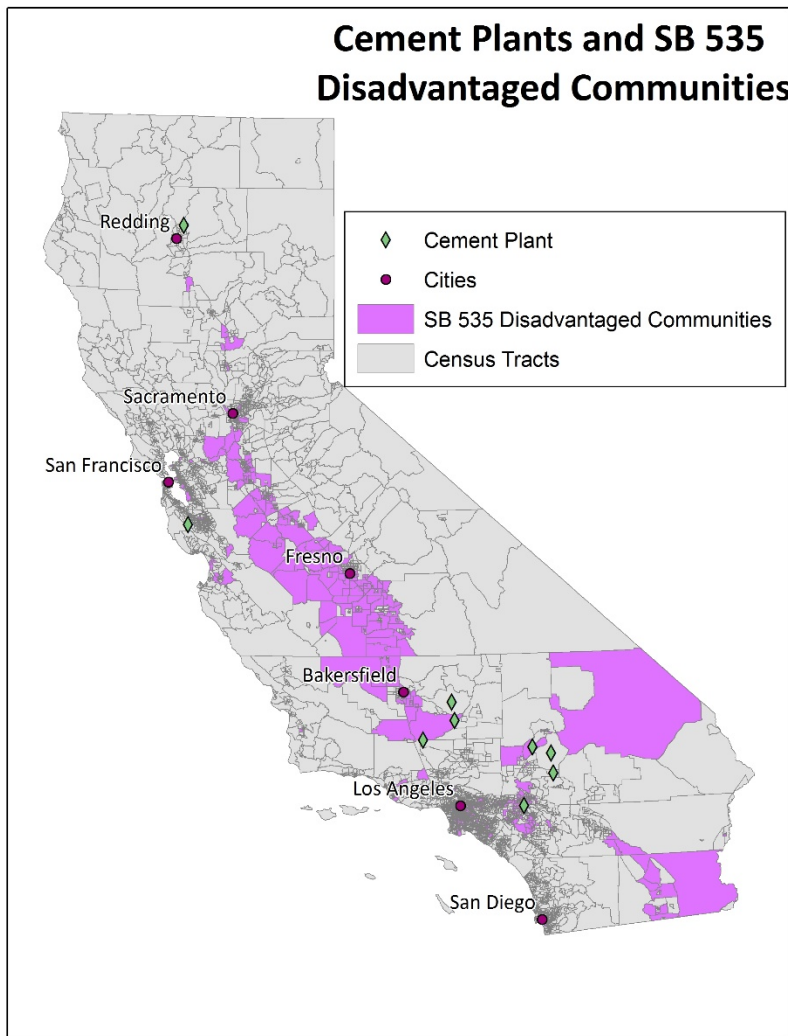
Cement manufacturing facilities were selected for a further analysis of the relationship between GHG emissions and emissions of toxic air contaminants. This sector was selected because (1) many of these facilities are among the highest scoring with respect to toxicity-weighted emissions to air (see Table 9) and (2) multi-year air toxics and criteria air pollutant emissions data are available from US EPA’s Toxic Release Inventory (TRI) Program and ARB, respectively. While TRI data have not yet been broadly matched for each facility across all Cap-and-Trade facility sectors, TRI emissions data are available for the nine cement plants that are currently covered by the Cap-and-Trade Program. The nine facilities are listed in Table 12 below and shown on the map in Figure 6.

Table 12. California Cement Plants Evaluated for GHG and Air Toxics Emissions.

Facility Name	Approx. Location
<i>CalPortland Co Colton Plant*</i>	Colton
<i>CalPortland Co Mojave Plant</i>	Mojave
<i>Cemex Construction Materials Pacific LLC</i>	Victorville
<i>Lehigh Southwest Cement Co Cupertino</i>	Cupertino
<i>Lehigh Southwest Cement Co Redding</i>	Redding
<i>Lehigh Southwest Cement Co Tehachapi</i>	Tehachapi
<i>Mitsubishi Cement Corp</i>	Lucerne Valley
<i>National Cement Co Of California Inc</i>	Lebec
<i>Riverside Cement Oro Grande Plant</i>	Oro Grande

*This facility ceased kilning operations in 2009; however, the plant retains grinding and distribution activities.

Figure 6. Location of Cement Plants Covered by the Cap-and-Trade Program.



The emissions data for these facilities were obtained for the years 2011-2014. GHG emissions were represented by those emissions that occurred locally and were covered by the Cap-and-Trade Program (emitter-covered emissions). TRI data obtained were toxicity-weighted emissions to air, as described above.²⁷ Since US EPA provides a calculated toxicity-weighted score for each facility, it was not necessary to adapt any of the chemical-specific scores, as was done for the data that originated from California's "Hot Spots" Program.²⁸ PM2.5 emissions data were obtained from ARB's CEIDARS (California Emission Inventory Development and Reporting System) data, which was downloaded from ARB's Integrated Emissions Visualization Tool.

