

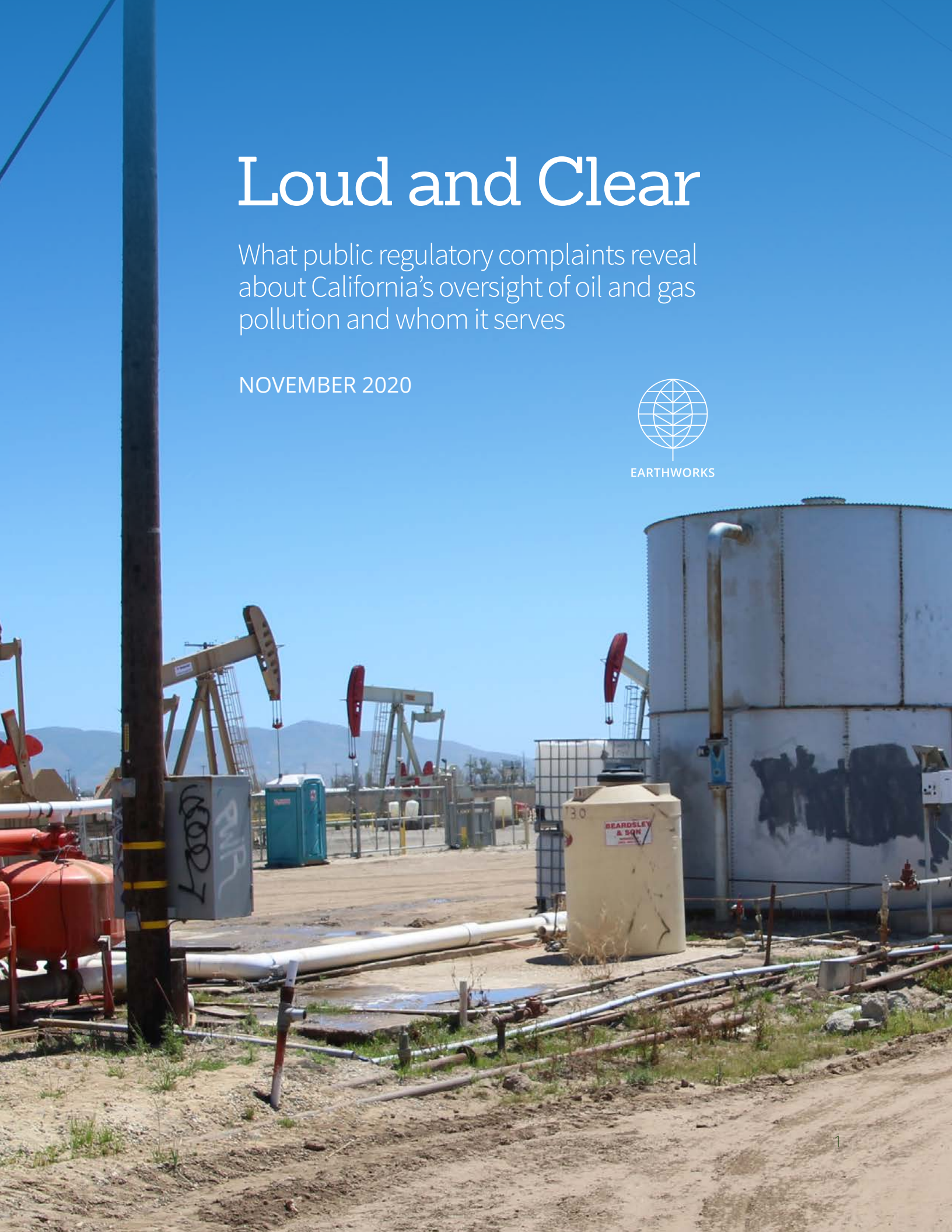
Loud and Clear

What public regulatory complaints reveal about California's oversight of oil and gas pollution and whom it serves

NOVEMBER 2020



EARTHWORKS



Loud and Clear

What public regulatory complaints reveal about California's oversight of oil and gas pollution and whom it serves

NOVEMBER 2020

Report available at earthworks.org/loudandclear-CA

Authors – Nadia Steinzor and Raphael Breit

Contributors – Bruce Baizel, Tyler Rivlin and Kyle Ferrar

Acknowledgments – This project was made possible with support from the John D. and Catherine T. MacArthur Foundation.

Photos by Earthworks except where noted.
Graphic Design by CreativeGeckos.com



EARTHWORKS

Offices in California, Colorado, Maryland, Montana, New Mexico, New York, Pennsylvania, Texas, and West Virginia

EARTHWORKS • 1612 K St., NW, Suite 904 Washington, D.C., USA 20006 • earthworks.org
202.887.1872 • Report available at earthworks.org/loudandclear-CA

Earthworks is dedicated to protecting communities and the environment from the adverse impacts of mineral and energy development while promoting sustainable solutions.

Table of Contents

1. Introduction: The Oil and Gas Pollution Threat	4
Earthworks' Community Empowerment Project: Documenting Pollution to Protect People and the Planet	5
2. The Complaint Process: Filing is Easy, Getting Answers is Hard	6
California's Separate Complaint Systems.....	6
Complaints Prompted Action and Some Pollution Reductions	9
Inspectors Respond, but Outcomes Not Always Clear	10
Persistence Pays Off to Slow Pollution in California's Oil Fields	12
Oil and Gas Oversight Capacity is Limited.....	13
Industry Expansion Clashes with Pollution Realities in the San Joaquin Valley.....	15
3. California Pollution Reduction Measures: Strong Progress but More is Needed	16
Leak Detection and Repair: Improvements Over Time	16
What is a Facility? Different Definitions May Blur the Pollution Picture.....	18
Tracking of Emissions: Comprehensive with Caveats.....	19
Timing Matters: California's Choice in Estimating Greenhouse Gas Impacts	21
4. Looking Ahead and Recommendations	22
Endnotes	25



1

Introduction The Oil and Gas Pollution Threat

The oil and gas industry in California is releasing large volumes of greenhouse gases – despite scientific consensus that current fossil fuel pollution must be greatly curtailed to prevent the most catastrophic effects of climate change.¹ This includes methane, which is 86 times more powerful than carbon dioxide over a 20-year time scale.²

At the same time, air quality is threatened in the communities near oil and gas operations. The main reason is increased pollution from methane and volatile organic compounds (VOCs), which science associates with a range of health problems.³

Yet despite these trends, policymakers (and the general public) continue to assume that state and federal governments have both the will and the resources to adequately oversee a complex and increasingly polluting industry. Years of research and field experience by Earthworks have demonstrated that this is not the reality on the ground.⁴

Currently, state regulatory and enforcement agencies are:

- Inconsistent and insufficient in how they respond to the public
- Primarily focused on issuing permits quickly
- Underfunded and short-staffed
- Subject to the political influence of the oil and gas industry
- Ill-equipped by state regulatory codes to address emissions



EARTHWORKS

COMMUNITY EMPOWERMENT PROJECT
Loud and Clear — Public Complaints Reveal Lack of Oil and Gas Pollution Oversight
earthworks.org/loudandclear-CA

Earthworks' Community Empowerment Project: Documenting Pollution to Protect People and the Planet

Earthworks started the Community Empowerment Project (CEP) because the oil and gas industry is putting people and the climate at risk – and agencies are failing in their responsibility to prevent that from happening.

Most air pollution from oil and gas operations is invisible, making it easy for companies and regulators to dismiss residents' concerns. CEP's certified thermographers use optical gas imaging (OGI) to make visible the pollution caused by intentional safety releases, equipment failures, and operator errors in oil and gas fields.

