

STEALING CALIFORNIA'S FUTURE

How Monterey County's Dirty Oil Business Worsens the Climate Crisis

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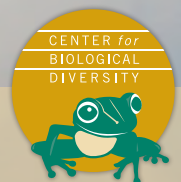


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STEALING CALIFORNIA'S FUTURE: How Monterey County's Dirty Oil Business Worsens the Climate Crisis

A Report from the Center for Biological Diversity

Executive Summary

To assess the climate threat from oil production in California, the Center for Biological Diversity analyzed data on the carbon intensity of crude produced from the state's oilfields. Carbon intensity is one measure of how much planet-warming pollution a given source of crude will produce. California regulators define the carbon intensity of crude oil as the amount of greenhouse gas pollution associated with its production, from the well to the refinery.

Our analysis found that California's oilfields generally threaten the climate by relying on energy-intensive methods such as steam injection to produce a large amount of dirty, carbon-intensive oil. But the data also show that the largest volume of the most carbon-intensive oil comes from a surprising source: Monterey County, on the Central Coast.

Monterey County is one of California's most important agricultural centers and a key destination for coastal recreation and wildlife viewing. It is also California's fourth-largest oil-producing county and the biggest source, by far, of the state's most carbon-polluting heavy crude.

All three oilfields in Monterey County produce oil that is among the 10 heaviest crudes produced in California. But it is Monterey County's San Ardo field that is the most carbon-intensive large oilfield in the state, ultimately generating about 3.3 million metric tons of greenhouse gas pollution per year — equivalent to driving a car 8 billion miles.

By this important measure, the San Ardo field supplies the most climate-damaging oil of any large source of crude produced in, or imported into, California. As California works to reduce greenhouse gas emissions and move to a renewable economy, it makes no sense to double down on the state's dirtiest supplies of oil with the greatest climate impacts. Yet state and federal regulators may be poised to allow oil companies to expand operations at San Ardo.



Monterey County's San Ardo Oilfield

More Carbon Intensive Than Alberta Tar Sands Oil

With more than 1,000 active wells and producing a total of nearly 20,000 barrels a day, Monterey County’s San Ardo oilfield is California’s eighth-most-productive field.¹ It produces more than 7.6 million barrels of oil a year, almost 4 percent of the state’s annual production.²

Oil companies operating in San Ardo are requesting exemptions from the groundwater protections of the federal Safe Drinking Water Act. If approved by California officials and the U.S. Environmental Protection Agency, these exemptions would allow companies to pump hundreds of thousands of barrels of oil-waste fluid into the groundwater around the oilfield. The aquifer exemptions would also pave the way for expanded operations at San Ardo.³

Extracting San Ardo’s heavy crude requires an inordinate amount of energy, which greatly increases the climate pollution associated with its production. For that reason oil from San Ardo is more carbon intensive, producing more climate pollution, than imported crude from the Alberta tar sands.⁴ Canadian tar sands oil is recovered through intensive strip-mining operations, heated to separate crude from tar shales, and then transported from Alberta to California’s refineries. Even with all of these inputs accounted for, Alberta tar sands crude has a substantially smaller carbon footprint than Monterey County’s San Ardo crude.

Table 1: Worse Than Tar Sands: Carbon intensity of Monterey County’s San Ardo crude compared to the five most energy-intensive crudes imported into California, including three tar sands oils from Canada. Carbon intensities in gCO₂e/MJ; volumes in barrels per year.⁵

Crude origin	Crude type	Carbon intensity	Barrels per year
Monterey County	San Ardo	28.82	7,682,477
Alberta, Canada	Suncor Synthetic (all grades)	24.49	710,900
Alberta, Canada	Albian Heavy Synthetic	21.02	746,514
Alberta, Canada	Cold Lake	18.74	5,334,932
Venezuela	Boscan	12.53	1,036,380
Russia	ESPO	12.09	752,695

¹ According to data from the California Department of Conservation, as of July 2016, 1,049 active wells are reported in San Ardo, including 183 injection wells; 42 active wells in Lynch Canyon, including 7 injection wells; and 16 active wells in McCool Ranch, including 5 injection wells.

http://www.biologicaldiversity.org/programs/public_lands/energy/dirty_energy_development/oil_and_gas/Active_Monterey_wells_as_of_7_6_16.xlsx or <http://www.conservation.ca.gov/dog/maps/Pages/GISMapping2.aspx>.

² From the California Department of Conservation, Online Production and Injection Query and Database: <http://opi.consrv.ca.gov/opi/opi.dll>.

³ There are 56 illegal injection wells listed for unexempted aquifers in Monterey County. Twenty-three are in San Ardo; 2 at McCool Ranch; one at Monroe Swell; and 6 outside of oilfield boundaries: *List of Permitted Wells Sent to EPA*, February 2015, at <ftp://ftp.consrv.ca.gov/pub/oil/UIC%20Files/>.

⁴ California’s Low Carbon Fuel Standard characterizes carbon intensity as “well to refinery,” including: exploration and development; production; surface processing; and transport to the refinery: http://www.arb.ca.gov/fuels/lcfs/crude-oil/opgee_v1.1e_user_guide_technical_doc.pdf.