Trends in emissions of both GHGs, air toxics, and PM2.5 are represented in Figure 7 below for each cement plant. One plant, CalPortland Colton, reported very low levels of GHGs and air toxics across all four years because it ceased kilning operations in 2009, though it continued to grind cement products. (This facility was excluded from the chart.) Across years within a given facility, there tended to be reasonable correlations in trends over time between GHG and toxicity-weighted emissions (for example, Cemex Construction Materials Pacific, Lehigh Southwest Cement Cupertino, Mitsubishi Cement, and Riverside Cement Oro Grande). Others showed poorer correlation (for example, CalPortland Mojave and National Cement). The pattern for National Cement is notable for a sudden increase in toxicity-weighted emissions in 2014. Further investigation of the specific chemical emissions data for this facility revealed that this increase was attributable to new reporting of chromium compound emissions in 2014, a departure from previous years. Since chromium emissions are generally consistently reported from cement plants, it is likely that the lack of chromium emissions for 2011-2013 is anomalous.

While year-over-year emissions at individual cement plants show some positive correlations, relative emissions of GHGs and toxicity-weighted air pollutants across facilities show fewer positive relationships. For example, Cemex Construction Materials Pacific had among the highest GHG emissions in this sector, while it was among the lower-scoring facilities for overall toxicity-weighted emissions, as reported to US EPA in their TRI program.

Although the observations from this specific industry are not directly applicable to other industries, this limited set of data suggests that year-over-year changes in GHGs within a facility are potentially meaningful in estimating changes in more toxic pollutants.

²⁷ TRI data were obtained through the TRI.NET tool available at URL: <https://www.epa.gov/toxics-release-inventory-tri-program/download-trinet>.

²⁸ Toxicity-weighted emissions from TRI are not directly comparable to those calculated from California "Hot Spots" emissions data. These are different regulatory programs with different reporting requirements.

Figure 7. Cement Plants: Emitter Covered Emissions of GHGs (MTCO₂e, MRR Data) (Top), Toxicity-Weight Air Emissions (TRI Data) (Middle) and PM_{2.5} Emissions (in tons, CEIDARS Data) (Bottom) over the Years 2011-2014.



Pearson and Spearman correlation coefficients were calculated using 2014 data on emissions of GHGs, air toxics, and PM2.5 and are shown in Table 13. The 2014 data used to calculate the correlations is shown graphically in Figure 7. GHG emissions and toxicity-weighted air emissions (TRI data) were not found to be correlated. A significant relationship (Spearman $r \cong 0.786$, p -value = 0.0208) was observed between GHG emissions and PM2.5 emissions.

Table 13. Correlations for Emitter Covered Emissions of GHGs (MRR Data) vs. Toxicity-Weighted Air Emissions (TRI Data) or PM2.5 Emissions (CEIDARS Data) for Eight Cement Plants

GHG Emissions vs. --	No.	Pearson (r-value)	Stat. Sig. (p-value)	Spearman (r-value)	Stat. Sig. (p-value)
<i>Toxicity-weighted air emissions</i>	8	0.097	0.82	0.405	0.32
<i>PM2.5</i>	8	0.593	0.122	0.786	0.0208

*2014 Emissions Data; Shaded r-Values Represent Statistically Significant Results, $p < 0.05$

Case Study: Refineries

Refineries represent another industrial sector covered by the Cap-and-Trade Program for which both GHG emissions and air toxics emissions data are available. Facilities from this sector were also identified as having among the highest toxicity-weighted emissions (see Table 9 above). Table 14 below lists 19 refineries reporting covered emissions in 2014. Most of these facilities are within one-half mile of an SB 535 disadvantaged census tract. Facilities have been grouped here by additional activities performed by the facilities that are relevant to GHG emissions, namely hydrogen production (generally for use by the refinery) and CO₂ production for off-site distribution.

Table 14. California Refineries Evaluated for GHG and Air Toxics Emissions. Shaded Rows Indicate Facilities within One-Half Mile of an SB 535 Disadvantaged Census Tract.