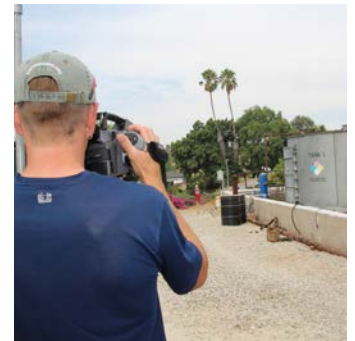
CEP staff then use that OGI evidence to file regulatory complaints with relevant state agencies and to document gaps in how they track and address oil and gas air pollution. It is a critical time to do so, with some states already committed to reducing oil and gas pollution and others moving in that direction. This report details findings of CEP's work in California from 2014-2020.

Nearly all state regulatory agencies have a complaint system. If properly designed and implemented, residents can notify regulators about problems at oil and gas sites – being critical “eyes and ears” while gaining needed assistance from public agencies.

For oil and gas regulatory regimes to be effective – in both combating pollution and protecting the public – complaint systems must be accessible, usable, responsive, and transparent.

Reduce pollution that harms health and the climate.

- Build trust in agencies mandated to both work with industry and serve the public.
- Respond to community concerns and experiences.
- Make government agencies more effective.
- Foster agency and operator accountability.



Seeing is Believing.

Earthworks uses Optical Gas Imaging to make invisible pollution visible.



Pollution viewed with the naked eye versus an OGI camera.

Yuba City Energy Center, Sutter County, California.



2

The Complaint Process: Filing is Easy, Getting Answers is Hard

California's Separate Complaint Systems

The California Air Resources Board (CARB) oversees policies, regulations, and programs to address the impacts of air pollution and climate change. CARB delegates planning, oversight, and permitting to 35 separate air pollution control districts (APCDs) or air quality management districts (AQMDs) statewide.⁵

Earthworks conducted OGI work and filed complaints in areas of the state covered by nine of the districts. However, we focused efforts in the four districts where the vast majority of the state's oil and gas wells and production are located: the San Joaquin Valley APCD, South Coast AQMD, Santa Barbara County APCD, and Ventura County APCD.⁶ The following analysis of public complaint systems and responses therefore focuses only on these four air districts.

All of these districts accept complaints by phone and online reporting forms. Earthworks' staff were also able to submit OGI footage and additional explanatory information about our field observations by email and to speak directly with district staff by phone.

In addition, CARB accepts air pollution tips and complaints through a hotline and submitted by email and online reporting forms.⁷ The California Environmental Protection Agency (CalEPA) also accepts complaints on a wide range of environmental problems, including air pollution from stationary and industrial sources (which presumably would include oil and gas operations). Depending on the nature of the complaint, both CARB and CalEPA may handle the complaint and launch an investigation or they may refer it to specific air districts.⁸

CARB and the four air districts in focus for this project state publicly that they will respond to complainants quickly and keep them informed of the status of complaints – but they do not provide specific timeframes within which the public can expect that to happen. CalEPA promises complainants they will receive an email within 15 days explaining how their complaints are being handled, but at the same time tell complainants to email the agency directly if they want to find out about the status of a complaint.⁹

CARB and the four air districts featured in this report state that they will respond to complainants quickly, but they do not provide specific timeframes within which the public can expect that to happen.



With regard to guidelines for investigating complaints, there are a few differences across the four districts:

- **San Joaquin Valley APCD** states on its website that inspectors respond to public complaints “on a priority basis.”¹⁰ Those priority levels are unclear, but the District promises that air pollution problems occurring at the time the complaint is submitted will be investigated “immediately” and that complaints made outside regular business hours are routed to on-call inspectors.¹¹ Apparently all complaints and supporting information are logged in a database, but it is deemed “confidential” and for agency use only.
- **South Coast AQMD** provides residents with detailed instructions on filing complaints, stating that all complaints are “immediately” sent to a supervisor and then assigned to an inspector, but not indicating response times to complainants themselves.¹²
- **Santa Barbara APCD** states that it strives to respond to all complaints quickly, usually within 24 hours – but only for complaints made within regular business hours.¹³ This would be problematic for residents experiencing impacts to their health and well being in the evenings and weekends, a real possibility for oil and gas complaints since operations are active 24-7.
- **Ventura County APCD** states that it strives to respond to all complaints quickly, usually within 24 hours.¹⁴ The District has a direct complaint line for the compliance division during normal business hours, as well as a 24-hour complaint hotline.

Of the four key air districts, only the South Coast AQMD appears to provide the public with an independent way to obtain information on the agency’s investigation outcomes, through an online database and tracking system.¹⁵



Earthworks made 174 visits to over 132 well sites, compressor stations, and other oil and gas facilities in the last five years in California.



School children playing near an active oil well in Arvin, Kern County, California.



Using an assigned complaint number and their own contact information, complainants can find out the status of their submissions, although not the supporting documentation (e.g., inspection reports) to determine how regulators held operators accountable for addressing the problems raised in complaints. The absence of any kind of public complaint tracking system in the other air districts makes it even more difficult for complainants to gain such knowledge and to learn how their complaints are connected to regulatory actions.

California's broad enforcement reports are important, but do not give residents a clear picture of problems at nearby wells and facilities and how regulators addressed them.

The state's primary oil and gas regulatory agency, the Geologic Energy Management Division (CalGEM) maintains an online, searchable map of wells that is linked to a database with downloadable information on well status and production, as well as drilling records and permits.¹⁶ However, the database doesn't include information on inspections, investigations, or enforcement actions related to particular sites.

CARB issues an annual enforcement report covering the entire state that summarizes violations and penalties for regulatory compliance actions by the agency in different sectors, as well as publicly posting all legal settlements for significant cases.¹⁷ Of the four districts, only the Ventura County APCD publishes regular reports on its regulatory enforcement actions, including a list of specific facilities for which notices of violation (NOV) were issued in the previous month and both the status of, and reason for, the violation.¹⁸

Such overarching enforcement reports help the public understand how agencies are performing their regulatory duties in the aggregate. However, they do not give residents a clear picture of problems that occurred at nearby wells and facilities and cause problems in the community, and how regulators may have addressed them.

To obtain that kind of information, residents must file public record requests directly with CARB or air district offices. This process can come with a considerable lag between when residents experienced problems and when they obtain records, and it can be time-consuming to review many pages of documentation looking for relevant and helpful information.

Earthworks' field staff were often able to obtain inspection reports detailing incidents and agency actions by contacting inspectors directly by phone and email. While positive, this process would be



more difficult for Californians with time constraints. In addition, not knowing the cause of a problem and whether or not it has been permanently resolved can be stressful for those living daily with pollution impacts.

Complaints Prompted Action and Some Pollution Reductions

Since 2014, Earthworks has made 21 trips to 13 California counties to film oil and gas pollution. We've made 174 visits to 132 wells, compressor stations, and processing plants, and documented significant pollution problems at many of them.

During this time, Earthworks staff filed 21 complaints with the San Joaquin Valley APCD, 25 complaints with the South Coast AQMD, 5 complaints with the Santa Barbara APCD, and 4 complaints with the Ventura County APCD. Earthworks also filed 8 additional complaints as part of field activities in areas covered by several other air districts.

Thirty eight (60%) of Earthworks' complaints resulted in actions intended to reduce pollution. Nineteen complaints (30%) led to a response by regulators in the form of an operator contact or inspection, but did not result in the issuance of any violations. Regulators didn't take any action in response to 4 complaints (6%). The results of the remainder (2, or 3%) are unclear, as they were filed more recently or could not be closed out at the time of writing.

RESULTS OF COMPLAINTS — FILED BY EARTHWORKS IN CALIFORNIA AS OF JULY 2020	
Closed — Action taken to reduce pollution	38
Closed — Other regulatory action taken	19
Closed — No action taken	4
Open Complaints	2
Total Complaints Filed by Earthworks	63

Earthworks uses the following three categories to track the regulator and operator responses to our complaints:

- 1 **Action taken is a regulator action specifically intended to reduce emissions** (i.e., the regulator requires an operator to replace or fix a piece of equipment).
- 2 **Other action is a regulator action** that, while not leading to pollution reductions, does potentially support more oversight (i.e., a regulator inspection or informing an operator of a problem).
- 3 **No action taken** means that agencies lost or ignored complaint submissions or otherwise declined to take action in response to a complaint.



