

STATE OF NEW MEXICO

**DEPARTMENT OF ENERGY, MINERALS, AND NATURAL RESOURCES
OIL CONSERVATION COMMISSION**

**APPLICATION OF THE NEW MEXICO OIL
CONSERVATION DIVISION TO ADOPT 19.15.27 NMAC
AND 19.15.28 NMAC, AND TO AMMEND 19.15.7 NMAC,
19.15.18 NMAC, AND 19.15.19 NMAC; STATEWIDE**

CASE NO. 21528

ENVIRONMENTAL DEFENSE FUND’S UPDATED EXHIBIT 9

Environmental Defense Fund (“EDF”) submits this updated Exhibit 9, New Mexico Oil & Gas Data, New Analysis Reveals Persistent Problem (updated November 2020), <https://www.edf.org/nm-oil-gas/>, to provide a better copy of the website text. This updated copy does not reflect the interactive portion of the website, which does not lend itself to easy duplication.

Dated: January 14, 2021

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New analysis reveals persistent methane
problem

Updated November 2020

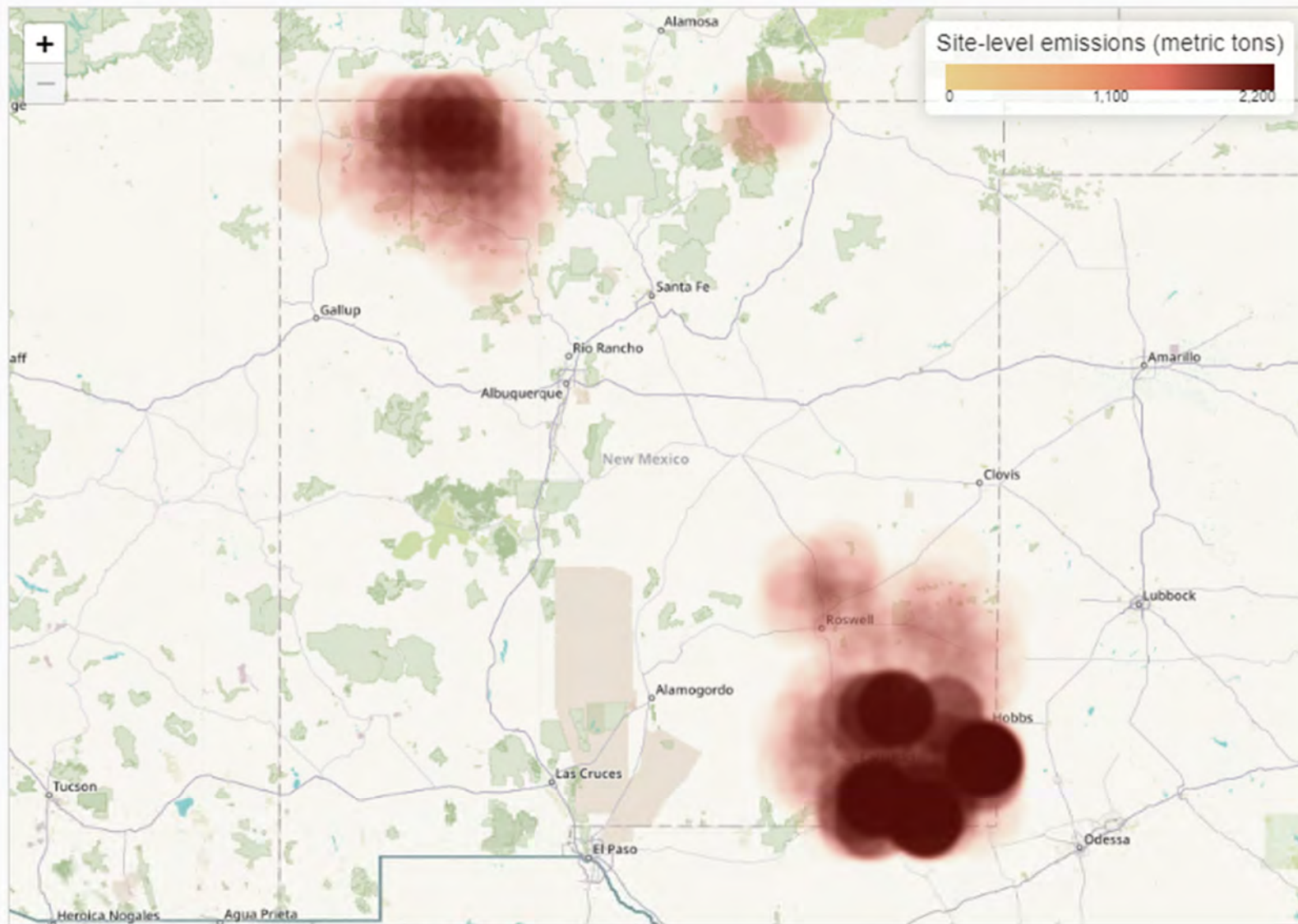
Using peer-reviewed satellite data and methods in tandem with extensive research studies, scientists at EDF have estimated oil and gas methane emissions across New Mexico to be over 1.1 million metric tons per year.

Persistent emissions in the state's Permian Basin, combined with insufficient management of leaks and wasteful venting and flaring practices, are the major contributing factors. These avoidable emissions are generating tangible impacts to New Mexico's economy, public health and climate.