Facility Name	Approx. Location	Sectors*
Alon Bakersfield Refinery, Areas 1 & 2	Bakersfield	Refinery
Edgington Oil Company	Long Beach	Refinery
Kern Oil Refinery	Bakersfield	Refinery
Lunday-Thagard Company, DBA World Oil Refining	South Gate	Refinery
Paramount Petroleum Corporation Refinery	Paramount	Refinery
Phillips 66 Company, Santa Maria Refinery	Arroyo Grande	Refinery
Ultramar Inc, Valero Wilmington	Wilmington	Refinery
Phillips 66 Company, San Francisco Refinery	Rodeo	Refinery, H ₂
San Joaquin Refining Company	Bakersfield	Refinery, H ₂
Shell Oil Products US	Martinez	Refinery, H ₂
Chevron Products Company	El Segundo	Refinery, H ₂ , CO ₂
Chevron Products Company	Richmond	Refinery, H ₂ , CO ₂
ExxonMobil Oil Corporation	Torrance	Refinery, H ₂ , CO ₂
Phillips 66 Company, Los Angeles Refinery	Carson	Refinery, H ₂ , CO ₂
Phillips 66 Company, Los Angeles Refinery	Wilmington	Refinery, H ₂ , CO ₂
Tesoro Refining & Marketing Company LLC, Los Angeles Refinery	Carson	Refinery, H ₂ , CO ₂
Tesoro Refining and Marketing Company	Martinez	Refinery, H ₂ , CO ₂
Valero Refining Company, Refinery and Asphalt Plant	Benicia	Refinery, H ₂ , CO ₂

* Refinery activities include production of hydrogen (H₂) on-site and production of CO₂ for distribution.

Figure 8. Location of Refineries Covered by the Cap-and-Trade Program.