Most of Earthworks' complaints generated at least one type of response, although regulators could have more than one response to a complaint (for example, contacting an operator and requiring an equipment fix that reduced emissions). The graph below shows the different responses that California regulators had to Earthworks' complaints.

These graphs show the types of responses California regulators had to Earthworks' complaints.



Inspectors Respond, but Outcomes Not Always Clear

Our field investigations in California revealed an overall willingness and ability on the part of air districts to respond to complaints and conduct inspections. Regulators with the San Joaquin Valley APCD and South Coast AQMD – the districts comprising most of the state's oil and gas production – were the most responsive to Earthworks' complaints. They consistently requested and used our OGI footage as the basis for conducting inspections and addressing leaks that we identified.

Regulators with the Ventura and Santa Barbara APCDs (as well as the other districts where Earthworks conducted field work) seemed much less familiar with taking complaints filed directly from the field and were not always sure how to process or respond to submissions of OGI footage. While inspectors sometimes indicated they had viewed the footage, resulting inspections were not as consistent or thorough as other districts.

In most cases, inspectors called or emailed Earthworks' staff (the complainants) within a few days and visited the sites quickly, or at most within several days. When we submitted higher counts of complaints to individual air districts in short time periods (e.g., in a day or week), it took a notably longer time for inspectors to respond – a likely indication of staffing shortages to review complaints and



determine regulatory actions. In the instances in which regulators issued a Notice of Violation (NOV), cases appeared to be investigated and resolved within several days to a few months.

In many instances, inspectors shared their reports with Earthworks by email following our direct requests. However, in some cases inspectors did not respond to our staff, who subsequently had to file public records requests in order to obtain information on how complaints and related problems at sites were resolved.

Based on inspection reports and emails with regulators, it appears that inspectors generally took action when they identified equipment failure (e.g., open valves and tank hatches) and improper maintenance (e.g., holes in pipes and rusted welds). In addition, in many cases, inspectors used portable gas analyzers to determine the presence of leaks and whether the volume of fugitive emissions being released exceeded regulatory limits established in the state's oil and gas climate pollution rule (see next page).

More broadly, Earthworks' collection of OGI evidence of pollution affirmed the concerns and experiences of frontline residents and supported engagement of local officials and efforts to achieve greater protections. Earthworks' complaint submissions and collection of OGI have supported the demands of community groups for stronger state and air district oversight of oil and gas operations to prevent pollution, rather than respond to it after-the-fact, particularly in disproportionately impacted communities in the Central Valley and Los Angeles areas (see box).

Pollution viewed with the naked eye versus an OGI camera, here at the Sun Mountain Jewett 1-23 well site in Arvin, Kern County California. On several occasions, Earthworks filmed pollution leaking from the top of tanks and filed complaints about this site, which is located close to homes and a school.



PERSISTENCE PAYS OFF

to Slow Pollution in California's Oil Fields



Above: Urban drilling puts homes in the path of oil and gas pollution, here at the Sentinel Peak Jefferson site in Los Angeles.

Several times in 2017-2019, Earthworks used OGI to document a leaking tank at the **Sun Mountain Oil Simpson 1 well in Arvin, Kern County**. We investigated at the request of the Central California Environmental Justice Network (CCEJN), which was responding to nearby residents plagued with sickening hydrocarbon odors. OGI footage confirmed that pollution was blowing from the well site toward nearby apartments and a playground.

Earthworks, CCEJN, and local residents filed complaints and asked the San Joaquin Valley APCD to address the ongoing pollution. Agency officials inspected the site, but repeatedly responded that due to an exemption in District rules for certain types of equipment, Sun Mountain didn't have to keep the tank "leak free." Earthworks and CCEJN pointed out to regulators that the District was also responsible for implementing California's new pollution rule for oil and gas facilities.

After repeated complaints and exchanges, it became clear that inspectors were trying to figure out where its own exemption ended and the state requirements began. In mid-2019, San Joaquin Valley inspectors sent a notice of violation to Sun Mountain Oil for failure to comply with the state's requirement to find and fix leaks of a certain volume. Ultimately, Sun Mountain shut the site down; if it comes back on line, air district inspectors now seem more prepared to subject it and other similar sites to state rules.

In addition, CCEJN used documentation of ongoing pollution and community complaints about the Simpson 1

and similar well sites in its campaign for an ordinance in Arvin (Kern County) to prevent new wells from being drilled in residential and commercially zoned areas. In 2018, the city council unanimously passed the ordinance.

Also in 2018, Earthworks filmed pollution at the **Sentinel Peak Jefferson well site in Los Angeles County**. We did so at the request of environmental justice coalition STAND-LA, which for years had been demanding action from regulators and city officials and filed a legal request for abatement of "nuisance" conditions. The site is just a few feet from the nearest home, 100 feet from a church, and 700 feet from an elementary school – putting many people in harm's way of toxic pollution and excessive light and noise.

In response to Earthworks' complaint and OGI footage, inspectors with the South Coast AQMD conducted an inspection, confirmed several leaks using an OGI camera and a gas analyzer, and issued a notice of violation to the operator. This may have been one of the "last straws" for South Coast AQMD, which soon after entered into an agreement with STAND and the City Council to shut down the site. STAND is now working to ensure that the operator cleans up the site before walking away, and doesn't leave the public with a toxic mess.



An apartment building and playground adjacent to the Simpson 1 well in Arvin, Kern County California.



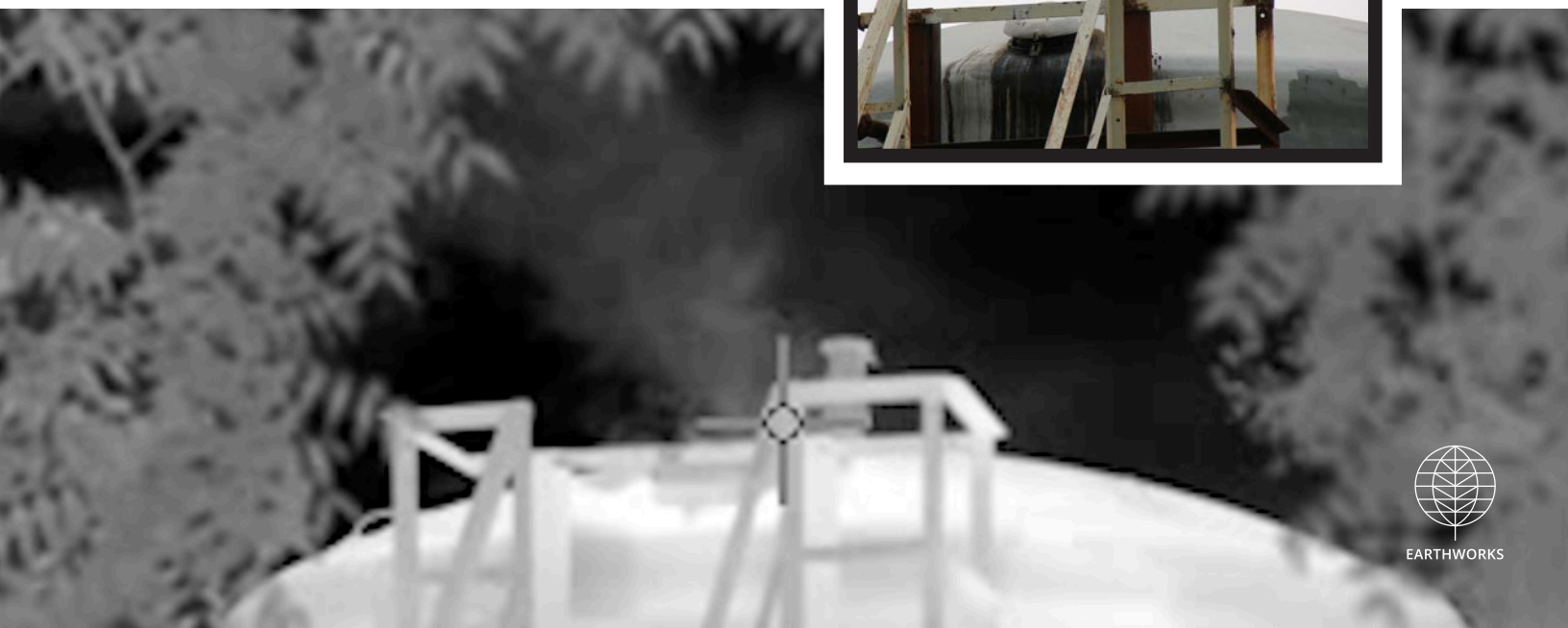
Oil and Gas Oversight Capacity is Limited