⁵ From the California Air Resources Board, Calculation of 2015 Crude Average Carbon Intensity Value, released June 2016, at https://www.arb.ca.gov/fuels/lcfs/crude-oil/2015_crude_average_ci_value_final.pdf.

Measuring Carbon Intensity

California officials determine the “carbon intensity” of each oilfield as part of the Low Carbon Fuel Standard — the state’s program to reduce the average greenhouse gas emissions that result from transportation fuels.

Carbon intensity measures the greenhouse gas emissions associated with all stages of the production process, from exploration and well development to extraction to transport to the refinery gate. It is expressed as a measure of the greenhouse gas emissions (in terms of equivalence to grams of carbon dioxide, or gCO₂e) associated with each unit of energy in the oil (in terms of megajoules, or MJ).

The carbon intensity is higher for those oilfields that require greater energy inputs for oil extraction (such as steam flooding of underground oil formations), or that produce heavier crudes that require higher energy inputs to transport (such as heating the crude so that it will flow through pipelines).



San Ardo Oilfield (Courtesy DrewBird Photo)

The carbon intensity for the production of crude in San Ardo is 28.82 gCO₂e per MJ. This is more than two and a half times the average carbon intensity for crudes used in California, which is 11.19 gCO₂e per MJ.

Extreme Extraction

A major reason San Ardo oil has such a high climate impact is that it is very difficult to extract this heavy crude oil from the geologic formation that contains it. Oil companies use extreme extraction techniques — involving large volumes of water and high energy inputs — to force this viscous and heavy crude to flow through underground pools toward extraction wells. At San Ardo this has been accomplished primarily through steam flooding. In 2015, oil companies used almost 2 billion gallons of water in steam-flood and cyclic-steam operations at San Ardo.⁶

In steam flooding, injection wells are drilled at the edges of the oil formation at some distance from the production well. Large volumes of water are heated to 600 degrees Fahrenheit or hotter

⁶ From the California Division of Oil, Gas, and Geothermal Resources, 2016, 2015 Report on California Oil and Gas production Statistics: ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2015/PR03_2015.pdf. Other extreme extraction methods used in California include cyclic steam injection and water flooding (both termed “enhanced oil recovery” or “EOR”) and hydraulic fracturing or fracking, acidization and gravel packing (termed “well stimulation”).

and injected under pressure into the underground formation through the injection wells. This heats the crude within the geologic formation, decreasing its viscosity and allowing it to flow more easily. The force and volume of the injected steam push the crude away from the injection well and toward the production well, where it can be extracted.

The San Ardo oilfield also uses cyclic steaming and fireflooding.⁷ In cyclic steaming, steam is injected into the oil well to heat the crude within the underground formation, allowing it to flow more easily up the well. In fireflooding, the crude is ignited underground with an electric coil inserted into the oil pool via the injection well. The pressure created by the underground combustion forces the crude toward the production wells.

Heavy Crude

All three oilfields in Monterey County produce heavy crudes that are among the top 10 heaviest crudes produced in California. API gravity is a measure of the density of crude compared to the density of water.⁸ The API gravity is presented as the inverse of the density: The lower the API gravity, the heavier the crude. Heavy crude has an API of 10 to 22; extra heavy crude is below 10. Lower API gravity is one of the factors that makes crude more difficult or energy-demanding to extract, pump through pipelines, and refine. The three Monterey County oilfields produce heavy crude: San Ardo has an API gravity of 13; McCool Ranch, 11.7; and Lynch Canyon, 11.0. The sheer size and annual volume of the San Ardo field make Monterey County one of California’s largest sources of heavy crude. In terms of volume of heavy crude production, San Ardo is surpassed only by the Kern River field, which produces 25 million barrels a year of crude with an API gravity of 13.0.

Table 2: San Ardo produces one of the top 10 heaviest crudes in California. Volume in barrels per year; API gravity in degrees API.⁹

County	Oilfield	2014 Volume produced	API gravity
Kern	Kern River	25,264,002	13.0
Monterey	San Ardo	7,682,477	13.0
Kern	Poso Creek	3,606,689	13.5
Santa Barbara	Cat Canyon	1,579,569	11.5
Ventura	Oxnard	336,359	8.4
Monterey	Lynch Canyon	291,504	11.0
Santa Barbara	Zaca	245,055	8.0
Tulare	Deer Creek	46,115	12.0
Monterey	McCool Ranch	21,835	11.7
Kern	Blackwells Corner	11,618	13.3

⁷ From http://www.liquisearch.com/san_ardo_oil_field/production_and_operations.

⁸ API gravity, (API stands for the American Petroleum Institute) is used nationally as the standard metric for density of crude oil.

⁹ From California Air Resources Board, “MCON Inputs Spreadsheet for Crude Lookup Table,” published April 2015 at <https://www.arb.ca.gov/fuels/lcfs/crude-oil/crude-oil.htm>.

California's Highest Carbon Footprint Crudes

Although San Ardo is not the largest oilfield in California — it ranks eighth in annual crude production — it produces some of the heaviest crude in the state, and that crude is one of the most energy-intensive to extract.