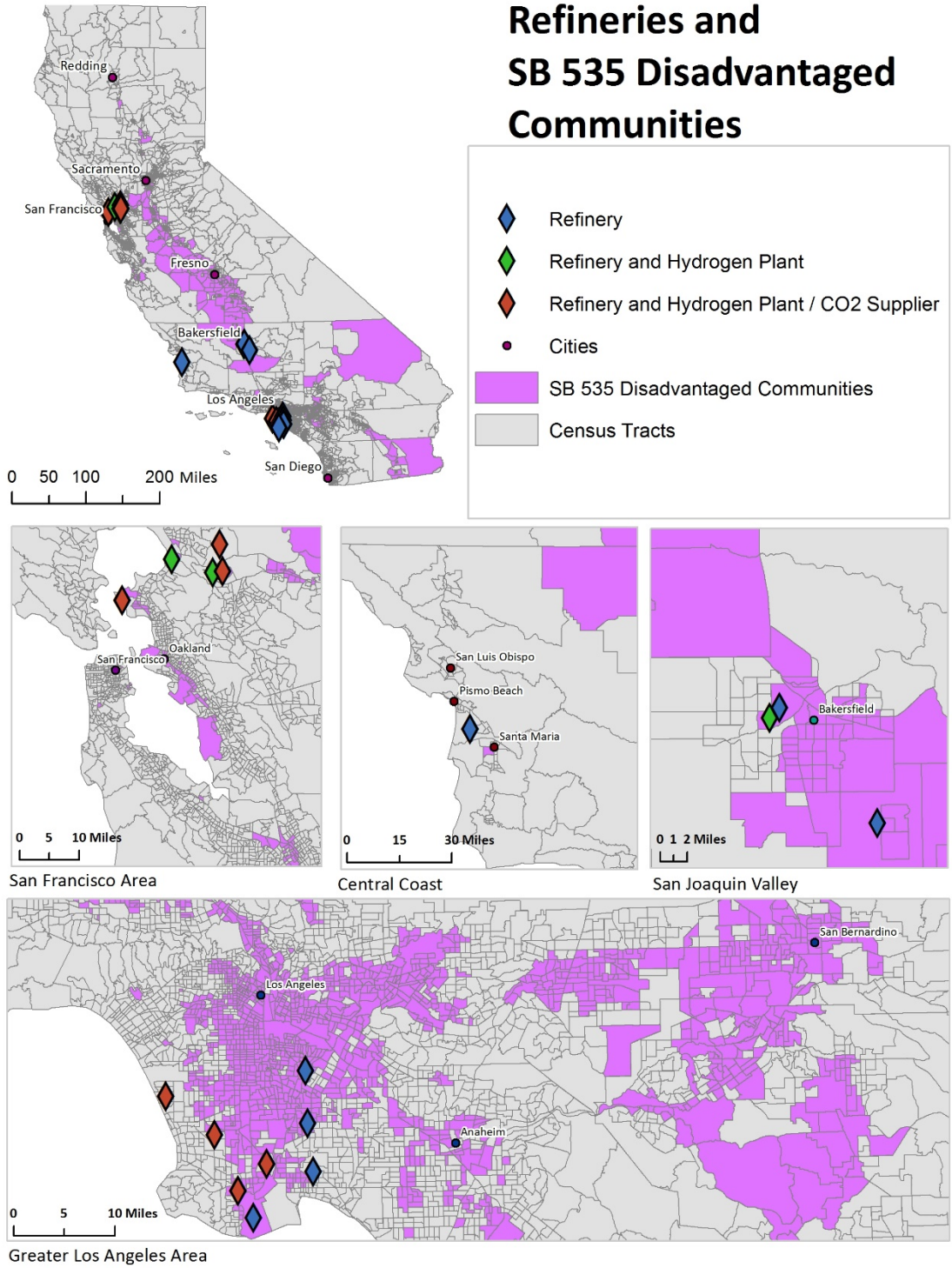
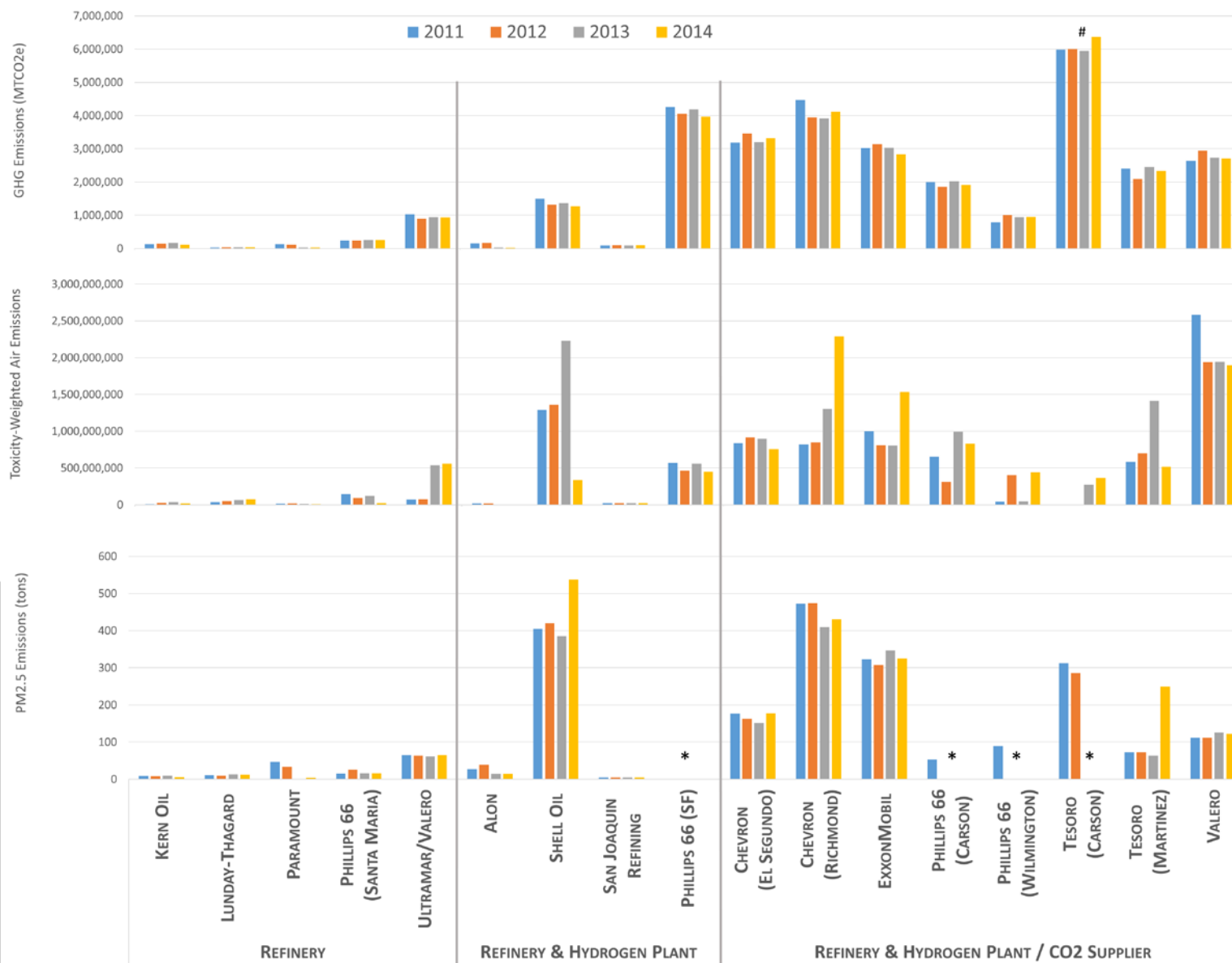


Figure 9. Refineries: Emitter Covered Emissions of GHGs (MRR Data) (Top), Toxicity-Weighted Air Emissions (TRI Data) (Middle), and PM2.5 Emissions (CEIDARS Data) (Bottom) for 18 Refineries Over the Years 2011-2014.