More than a century of oil and gas activity in California has resulted in immense production fields, massive refineries, and the industrialization of both rural and urban communities. The California Department of Conservation maintains WellSTAR, an online well tracking database that contains well location, status, and permit data. The WellSTAR page has an interactive well map.¹⁹ Well data is publicly available on the Department of Conservation's geographic information system (GIS) page, which is updated daily along with the WellSTAR map.²⁰ As of July 20, 2020, the well database lists nearly 68,000 active and 37,000 "idle" wells statewide (i.e., those that haven't registered production in two years but haven't yet been plugged).²¹

In addition, a recent research report indicates that across California, there are over 5,500 "orphan" wells that have not produced in at least five years and have no clear owner, as well as 70,000 wells that produce so little or have been idle for so long that they will eventually have to be plugged, at a significant cost to the state.²²

CalGEM tracks the number of active and idle wells by county, legislative district, and its own type of district – but those delineations don't match the boundaries of air pollution control and air quality management districts. To obtain the well numbers in air districts, Earthworks' researchers had to use GIS software and combine different data sets. This involved independently downloading the well dataset from CalGEM and air district boundary data from CARB and then combining them. Only then could well numbers per air district be calculated.

Pollution viewed with the naked eye versus an OGI camera, here from a leaking tank at the Simpson 1 well in Arvin, Kern County California (for more information see previous page).



It is unclear whether California’s air districts have the resources to properly oversee operations of active wells – as well as idle wells, which can also leak pollution into air and water over time. Because the districts are mandated to control pollution across several sectors (e.g, agriculture, transportation, and industry), it is difficult to determine the level of oversight resources dedicated specifically to oil and gas operations.

As seen in the table below, Earthworks’ researchers were able to identify the number of inspectors employed by the four air districts for this report. The specific oil and gas caseloads of those inspectors, i.e., how many wells and facilities they oversee, is difficult to discern. However, if these caseloads are on top of inspectors’ responsibilities in other sectors, staff shortages could potentially be even more challenging.

Piecing together data on both wells and inspectors was far from straightforward for Earthworks’ researchers. It would be even more challenging for Californians with time constraints to gain a clear picture of the capacity of the air districts to oversee the state’s oil and gas industry.

CALIFORNIA AIR DISTRICT INSPECTION CAPACITY			
Air Districts	Number of Air District Inspectors	Counts of Operational Wells	Inspector/Well Ratio
San Joaquin Valley ²³	64	84,458	1/1,320
Santa Barbara County ²⁴	6	2,592	1/432
South Coast ²⁵	113	8,912	1/79
Ventura County ²⁶	7	4,073	1/582



INDUSTRY EXPANSION CLASHES WITH POLLUTION REALITIES IN THE SAN JOAQUIN VALLEY



Long a significant oil producer, California currently ranks seventh among US states. However, volumes have been declining since the 1980s, when the state produced twice as much as today.²⁷ Yet even in the face of this downward trend, operators continue to drill, plan for expansion, and hope that market and political forces will work in their favor in the future.

These ambitions increasingly clash with the realities of environmental harm caused by the industry. Nowhere is this clearer than in the San Joaquin Valley, where socioeconomic vulnerability and the health hazards of pollution exposure are interlinked and persistent.²⁸

In 2015, **Kern County officials passed an ordinance to fast-track oil and gas permits** and support expanded oil and gas production, projecting that more than 3,600 new wells could come online annually for the next 20 years.²⁹

In response, environmental and social justice organizations and farmers sued the county for ignoring the potential harm from water use, air pollution, farmland degradation, and noise, and for eliminating public notice in the well permitting process.³⁰ A state court recently agreed, ruling that Kern County had failed to comply with California's Environmental Quality Act. As a result, the county has stopped issuing permits under the ordinance and going forward, the state will be in charge of environmental reviews of new drilling proposals.

For decades, the San Joaquin Valley Air Pollution Control District (APCD) has issued **emission reduction credits (ERCs)** to industries, including oil and gas. ERCs allow operators whose facilities pollute to offset excessive emissions by trading or purchasing credits representing pollution elsewhere.

Credits are particularly coveted where air quality is so poor that the region is classified as being out of attainment with (i.e., doesn't meet) federal standards, and therefore unable to absorb the additional pollution burden posed by new industrial projects. This is exactly the situation in the San Joaquin Valley.

In 2018, Earthworks, working with state and local partners, investigated the APCD's issuance of ERCs for the release of greenhouse gases and VOCs, revealing numerous instances in which credits were issued even though they didn't meet the air district and federal requirements. A key conclusion was that because ERCs in California don't have expiration dates, they can be purchased and used for decades regardless of whether or not they still would help to reduce pollution and mitigate air quality problems.

In response, CARB launched an audit of the San Joaquin Valley ERC program. CARB concluded that while the APCD has over time required more stringent pollution controls, ongoing industrial activities compromise progress to safeguard air quality and health. Because of this, the feasibility of expanding industrial activities, including oil and gas operations, is being called into question. As summed up by CARB in its audit report, "Further improvements in air quality will require both stationary and mobile source emissions to be minimized."³¹

Oil and gas operators continue to drill new wells and plan for expansion—ambitions that increasingly clash with degraded air quality and health.



3

California Pollution Reduction Measures: Strong Progress but More is Needed

Like many states, California is struggling to improve air quality in the face of the triple pollution threat of transportation, agriculture, and heavy industry. Large portions of the state have the status of non-attainment for federal limits on ozone, with many counties classified as “serious” and “extreme” in that regard.³²

Some California areas with the most compromised air quality also have extensive oil and gas development. According to the American Lung Association’s State of the Air 2020 report, Los Angeles has the worst ozone pollution in the nation, while in the San Joaquin Valley, the city of Bakersfield and the Fresno-Madera-Hanford metropolitan area have the worst year-round and short-term particle pollution, respectively.³³ Both particulate matter and ozone are linked to a range of respiratory, pulmonary, and cardiovascular conditions and an increased prevalence of illness and premature death.³⁴

These realities leave regulators with no choice but to contend with pollution created by the oil and gas industry. Doing so is particularly pressing in the face of recent studies showing that on top of being bad for the climate, methane and ethane (key oil and gas pollutants) contribute to the formation of ground-level ozone.³⁵ According to CARB, oil and gas operations account for 15% of methane pollution in California.³⁶

Regulators have no choice but to address oil and gas pollution—particularly since studies show that in addition to being bad for the climate, methane and ethane contribute to the formation of health-harming ozone.

Leak Detection and Repair: Improvements over Time

California has held a leadership position in addressing climate change, taking action sooner than many other states by adopting goals for greenhouse gas reductions into law in 2006.³⁷ Since that time, the state has been pursuing a variety of strategies to rein in climate-causing pollution from all sectors.