In fact San Ardo heavy crude has a higher carbon intensity than crude from any other oilfield in California except two smaller oilfields that produce a small fraction of San Ardo's volume. The San Ardo oilfield produces 7.6 million barrels of high carbon intensity oil per year (carbon intensity 28.82).

In comparison, the Placerita oilfield (carbon intensity 31.66) in Los Angeles County produces 896,067 barrels per year, and the Lompoc oilfield (carbon intensity 31.05) in Santa Barbara County produces 342,134 barrels per year.

Table 3: San Ardo is California's most carbon-intensive large oilfield: The most energy-intensive crudes produced in California. Carbon intensities for production and transportation in gCO₂e/MJ; volumes in barrels/year.¹⁰

County	Oilfield	Carbon intensity	Barrels per year
Los Angeles	Placerita	31.66	896,067
Santa Barbara	Lompoc	31.05	342,134
Monterey	San Ardo	28.82	7,682,477
Kern	Round Mountain	28.73	4,225,365
Kern	Poso Creek	28.41	3,606,689
SLO	Arroyo Grande	27.81	422,592
Kern	Ant Hill	26.37	48,791
Fresno	Coalinga	25.36	6,105,373
Kern	Kern Front	25.06	4,619,561
Kern	Midway-Sunset	21.18	29,287,992
Kern	Mount Poso	20.57	1,258,638
Kern	Cymric	19.91	15,685,203
Tulare	Deer Creek	18.29	46,115
Kern	Jasmin	17.54	125,925
Ventura	Oxnard	16.89	336,359
Fresno	Burrel	16.44	14,858
Kern	McKittrick	15.47	3,131,900

¹⁰ From the California Air Resources Board, Calculation of 2015 Crude Average Carbon Intensity Value, released June 2016, at https://www.arb.ca.gov/fuels/lcfs/crude-oil/2015_crude_average_ci_value_final.pdf

3.3 Million Metric Tons of Greenhouse Gas Emissions a Year

The total greenhouse pollution caused by using crude oil includes not only the pollution that results from production and delivery of crude oil to the refinery gate (California's measure of carbon intensity), but also the pollution that results from refining, distributing and combusting the resulting gasoline.

When all of these processes are accounted for, Monterey County's highly energy-demanding San Ardo oilfield results in greenhouse gas emissions equivalent to more than 3.3 million metric tons of CO₂ per year.¹¹ This is equivalent to the emissions of 697,071 passenger vehicles driven for a year or 8 billion miles of driving.¹²

Compared to using an equivalent amount of fuel with the *average* California carbon footprint, San Ardo oil results in an additional 526,000 metric tons of CO₂e annually.¹³ Even compared to *Alberta tar sands oil*, San Ardo oil results in an additional 129,000 to 300,000 metric tons of CO₂e per year.¹⁴



San Ardo oilfield (Courtesy DrewBird Photo)

From a climate perspective, it is critical for California to move quickly away from fossil fuel use and production to accomplish a just transition to 100 percent clean, renewable energy. Allowing an expansion at the San Ardo oilfield, which is already California's single-largest source of the most climate-damaging oil, would directly contradict the state's crucial efforts to reduce pollution and avert the most dangerous effects of climate change.

¹¹ One barrel (42 gallons) of crude oil produces an average of about 12 gallons of diesel fuel and 19 gallons of gasoline. U.S. Energy Information Administration at <https://www.eia.gov/tools/faqs/>. Gasoline in California has an average energy density of 119.53 MJ/gal; diesel has an average energy density of 134.47 MJ/gal. From CA Air Resources Board, 2015, Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Proposed Re-Adoption of the Low Carbon Fuel Standard, Table III-2: <https://www.arb.ca.gov/regact/2015/lcfs2015/lcfs15isor.pdf>. The average carbon intensity for refineries in CA for gasoline is 8.90 gCO₂e/MJ; for diesel, 7.94 gCO₂e/MJ. From California Air Resources Board, 2015, *ibid*, Table III-8. CA gasoline has an average energy density of 119.53 MJ/gal; CA diesel has an average energy density of 134.47 MJ/gal. From LCFS ISOR III-21. About 19.64 pounds (8.9 kg) CO₂ are produced from burning a gallon of gasoline that does not contain ethanol. About 22.38 pounds (10.2 kg) of CO₂ are produced by burning a gallon of diesel fuel. From U.S. Energy Information Administration at <https://www.eia.gov/tools/faqs/faq.cfm?id=327&t=9>. The sum of production and transport 860,000 MT, refining 253,000 MT, and combustion 2,239,000 MT is 3,352,000 or 3.35 million metric tons CO₂. Alternatively, using a generic national average value 0.43 MTCO₂/barrel crude, 3.30 million metric tons CO₂. From U.S. Environmental Protection Agency: <https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references>.

¹² From EPA Greenhouse Gas Equivalencies Calculator: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

¹³ These figures are conservative, based on the differences in production and transport carbon intensity alone, and do not account for additional emissions from refining Monterey County's heavy crude.

¹⁴ The range of differences reflects the range in carbon intensities of the three Alberta tar sands crudes currently imported into California.