* Complete data (2011-2014) for PM2.5 emissions were not available for four facilities.

Emissions for three Tesoro refineries in Carson were combined in 2014 and are reported here as Tesoro (Carson). The emissions from the three facilities were added for each of the 2011-2013 reporting years to produce the Tesoro (Carson) estimates.

Charts showing the trends in GHG, air toxics, and PM2.5 emissions over the years 2011-2014 are shown in Figure 8. Edgington Oil Company was omitted from the chart because emissions levels were negligible over this reporting period.

Correlations between covered GHG emissions and toxicity-weighted air emissions from refineries were positive and statistically significant using this US EPA data set for air toxics emissions (Pearson r-value = 0.56; p = 0.015; Spearman r-value 0.81, p<0.0001); the correlations increased with logarithmic transformation (Pearson r-value = 0.87, p<0.00001). Visual inspection of the overall patterns also suggests facilities with higher emissions of GHGs tend to have higher emissions of both toxicity-weighted emissions and PM2.5.

In certain cases, the emission levels across these types of facilities did not correlate well. For example, the Shell Oil refinery and hydrogen plant (Martinez) produced moderate GHG emissions, but it was one of the highest sources of PM2.5 emissions across all facilities. Similarly, the Valero refinery, hydrogen plant, and CO₂ distributor (Benicia) also produced modest levels of GHGs, but it had among the highest rates of toxicity-weighted air emissions. Differences in relative emissions may correspond, for example, to the types of products that are made at different facilities.

Table 15. Correlations for Emitter Covered Emissions of GHGs (MRR Data) vs. PM2.5 Emissions (CEIDARS Data) or Toxicity-Weighted Air Emissions (TRI Data) for Refineries*.

GHG Emissions vs. --	No.	Pearson (r-value)	Stat. Sig. (p-value)	Spearman (r-value)	Stat. Sig. (p-value)
<i>Toxicity-weighted air emissions</i>	18	0.563	0.0150	0.806	<0.0001
<i>PM2.5</i>	14	0.914	< 0.00001	0.916	< 0.00001

*2014 Emissions Data; Shaded r-Values Represent Statistically Significant Results, p<0.05

VIII Discussion & Conclusions

This initial analysis is intended to inform future investigation of potential benefits and impacts to disadvantaged communities from emissions of toxic air pollutants, especially to the extent they are influenced by the greenhouse gas limits put in place through activities pursuant to AB 32. However, there are not enough emissions data available at this time to allow for a comprehensive and conclusive analysis. This report makes some preliminary findings that OEHHA expects to build upon in future analyses as it acquires and evaluates more data, but does not provide definitive findings regarding the effects of the GHG limit on any individual community, or disadvantaged communities in general.

Still, at this point in time, the analysis shows that many SB 535 disadvantaged communities are likely to see benefits or impacts from changes in emissions from the facilities covered under the Cap-and-Trade Program. This is because a disproportionate number of these facilities are located in or very close to these communities, and 2014 data show that overall GHG emissions appear to be positively correlated with criteria air pollutants and toxic air contaminants, although within specific industrial sectors not all correlations are statistically significant. In addition, some of the most highly polluting of these facilities are more likely to be located in these communities.

The relationship between greenhouse gas and toxic air pollutant emissions is complex. Fuel combustion is a primary source of GHG emissions across many of the industrial sectors that are currently covered by the Cap-and-Trade Program. Fuel combustion is also likely to produce a number of toxic air pollutants. For this reason, responses by facilities to the Cap-and-Trade Program that result in reductions in fuel use or increases in fuel efficiency are likely to have benefits from reductions of toxic pollutants at similar levels of production. Toxic air pollutants from activities other than fuel combustion are likely to vary widely by industrial processes. Additional investigation is warranted to understand how industrial facilities will comply with the Cap-and-Trade Program's requirements over time and how this may affect the release of air toxics.

For calendar year 2014 data, there are positive correlations between GHG, PM2.5 and toxic air pollutant emissions. The correlation between GHG and toxic emissions is especially notable in this initial analysis for refineries, hydrogen plants, and cement plants, although the total number of facilities in each of these sectors is relatively small. Further analysis by industrial sector and by specific chemical pollutants may reveal additional important relationships.