In 2017, the state established measures to reduce greenhouse gas pollution from oil and gas operations and natural gas storage facilities.³⁸ Commonly referred to as the California Oil and Gas Regulation (COGR), these rules incorporated key aspects of federal rules to reduce emissions of VOCs and methane using Leak Detection and Repair (LDAR) protocols and the installment of new equipment and technologies.³⁹ Under these rules, operators have to conduct quarterly inspections of their sites, with the recommendation of using OGI as a screening tool to find visible leaks, followed by measurement using a gas analyzer.⁴⁰

In addition, COGR requires operators to conduct daily audio/visual inspections to improve the chances of finding leaks. As indicated in the table below, COGR also establishes compliance periods that, over time, require operators to detect and repair ever-smaller leaks faster. This is in contrast to weaker federal rules that give operators 30 days to repair any leaks visible with OGI.⁴¹

CARB holds primary responsibility for implementation of the new rules, but has delegated ongoing enforcement authority to air districts through memoranda of understanding.⁴² As a first step, oper-

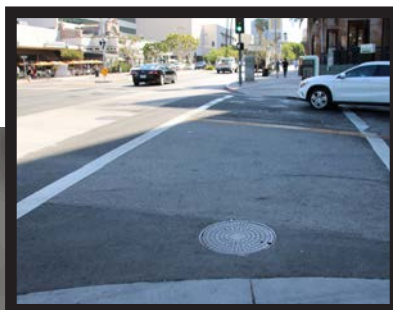


ators were required to register all of their equipment subject to COGR with the relevant air districts. Data from operators on implementation activities, including the number and concentrations of leaks detected and repaired, were due by July 2019.

CALIFORNIA LEAK DETECTION AND REPAIR (LDAR) REQUIREMENTS		
Regulation implementation timeline	Leak concentration (in parts per million by volume, ppmv)	Period to repair or remove from service
<i>January 2018-December 2019</i>	10,000-49,999 ppmv	14 days
	50,000 ppmv or greater	5 days
<i>Starting January 2020</i>	1,000-9,999 ppmv	14 days
	10,000-49,999 ppmv	5 days
	50,000 ppmv or greater	2 days

At the time of this writing, CARB is compiling that data and preparing to report on progress made to implement COGR, including estimates of the greenhouse gas emission reductions achieved to date as a result of the rule.⁴³ CARB’s work will be the first estimates nationwide of the degree to which LDAR rules result in emission reductions.

When COGR was adopted, CARB estimated that, if fully implemented, it would result in pollution reductions of more than 1.4 million metric tons of carbon dioxide equivalent (CO₂e) per year.⁴⁴ Calculations by Clean Air Task Force show a lower level of reduction, projecting that California’s methane reduction rules could, *if properly enforced*, achieve reductions in methane, VOC, and hazardous air pollution of about 152,000 metric tons by the end of 2019 and further reductions of about 110,000 metric tons annually in coming years.⁴⁵



Pollution viewed with the naked eye versus an OGI camera, here coming from a manhole in a busy neighborhood in Los Angeles. The source is likely an abandoned oil well leaking underground.

What is a facility?

DIFFERENT DEFINITIONS MAY
BLUR THE POLLUTION PICTURE



CARB's inventories provide the public with critical information, but vary due to the different types and levels of pollution and operations that are required to report emissions. This makes it difficult to compare data across sites and locations – a problem that becomes even more complicated because of the very definition of “facility.”

In the CEIDARS database, which underpins inventories for criteria (i.e., federally regulated) and toxic pollutants, an oil and gas facility is defined as a “discrete, contiguous operation” that may have a single lease and name, or which encompasses defined pollution sources (which could include certain equipment at well sites) across an area up to one square mile.⁴⁶

In the Mandatory Reporting Regulation (MRR) database that underpins the greenhouse gas inventory, both large, distinct facilities and oil and gas wells are included. However, companies report emissions for all their wells across an entire geologic basin – with these aggregated results defined as a single “facility.”⁴⁷

CARB states that “because of this difference, most onshore oil and gas production facilities do not have a one-to-one relationship between CEIDARS and MRR data.”⁴⁸ CARB has developed a “crosswalk” methodology that agency staff use to associate the largest pollution sources in the different databases, but acknowledges that there is inherent “uncertainty” and “complexity” in the approach, particularly when the names of operators and sites don't match.⁴⁹

This variability across databases can make it difficult for the public to gain a clear picture of the pollution caused by specific sites and operators. For example, a search in CARB's Pollution Mapping Tool for greenhouse gases in the San Joaquin Valley in 2017 turns up over 150 sources, including total volumes from entire companies (e.g., Aera Energy and Berry Petroleum). Conducting the same search for VOCs and benzene instead turns up only about 20 sources, including a few energy-related stations but no oil and gas production companies.



As a result, the public might get the impression that certain operators release greenhouse gases but not other pollutants – when in reality all oil and gas activities (from production to processing to transport) release a mix of different types of emissions. Only by digging a bit deeper into the Mapping Tool, can users view facility-level summary reports reflecting data pulled from the different inventories (at least for those pollution sources that CARB has been able to match).

Oil well pump jacks at the Lost Hills Oil Field in central California.

Photo by Richard Masoner/Cyclelicious/creativecommons.org



Tracking Emissions: Comprehensive with Caveats

California has been systematically tracking and compiling data on pollutants that harm air quality and health since the 1980s and on greenhouse gas emissions since global warming legislation passed in 2006 – far longer than other states.⁵⁰ State-level pollution reporting and tracking systems provide critical information for regulators, policymakers, researchers, and the public to determine the relative success in meeting air quality and climate goals over time.

Recent legislation requires CARB to develop regulations and systems for increased air monitoring and pollution tracking, more uniform data collection across air districts, and greater public access to information.⁵¹ Emission inventories (as well as community-based air monitoring programs) now exist that, to varying degrees, provide pollution information on industrial processes as a whole or by location and facility.

- **US Environmental Protection Agency’s (US EPA’s) Greenhouse Gas Reporting Program (GHGRP).** California’s oil and gas operations with the largest volumes of pollution submit annual data on their estimated greenhouse gas emissions directly to the GHGRP.⁵² This database is frequently used by federal and state regulators and policymakers to judge how much the oil and gas sector emits. However, it only covers sources permitted to release more than 25,000 metric tons of carbon dioxide equivalent (CO₂e) – the common measurement of total greenhouse gases – per year. This effectively excludes many thousands of wells, compressor stations, and other facilities that report lower volumes of emissions or are exempt from GHG reporting requirements entirely, but nonetheless collectively have a widespread, significant pollution impact.
- **California Greenhouse Gas Emissions Inventory.** CARB oversees this inventory, which is based on mandatory reporting requirements.⁵³ The inventory tracks emissions on an annual basis from various sectors, including petroleum and natural gas systems; the data is primarily self-reported by companies and large facilities, supplemented by data from various state agencies.⁵⁴

Facilities emitting 10,000 metric tons or more of CO₂e must report to the inventory every year; CARB also takes the extra step of verifying the emissions estimates submitted by facilities emitting 25,000 metric tons or more.⁵⁵

The emissions inventory includes estimates for carbon dioxide, methane, nitrous oxide, and fluorinated gases with high Global Warming Potentials (GWPs), a measure of climate impact. CARB makes current and past inventories available online with associated reports and explanations of data sources and approaches. Annual emissions data are available in summary form for entire sectors (e.g., oil and gas production and processing and petroleum refining) and specific activities (e.g., flaring and fuel combustion).⁵⁶



Oil tanks close to homes in Los Angeles County.