Future Data Collection and Analysis

The key challenge in analyzing the benefits and impacts of climate-change programs on disadvantaged communities is acquiring adequate data. As discussed in this report, data on emissions of GHGs, criteria air pollutants and toxic air pollutants are collected by multiple entities under different programs and statutory mandates. To date, there is no co-reporting of GHG and toxic emissions, and differences in reporting requirements across regulatory programs can complicate data analysis. In addition, toxic emissions data for many facilities are only updated every four years, further limiting conclusions that can be reached. Co-reporting of criteria, air-toxic and GHG emissions for the facilities subject to the Cap-and-Trade Program would aid investigation of emissions impacts. OEHHA will continue to acquire and analyze data for future reports, which will build upon the initial findings presented in this report.

Also, the Cap-and-Trade Program is still new, making it difficult to discern trends in how the program over time may be affecting emissions of criteria air pollutants and toxic air

contaminants. As the program continues to generate data over the next several years, it will be easier to detect and evaluate any such trends. It will also be important to evaluate the Cap-and-Trade Program in concert with other climate policies to evaluate the entire climate change program in aggregate.

In the near-term, OEHHA intends to obtain pre-2014 toxic air pollutant data to investigate how such data can be used to analyze impacts in SB 535 disadvantaged communities. OEHHA will also explore how Cap-and-Trade Program data may be helpful to understanding the drivers of changes in toxic pollutant emissions.

OEHHA also intends to further examine relationships between the emissions of GHGs and toxic air pollutants in specific industrial sectors in order to gain a better understanding of likely benefits or impacts that may result from changes in GHG emissions, even if air toxics emissions data are not available.

Lastly, OEHHA will explore opportunities to examine potential benefits and impacts in disadvantaged communities for other AB 32 programs outside of the Cap-and-Trade Program. OEHHA will work with ARB in developing analyses to support implementation of the Cap-and-Trade Adaptive Management Program to identify and track any emissions increases that could be attributable to the Cap-and-Trade Program.

Appendix A

California's Cap-and-Trade Program, Air Toxics "Hot Spots" Program, and US EPA's Toxic Release Inventory Program each has slightly different definitions of "facility". Some of these differences may have implications for how emissions data are reported such that there may not be an exact one-to-one relationship.

The following definitions of "facilities" are from different programs:

Cap-and-Trade Program

- (144) (A) "Facility," unless otherwise specified in relation to natural gas distribution facilities and onshore petroleum and natural gas production facilities as defined in section 95802(a), means any physical property, plant, building, structure, source, or stationary equipment located on one or more contiguous or adjacent properties in actual physical contact or separated solely by a public roadway or other public right-of-way and under common ownership or common control, that emits or may emit any greenhouse gas. Operators of military installations may classify such installations as more than a single facility based on distinct and independent functional groupings within contiguous military properties.
- (B) "Facility," with respect to natural gas distribution for the purposes of sections 95150 through 95158 of MRR, means the collection of all distribution pipelines and metering-regulating stations that are operated by a Local Distribution Company (LDC) within the State of California that is regulated as a separate operating company by a public utility commission or that are operated as an independent municipally-owned distribution system.
- (C) "Facility," with respect to onshore petroleum and natural gas production for the purposes of sections 95150 through 95158 of MRR, means all petroleum and natural gas equipment on a well-pad, or associated with a well pad or to which emulsion is transferred and CO₂ EOR operations that are under common ownership or common control including leased, rented, or contracted activities by an onshore petroleum and natural gas production owner or operator and that are located in a single hydrocarbon basin as defined in section 95102(a) of MRR.

When a commonly owned cogeneration plant is within the basin, the cogeneration plant is only considered part of the onshore petroleum and natural gas production facility if the onshore petroleum and natural gas production facility operator or owner has a greater than fifty percent ownership share in the cogeneration plant. Where a person or entity owns or operates more than one well in a basin, then all onshore petroleum and natural gas production equipment associated with all wells that the person or entity owns or operates in the basin would be considered one facility.

Air Toxics 'Hot Spots' Program

Health and Safety Code, Section 44304 defines facility as "every structure, appurtenance, installation, and improvement on land which is associated with a source of air releases or potential air releases of a hazardous material." The Guidelines further state that: "[e]xcept for the oil production operations defined in section X.14(b), for purposes of this regulation, the phrase "every structure, appurtenance, installation" shall mean all equipment, buildings, and other stationary items, or aggregations thereof, (A) which are associated with a source of air emission or potential air emission of a listed substance; (B) which involve activities that belong to the same two-digit Standard Industrial Classification code, or are part of a common operation; (C) which are located on a single site or on contiguous or adjacent sites; and (D) which are under common ownership,

operation, or control, or which are owned or operated by entities which are under common ownership, operation, or control.”

US EPA Toxic Release Inventory Program

Facility definition: “An entire facility means all buildings, equipment, structures, and other stationary items which are located on a single site or on contiguous or adjacent sites and which are owned or operated by the same person (or by any person which controls, is controlled by, or under common control with such person). A facility may contain more than one establishment.”

Table A1. Pearson (P) & Spearman (S) Correlation Coefficient R-Values for Criteria Air Pollutants and GHGs by Industrial Sector. Shaded Boxes Indicate Statistically Significant Correlations.

	Cement Plants		Cogeneration		Hydrogen Plants		Electricity Generation		Oil & Gas Production		Refineries		Other Combustion	
	P	S	P	S	P	S	P	S	P	S	P	S	P	S
CO	0.094	0.050	-0.031	0.197	-0.072	0.464	0.262	0.465	0.519	0.073	0.802	0.918	0.318	0.186
NOx	0.877	0.883	0.128	0.363	0.612	0.786	0.472	0.728	-0.026	0.122	0.913	0.921	0.884	0.306
SOx	0.193	0.467	0.211	0.484	0.574	0.771	0.487	0.651	0.265	0.361	0.675	0.797	0.202	0.544
PM	0.785	0.867	0.025	0.220	0.538	0.500	0.699	0.648	0.259	0.184	0.883	0.906	0.414	0.442
PM10	0.748	0.833	0.095	0.294	0.574	0.679	0.711	0.655	0.260	0.190	0.898	0.944	0.509	0.499
PM2.5	0.645	0.817	0.137	0.377	0.608	0.786	0.713	0.663	0.261	0.189	0.908	0.944	0.616	0.598
ROG	0.604	0.467	0.267	0.108	0.547	0.643	0.441	0.439	0.155	0.207	0.833	0.965	-0.003	0.043
TOG	0.525	0.467	0.331	0.148	0.799	0.821	0.556	0.660	0.255	0.271	0.892	0.959	0.075	0.141
VOCs	0.698	0.667	0.267	0.152	0.765	0.714	0.505	0.480	0.155	0.207	0.845	0.956	0.006	0.044

Exhibit 5

**The California Environmental Justice Advisory Committee's
Declaration in Support of Carbon Pricing Reform in California**

Approved by Environmental Justice Advisory Committee by majority vote (6-0, 3 abstained) February 15, 2017

1. **Whereas**, the climate system of the planet and the energy choices we make are inextricably linked to a looming ecological and social catastrophe; and
2. **Whereas**, the United States and all other countries of the world face a moment of great promise and great peril regarding our energy production and use, including: 1) our overdependence on fossil fuels such as oil, natural gas, and coal; 2) the production and use of bio-fuels with dubious sustainability attributes; and 3) the resurgence of domestic and international nuclear power development; and
3. **Whereas**, Asian, Black, Latino, and Native American communities in the United States, as well as indigenous and poor people around the world, disproportionately bear the negative economic, environmental, and health impacts of the fossil fuel economy at every stage of its life cycle including its exploration, extraction, production, refining, distribution, consumption, and disposal of its waste; and
4. **Whereas**, global climate change caused by the entire life cycle of fossil fuels, resulting in the release of carbon dioxide, other greenhouse gases, and associated co-pollutants into our oceans, air, soil, and vegetation jeopardizes the planet's ability to maintain a livable climate and causes grave health problems in poor communities, communities of color, and indigenous communities around the world; and
5. **Whereas**, the international scientific community predicts that climate change will cause great human suffering, the brunt of which will be borne by the world's poor, developing nations, disenfranchised indigenous communities, the infirm, and peoples of color that have been historically discriminated against at global, national, and local levels; and
6. **Whereas**, the best available science indicates that the planet is warming more rapidly than we understood when the Kyoto Accord was ratified and that reductions in greenhouse gases must be undertaken more quickly and with greater urgency than previously recognized; and
7. **Whereas**, economic globalization steers international commodity markets to manufacture and privatize the "right" to dispose of greenhouse gases and their co-pollutants into the air, oceans, soil, vegetation and human bodies and is in direct conflict with the true human rights of people and respect for our planet; and
8. **Whereas**, his Holiness Pope Francis believes that the "strategy of buying and selling 'carbon credits' can lead to a new form of speculation which would not help reduce the emission of polluting gases worldwide . . . [and] in no way does it allow for the radical change which present circumstances require"; and
9. **Whereas**, carbon trading is undemocratic because it allows entrenched polluters, market designers, and commodity traders to determine whether and where to reduce greenhouse gases and co-pollutant emissions without allowing impacted communities or governments to participate in those decisions; and
10. **Whereas**, the political power of the major global polluters has resulted in a carbon trading scheme in California that prevents the public from access to essential facility-specific compliance data, allows gaming of the system by market participants through such practices as resource shuffling, allows for excessive use of out-of-state offsets, and lacks meaningful penalties for failure to comply; and
11. **Whereas**, a recent study of California cap and trade found that many industry sectors increased in-state emissions, environmental justice communities are disproportionately impacted by climate polluters, excessive use of offsets denies environmental justice communities the benefits of on-site reductions, and validates the concerns raised by the environmental justice community after the passage of Assembly Bill 32; and
12. **Whereas**, revenue from the auction of allowances has provided important funding for greenhouse gas emissions reduction projects, and the Environmental Justice Advisory Committee has secured a portion of that revenue to benefit low-income and disadvantaged communities throughout California; and
13. **Whereas**, the California Legislature passed Senate Bill 32 in 2016, which enacted the most stringent climate reduction mandate in the world, requiring a forty percent reduction from 1990 levels by 2030; and
14. **Whereas**, the California Legislature passed Assembly Bill 197 in 2016, which enacted substantial reform to benefit environmental justice communities, including a mandate to the Air Resources Board to prioritize direct emissions reductions in the strategy to achieve the 2030 target; and