- **Criteria Air Pollutant Inventory.** This CARB inventory is based on the California Emission Inventory Database and Reporting System (CEIDARS) database.⁵⁷ The inventory includes hazardous air pollutants that are particularly toxic to health (e.g., benzene and formaldehyde) and the “criteria” pollutants regulated under the US Clean Air Act.⁵⁸

CEIDARS has data on pollution from various sources and processes, including “excess” emissions above permitted levels (e.g., malfunctions and “blowdowns”). Environmental health research confirms that large, episodic emission events, such as these, can cause health impacts immediately, or in as little as 1-2 hours, in part because toxicity is determined by the concentration of the chemical and intensity of exposure.⁵⁹

In keeping with US EPA requirements, stationary sources that emit at least 250 tons per year (tpy) of criteria pollutants are required to report emissions every three years.⁶⁰ However, CARB goes further, setting this threshold at 10 tpy and allowing air districts to set even lower levels for reporting – which results in many more sources captured than if the state depended on federal rules alone.⁶¹ The inventory currently covers 1987-2017 and is publicly accessible through a facility search function that allows users to identify pollution from specific facilities by air district, county, city, zip code, and year.⁶²

- **CARB Toxics Inventory** is also based on the CEIDARS database and is accessible through the same facility search function.⁶³ This data collection system is part of California’s “Hot Spots” program established by law in 1987 to track, assess the health impacts of, and notify the public about the release of hazardous substances from a range of sources.⁶⁴
- **CARB Pollution Mapping Tool.** This interactive, online system allows users to easily find emissions data for criteria pollutants, greenhouse gases, and hazardous air pollutants that are particularly toxic to health (e.g., benzene and formaldehyde).⁶⁵ The tool covers both large facilities (such as processing plants) and overall production by an operator.

The Tool covers various industrial sectors, including oil and gas production and associated processes (i.e., extraction, pipeline transportation, and use in utilities). Users can search the data by air district, county, and zip code.

This type of information can be useful to residents wanting to understand emission sources near them and the types of pollution to which they may have been exposed – information that is necessary to hold operators and regulators accountable for enforcing safeguards and permit limits. At the time of this writing, however, the latest data available was for 2017.

- **South Coast Air Quality Management District Emissions Inventory.** This inventory covers criteria and toxic pollutants and is based on self-reported estimates by permitted facilities within the South Coast AQMD. The district has been collecting these data since 2000, uses them to track emission trends and calculate annual emission fees, and publishes the inventory on an annual basis in its Air Quality Management Plan.⁶⁶

The inventory covers facilities with estimated annual emissions of at least four tons of sulfur oxides, VOCs, nitrogen oxides, specific organics, and particulate matter, or at least 100 tpy of carbon monoxide.⁶⁷ An associated search tool allows the public to look up pollution types and volumes for specific facilities by year, using facility ID or name, street, city, or zip code.⁶⁸ However, South Coast AQMD’s limited reporting requirements mean that for the oil and gas sector, only large refineries are included in this inventory.



Timing Matters:

California's Choice in Estimating Greenhouse Gas Impacts

To determine the climate impact of different greenhouse gases, scientists calculate their inherent warming ability in relation to carbon dioxide (CO₂), the climate pollutant that is generally emitted in the largest volumes.⁶⁹ CO₂ is assigned a value of "1" and other gases are given values relative to that baseline, called Global Warming Potential (GWP).⁷⁰ This allows for the comparison of the potency of different greenhouse gases and the calculation of overall volumes in terms of "carbon dioxide equivalent" (CO₂e).

When the California Air Resources Board (CARB) established greenhouse gas reduction goals for the state's Oil and Gas Rule (COGR), it assigned methane a 20-year GWP in keeping with the most recent international standards from 2014.⁷¹ With this GWP, methane is defined as 84-86 times as potent for the climate as carbon dioxide.⁷²

Yet at the same time, California's Greenhouse Gas Emissions Inventory uses older international standards established in 2007, relying on 100-year GWPs to determine the impact of methane and other greenhouse gases.⁷³ Updating the calculation methods used in the Emissions Inventory could potentially yield a more accurate assessment of the potential impact of reported pollution.

Using a 100-year GWP puts methane at only 28-36 times worse for the climate than carbon dioxide.⁷⁴ This has the effect of lowering the projected climate impact of methane emissions and the volume calculated as CO₂e. For example, 10 tons of methane equals 840-860 tons of CO₂e at the 20-year timescale, but only 280-360 tons at the 100-year timescale.

Using a 20-year GWP for methane is important because it better reflects the real impacts of the gas, which remains in the atmosphere for only about 12 years.⁷⁵ This approach also puts COGR in line with another California strategy to significantly reduce pollutants that are "short-lived" (i.e., remain in the atmosphere relatively briefly) – which in turn was mandated by law because of the health and safety impacts of climate change.⁷⁶



4

Looking Ahead and Recommendations

According to a recent state analysis, California met its initial goal of reducing greenhouse gas emissions below 1990 levels in 2016, four years ahead of schedule.⁷⁷ Last year, the Governor adopted state climate goals that include a reduction in greenhouse gas levels to 40% below 1990 levels by 2030.⁷⁸

California has set a high bar for reducing large volumes of pollution across all economic sectors. For the oil and gas sector, although operations are in decline in terms of production volumes, the number of permits being issued to drill new wells continues to increase.⁷⁹ This trend conflicts with the Governor's recent call for greater scrutiny of the environmental and climate impacts of the state's fossil fuel industry, and with the state's investment in mapping out management of the oil and gas sector's eventual decline.⁸⁰

California will have to address this contradiction between pollution reduction goals and the increased issuance of permits. In the meantime, there is room for improvement in the information that state agencies provide to the public who are concerned with, and directly experiencing the impacts of, oil and gas operations. Going forward, California should:

- 1 Adopt a public service lens when assessing and responding to complaints.** A complaint system is supposed to serve the impacted public. Currently, California's air district systems do so only if complainants invest considerable time and effort, or indirectly if groups such as Earthworks make use of it in service of impacted communities. A properly functioning system would allow residents to use the complaint system themselves easily and without assistance.
- 2 Shift the burden of proof for problems underpinning complaints.** Earthworks' experience filing complaints and assessing agency response in California demonstrates that it can take multiple complaints and long periods of time for problems to be resolved. As long as communities continue to experience pollution impacts, inspectors should continue to investigate until operators can demonstrate they're not causing harm.
- 3 Create a publicly accessible tracking system for complaints.** Any resident should be able to go online and easily obtain information about the status of complaints they or others have filed about specific operations and concerns (e.g., persistent odors, noise, and onset of health symptoms).

Complaint submission and response systems should be consistent across air districts, with an eye to maximum ease and responsiveness to residents. Routing of complaints to inspectors should occur every day of the week and hotlines should be available to report complaints 24/7. Timeframes for a response and/or resolution should be made publicly available, alongside the information for reporting complaints. Impacted residents should not be forced to make multiple calls, send numerous emails, and "connect the dots" among several sources of information.

Such improvements would build on and complement the work of Identifying Violations Affecting Neighborhoods (IVAN), an innovative, community-based project launched in 2007 by environmental justice organizations.⁸¹ In collaboration with state and local agen-



cies and academic institutions, IVAN currently operates projects on air monitoring and resident reporting of environmental problems in seven California communities, selected because they are disproportionately impacted by environmental pollution.

Using an online application, residents can submit reports of odors, observed pollution, health symptoms, and other problems. Local IVAN groups meet monthly with CARB and air district staff to discuss the complaints and agency response (e.g., inspections and enforcement actions).⁸²

4 Create a publicly accessible map of all complaints. Community members should be able to easily see where complaints have been filed, via a map that reflects data in the complaint tracking system. They should be able to identify the operators and facilities nearby that could be connected to the problems they're experiencing. This map could also include additional data layers related to complaints, such as well sites, violations, and inspections. CARB should consider adding both complaints and related enforcement information to its Pollution Mapping Tool, or create a separate, similar search tool for that purpose.

5 Update data methods in the California Greenhouse Gas Emissions Inventory. In light of the significant impacts of the oil and gas industry on climate, CARB should consider updating the methodologies used to determine the impact of different greenhouse gases in the emissions inventory.