15. **Whereas**, the California Air Resources Board has drafted a 2030 Target Scoping Plan that does not reflect best practices in research or serve the interests of poor communities, communities of color, and indigenous communities in California and around the world; and
16. **Whereas**, greenhouse gases from fossil fuels will be substantially reduced only through a transition to greater energy efficiency and sustainable energy technologies that do not rely on fossil fuels; and
17. **Whereas**, capturing energy from the wind, sun, ocean, and heat stored within the Earth's crust builds the health and self-reliance of people and our communities, protects the planet, creates jobs, and expands the global economy; and
18. **Whereas**, greenhouse gases from agricultural sources must be reduced substantially in order to achieve the 2030 target, especially methane emitted by liquefied manure at factory farms; and
19. **Whereas**, sustainable agricultural practices such as pasture-based carbon sequestration presents the opportunity to utilize regenerative farming practices which benefit the climate and rural environmental justice communities; and
20. **Whereas**, global energy transformation is the politically unifying and inclusive principle that affirms the rights of all people -- including the poor, women, rural and indigenous communities -- to have access to affordable and sustainable energy and the enhanced quality of life that such access affords; and
21. **Whereas**, placing an appropriate price on carbon provides further incentives to decrease greenhouse gas emissions while generating revenue.

The California Environmental Justice Advisory Committee DECLARES that the California Cap and Trade system is inequitable and does not reflect the principles of environmental justice; and

The California Environmental Justice Advisory Committee FURTHER DECLARES that we will oppose at every turn all efforts to extend the California Cap and Trade system in California beyond 2020; and

The California Environmental Justice Advisory Committee FURTHER DECLARES that our demands for real changes in the way we make and use energy will not be silenced by promises of money or token adjustments to the fundamentally flawed trading and offsets approach.

The California Environmental Justice Advisory Committee FURTHER DECLARES that it supports a carbon tax, used in combination with direct emissions reductions, as a policy to replace the revenue generating component of Cap and Trade and to benefit environmental justice communities, support clean energy development, fund a just workforce transition to clean energy, invest in communities' capacity and infrastructure to adapt to climate change, and return a substantial portion to the public so that Californians, especially low-income residents, receive financial support during the transition to a clean energy economy.

BE IT THEREFORE, RESOLVED, that the California Environmental Justice Advisory Committee stands with communities around the world in opposition to carbon trading and offset use and the continued over reliance on fossil fuels; and

BE IT FURTHER RESOLVED, that the California Environmental Justice Advisory Committee will support conservation, regulatory, and other measures to address greenhouse gases only if they directly and significantly reduce emissions, require the shift away from use of fossil fuels and nuclear power, and do not cause or exacerbate the pollution burden of poor communities of color in California, as well as in the United States and developing nations around the world; and

BE IT FURTHER RESOLVED, that the California Environmental Justice Advisory Committee will oppose efforts by our state government to extend Cap and Trade, because this program will not reduce greenhouse gas emissions at the pace called for by the international scientific community, it will not result in a shift to clean and sustainable energy sources, it will support and enrich the state's worst polluters, it will fail to address the existing and future inequitable burden of pollution, it will deprive communities of the ability to protect and enhance their communities, and because if our state joins regional or international trading schemes it will further create incentives for carbon offset programs that harm communities in California, the region, the country, and developing nations around the world.

THEREFORE We, the undersigned organizations and individuals, affirm our solidarity with the California Environmental Justice Advisory Committee, poor, and indigenous people around the world.