This would primarily require using a 20-year GWP for methane (instead of the current 100-year), bringing analysis of the climate impact of reported emissions in line with more current scientific standards and with CARB's more recent approach in COGR. This shift is also necessary because, according to the general scientific consensus, there is only about a decade left to avoid the most catastrophic environmental and social impacts of climate change.⁸³

6 Expand field measurement projects to determine actual volumes of oil and gas pollution. Operators should continue to be required to report data to California's different emissions inventories, but additional data are needed to obtain a full, accurate picture. Several studies demonstrate that measured emissions can be significantly higher than what operators report to inventories.⁸⁴ Direct measurement should occur, at a minimum, near significant pollution sources, such as compressor stations, processing plants, and the largest oil and gas operations. CARB should then use the results to verify the accuracy of the data that operators self-report to the inventories.

This work would complement CARB's efforts to monitor and reduce health-harming pollution through the Community Air Pollution Protection Program (CAPP), the result of legislation passed in 2017 to reduce exposure by disproportionately impacted residents.⁸⁵ It would also build on CARB's previous work to quantify emissions from selected sources, including for the development of COGR.⁸⁶



7

Clarify the different data sources behind the Pollution Mapping Tool so that the public clearly understands what the data they search for actually shows. CARB provides users with caveats and notes about the tool and the information that is included or omitted.⁸⁷ However, the agency does not state clearly up front that users may be able to gain only a partial understanding of pollution in their areas depending on how they conduct searches. The tool should clearly explain that searches will get different results for pollution sources in an area, depending on the pollutant (greenhouse gases vs. VOCs and toxics) and the underlying definition of “facility” used in different pollution reporting systems.

A well site close to homes in Kern County, California.



Endnotes

- 1 SEI, IISD, ODI, Climate Analytics, CICERO, and UNEP. 2019. *The Production Gap: The discrepancy between countries' planned fossil fuel production and global production levels consistent with limiting warming to 1.5°C or 2°C*. <http://productiongap.org>
- 2 Gayathri Vaidyanathan, "How bad of a greenhouse gas is methane?" *Scientific American*, 2015. <https://www.scientificamerican.com/article/how-bad-of-a-greenhouse-gas-is-methane/>
- 3 See database of peer-reviewed science on health impacts at https://www.zotero.org/groups/248773/pse_study_citation_database/items/collectionKey/SASKSKDG; and Concerned Health Professionals of New York, *Compendium of Scientific, Medical, and Media Findings Demonstrating Risks and Harms of Fracking (Unconventional Oil and Gas Extraction)*, Sixth Edition 2019. <http://concernedhealthny.org/compendium/>
- 4 Lisa Sumi, *Breaking All the Rules: The Crisis in Oil and Gas Regulatory Enforcement*. Earthworks 2012; Sharon Wilson, Lisa Sumi, and Wilma Subra, *Reckless Endangerment While Fracking the Eagle Ford Shale*. Earthworks 2013; Nadia Steinzor, *Blackout in the Gas Patch: How Pennsylvania residents are left in the dark on health and enforcement*. Earthworks 2014; Nadia Steinzor, *Permitted to Pollute: How oil and gas operators and regulators exploit clean air protections and put the public at risk*. Earthworks 2017; Nathalie Eddy, *New Mexico's Moving Ahead: Restoring the Oil Conservation Division's Strength and Authority*. Earthworks 2019; Nathalie Eddy, *Putting the Public First: How CDPHE can overcome its legacy of prioritizing oil and gas interests ahead of public health, safety, welfare, and the environment*. Earthworks 2020.
- 5 CARB, Air Districts, <https://ww2.arb.ca.gov/california-air-districts>
- 6 CARB Annual Oil and Gas report, "Oil, Gas, and Water Production and Well by County," 2018, https://www.conservation.ca.gov/calgem/pubs_stats/annual_reports/Pages/annual_reports.aspx
- 7 CARB, Tips and Complaints, <https://ww2.arb.ca.gov/our-work/programs/environmental-complaints/tips-complaints>
- 8 CalEPA, Complaint System FAQ, <https://calepa.ca.gov/enforcement/complaints/faqs/>
- 9 CalEPA, Complaint System FAQ, <https://calepa.ca.gov/enforcement/complaints/faqs/>
- 10 San Joaquin Valley APCD, File a complaint, <https://www.valleyair.org/busind/comply/complaint.htm>
- 11 San Joaquin Valley APCD, "Reporting an air pollution complaint" brochure, http://www.valleyair.org/brochures/docs/English/Complaint-Brochure_1012_WEB.pdf
- 12 South Coast AQMD, "Making Air Quality Complaints" video, <https://www.aqmd.gov/home/air-quality/complaints>
- 13 Santa Barbara Air District, Complaint Process, <https://www.ourair.org/complaints/>
- 14 Ventura County APCD, Air Quality Complaints http://www.vcapcd.org/air_quality_complaints.htm
- 15 South Coast AQMD, Track your Complaint, <http://www3.aqmd.gov/webappl/complaintssystemonline/TrackComplaint.aspx>
- 16 CalGem, CA Open Data Portal, Well Finder, <https://data.ca.gov/showcase/well-finder>
- 17 CARB, Enforcement reports, <https://ww2.arb.ca.gov/resources/documents/enforcement-reports>; and Enforcement Case Settlements, <https://ww2.arb.ca.gov/our-work/programs/enforcement-policy-reports/enforcement-case-settlements>
- 18 Ventura County APCD, Enforcement Activity Updates, <http://www.vcapcd.org/Enforcement-Activity-Updates.htm>
- 19 CA Department of Conservation, WellSTAR, https://www.conservation.ca.gov/calgem/for_operators/Pages/WellSTAR.aspx
- 20 CA Department of Conservation, GIS Mapping, <https://www.conservation.ca.gov/calgem/maps/Pages/GISMapping2.aspx>
- 21 Idle Well Program, https://www.conservation.ca.gov/calgem/idle_well
- 22 California Council on Science and Technology, *Orphan Wells in California: An Initial Assessment of the State's Potential Liabilities*, 2020.
- 23 Personal communication with Earthworks staff, July 2020.
- 24 Ibid.
- 25 South Coast AQMD, Contact, <http://www.aqmd.gov/nav/contact>
- 26 Ventura County APCD, Employee Contact List, <http://www.vcapcd.org/EmployeeList.htm>
- 27 US Energy Information Administration, California state profile, <https://www.eia.gov/state/analysis.php?sid=CA>; and Field Production of Crude Oil (by decade), <https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRFPCA1&f=A>
- 28 Jonathan London, Ganlin Huang, and Tara Zagofsky. *Land of Risk, Land of Opportunity: Cumulative Environmental Vulnerabilities in California's San Joaquin Valley*. UC Davis Center for Regional Change, 2011.
- 29 Center for Biological Diversity press release, "Lawsuit seeks to safeguard Kern communities from flawed oil drilling amendment," December 10, 2015, https://www.biologicaldiversity.org/news/press_releases/2015/oil-and-gas-12-10-2015.html.



- 30 Center for Biological Diversity, “California Court: Kern County Violating Law by Rubberstamping Oil Drilling,” Media Release, Feb. 25, 2020.
- 31 CARB Enforcement Division, *Review of the San Joaquin Valley Air Pollution Control District Emission Reduction Credit System*, final report, June 2020.
- 32 CARB, Air Quality Analysis Division, *Recommended area designations for the 0.070 ppm federal 8-hour ozone standard*, 2016.
- 33 American Lung Association, *State of the Air 2020*, Key Findings.
- 34 USEPA, “Health and environmental effects of particulate matter (PM),” <https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm>; and “Health effects of ozone pollution,” <https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution>
- 35 Fiore, A. M., West, J.J., Horowitz, L.W. et al. “Characterizing the tropospheric ozone response to methane emission controls and the benefits to climate and air quality.” *Journal of Geophysical Research*, 2008.
- 36 CARB, “CARB approves rule for monitoring and repairing methane leaks from oil and gas facilities,” Media Release, March 23, 2017.
- 37 Assembly Bill 32, the California Global Warming Solutions Act of 2006.
- 38 California Code of Regulations, Title 17, Division 3, Chapter 1, Subchapter 10 on Climate Change, Article 4, Subarticle 13: Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities.
- 39 EPA’s Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution 40 C.F.R. Part 60, Subpart OOOO and Subpart OOOOa.
- 40 CARB, Oil and Gas Methane Regulation, <https://ww2.arb.ca.gov/resources/fact-sheets/oil-and-gas-methane-regulation>
- 41 EPA’s Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution 40 C.F.R. Part 60, Subpart OOOO and Subpart OOOOa.
- 42 CARB, Oil and Gas Regulation Memoranda of Agreements, <https://ww2.arb.ca.gov/resources/documents/oil-and-gas-regulation-moa>
- 43 Personal communication with CARB staff, May 2020.
- 44 CARB, Oil and Gas Methane Regulation, <https://ww2.arb.ca.gov/resources/fact-sheets/oil-and-gas-methane-regulation>
- 45 Calculations by CATF provided to Earthworks, using a methodology developed for assessing federal and state methane control rules (for more information, see <https://www.catf.us/wp-content/uploads/2019/11/CATF-EPA-rollback-memo.pdf>). This figure is in addition to significant presumed reductions based on enforcement of a 2012 federal rule reducing VOC pollution from new oil and gas sources, which also reduces methane.
- 46 Overview of CARB pollution reporting program requirements, <https://ww2.arb.ca.gov/capp-resource-center/data-portal/carb-pollution-mapping-tool>
- 47 Ibid.
- 48 CARB, Pollution Mapping Tool – Sources in Your Community, <https://ww2.arb.ca.gov/capp-resource-center/data-portal/carb-pollution-mapping-tool>
- 49 CARB, “Onshore Oil and Gas Facility Crosswalk,” Version 1.1.
- 50 Assembly Bill 2588, the Air Toxics Hot Spots Information and Assessment Act, 1987; Assembly Bill 32, the California Global Warming Solutions Act of 2006.
- 51 CARB, “CARB adopts uniform, statewide system for reporting criteria air pollution emissions data for stationary sources,” Media Release, Dec. 14, 2018; underpinning legislation was Assembly Bills 197 (2016) and 617 (2017).
- 52 EPA, Greenhouse Gas Reporting Program (GHGRP), <https://www.epa.gov/ghgreporting>.
- 53 CARB, Mandatory Greenhouse Gas Emissions Reporting, <https://ww2.arb.ca.gov/our-work/programs/mandatory-greenhouse-gas-emissions-reporting>
- 54 CARB, GHG Current California Emission Inventory Data, <https://ww2.arb.ca.gov/ghg-inventory-data>
- 55 Overview of CARB pollution reporting program requirements, <https://ww2.arb.ca.gov/capp-resource-center/data-portal/carb-pollution-mapping-tool>
- 56 CARB, GHG Inventory Query Tool, https://www.arb.ca.gov/app/ghg/2000_2017/ghg_sector.php
- 57 CEIDARS 2.5 Database Structure, <https://ww3.arb.ca.gov/ei/drei/maintain/dbstruct.htm>
- 58 These include ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur oxide, and lead, as well as as many hazardous air pollutants. <https://www.epa.gov/title-v-operating-permits/who-has-obtain-title-v-permit>
- 59 Brown, D., Weinberger, B., Lewis, C., and Bonaparte, H. “Understanding exposure from natural gas drilling puts current air standards to the test.” *Reviews on Environmental Health*, 2014.
- 60 US EPA, Air Emissions Reporting Requirements, <https://www.epa.gov/air-emissions-inventories/air-emissions-reporting-requirements-aerr>
- 61 Overview of CARB pollution reporting program requirements, <https://ww2.arb.ca.gov/capp-resource-center/data-portal/carb-pollution-mapping-tool>
- 62 CARB, Facility Search Engine, <https://www.arb.ca.gov/app/emsinv/facinfo/facinfo.php?dd=y>
- 63 CARB, Facility Search Engine, <https://www.arb.ca.gov/app/emsinv/facinfo/facinfo.php?dd=y>



- 64 CARB, AB 2588, Air Toxics “Hot Spots” program, <https://ww2.arb.ca.gov/our-work/programs/ab-2588-air-toxics-hot-spots>
- 65 CARB Pollution Mapping Tool: Sources in Your Community, https://ww3.arb.ca.gov/ei/tools/pollution_map/pollution_map.htm
- 66 South Coast AQMD, Annual Emissions Reporting, <http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting>
- 67 South Coast AQMD, Annual Emissions Reporting, <http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting>
- 68 South Coast AQMD, Public Inquiry System for Emission Inventory Data, <http://www.aqmd.gov/home/rules-compliance/annual-emission-reporting/public-inquiry-system>
- 69 Intergovernmental Panel on Climate Change, Fifth Assessment Report 2014, Chapter 8, “Anthropogenic and Natural Radiative Forcing.”
- 70 US Environmental Protection Agency, Understanding Global Warming Potentials, <https://www.epa.gov/ghgemissions/understanding-global-warming-potentials>
- 71 Intergovernmental Panel on Climate Change, Fifth Assessment Report 2014, Chapter 8, Table 8.7.
- 72 Intergovernmental Panel on Climate Change, Fifth Assessment Report 2014, Chapter 8, Table 8.7.
- 73 CARB, GHG Global Warming Potentials, based on the Intergovernmental Panel on Climate Change Fourth Assessment Report (2007), <https://ww2.arb.ca.gov/ghg-gwps>
- 74 US Environmental Protection Agency, Understanding Global Warming Potentials, <https://www.epa.gov/ghgemissions/understanding-global-warming-potentials>
- 75 Intergovernmental Panel on Climate Change, Fifth Assessment Report, *Climate Change 2013: The Physical Science Basis*, Contribution of Working Group I.
- 76 CARB, Final Short-Lived Climate Pollutant Reduction Strategy, <https://ww2.arb.ca.gov/resources/documents/final-short-lived-climate-pollutant-reduction-strategy-march-2017>; and California Health and Safety Code, Division 26, Chapter 4.2, §39730-39734.
- 77 CARB, *California Greenhouse Gas Emissions for 2000 to 2017: Trends of Emissions and Other Indicators*.
- 78 California Environmental Protection Agency, Climate Action Program, <https://calepa.ca.gov/climate/>
- 79 Newsom Well Watch tracking of permits under the current state administration, <https://www.newsomwellwatch.com/>
- 80 Phil Willon, “Newsom blocks new California fracking pending scientific review,” *Los Angeles Times*, November 19, 2019; and Last Chance Alliance, “Governor Newsom’s budget revision highlights need for ‘managed decline’ of fossil fuel supply in California,” media release, May 6, 2019.
- 81 Identifying Violations Affecting Neighborhoods, <https://ivanonline.org/about>
- 82 See references to IVAN and the CalEPA Environmental Justice task force in recent CARB enforcement reports, <https://ww2.arb.ca.gov/resources/documents/enforcement-reports>
- 83 Intergovernmental Panel on Climate Change, Global Warming of 1.5 degrees celsius, 2018, <https://www.ipcc.ch/sr15/>
- 84 Alvarez, R.A., Zavala-Araiza, D., Lyon, D.R. et al. “Assessment of methane emissions from the US oil and gas supply chain.” *Science*, 2018; Barkley, Davis, Feng, et al. “Forward Modeling and Optimization of Methane Emissions in the South Central United States Using Aircraft Transects Across Frontal Boundaries.” *Geophysical Research Letters*, 2019.
- 85 CARB, Community Air Protection Program, <https://ww2.arb.ca.gov/capp/about>
- 86 CARB, Research Reports Related to Oil and Gas Regulation, <https://ww2.arb.ca.gov/resources/documents/oil-and-gas-research-reports>
- 87 CARB, Important Notes About the CARB Pollution Mapping Tool, https://ww3.arb.ca.gov/ei/tools/pollution_map/doc/caveats%20document12_22_2017.pdf