Thanks to the incredible scope and frequency of satellite observation along with extensive and ongoing [field research](#) by EDF in the Permian Basin, scientists now have an unprecedented view into oilfield emissions in New Mexico and what will be required to reduce them.

This analysis models the proposed solutions put forward by New Mexico's Environment Department and Energy Minerals and Natural Resources Department to reduce emissions, and finds that, as written, they would exempt the vast majority of well sites and emissions statewide. The Explorer feature of this digital report also enables users to map those wellsites which would be exempt from the proposed rules.

In addition, this analysis models policy recommendations that have proven successful in other oil and gas producing regions, and finds that New Mexico has an opportunity to eliminate about 56% of statewide methane emissions from oil and gas with nation-leading regulations.



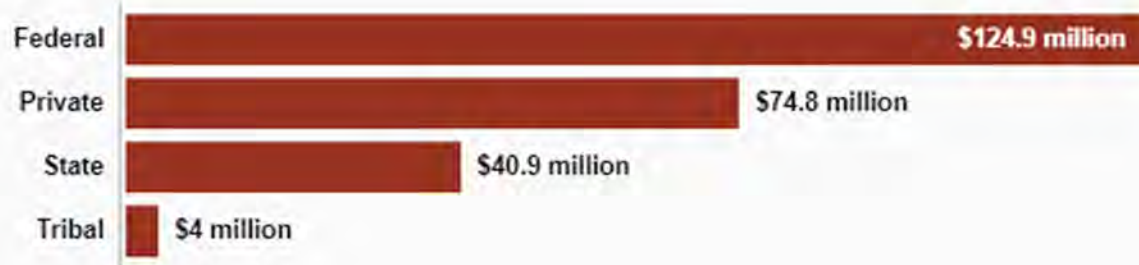
Methane emissions density across New Mexico

Source: see [methodology](#).

Key findings

Economic losses:

- Flaring, venting and leaks lead to the loss of at least **\$271 million** worth of natural gas in New Mexico every year.
- As a result, New Mexico is losing roughly **\$43 million** in state tax and royalty revenue annually – money that would otherwise fund schools, infrastructure and other public services.



Value of wasted gas by land type (dollars) – total: \$271 million/year

Values do not sum to the total because Gathering/Boosting and Abandoned Wells emissions are not apportioned to land types.

Source: see [methodology](#).

Public health risks:

- Oil and gas emissions contribute to poor local air quality. EDF's analysis shows that **more than 337,500 metric tons of volatile organic compounds (VOCs)** are emitted annually from oil and gas sites across the state. These include various air toxics and smog-forming pollutants that can cause respiratory illness among other acute and chronic health problems – especially among children and the elderly.
- New Mexico's largest oil and gas producing regions are struggling with increasing ozone pollution levels, which threaten to push some areas – like San Juan and Eddy counties – beyond federal air quality standards.

Environmental impact:

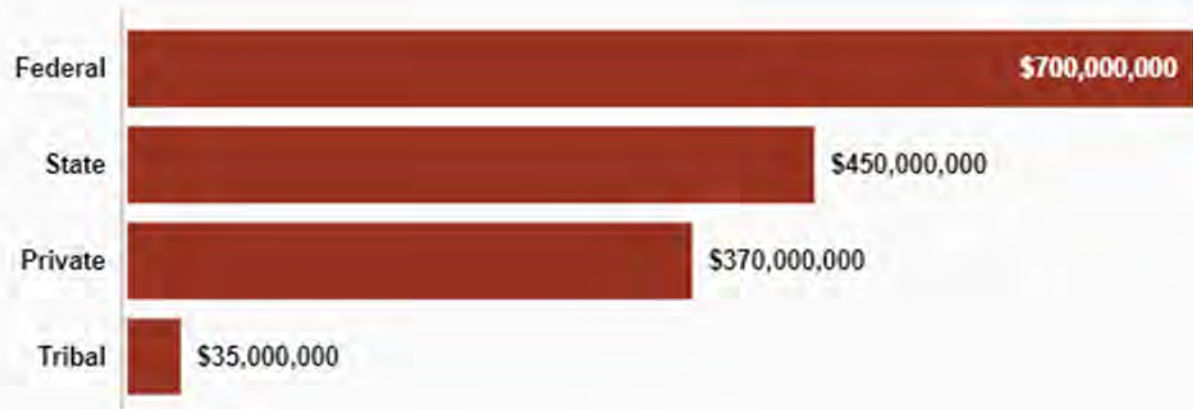
- EDF estimates that statewide methane emissions from upstream oil and gas sites total more than 1.1 million metric tons a year, which has the same short-term climate impact as 25 coal plants or 21 million automobiles. These emissions are about 5 times higher than what EPA emissions data suggest.
- Leaks, equipment malfunctions and other avoidable issues are responsible for the majority of emissions, contributing to climate change and wasting a valuable natural resource.

Crafting solutions:

Gov. Michelle Lujan Grisham has made tackling New Mexico's methane challenge a priority for her administration, and has an opportunity to strengthen rules put forward by state agencies to deliver nation-leading pollution standards.

As written, proposed regulations from New Mexico's Environment Department would exempt 95% of wells across the state. These exemptions are based on production and potential-to-emit thresholds and could be easily and cost effectively closed to ensure all wells in the state are covered. Together, the state's proposed regulations would reduce only 20.6% of methane and 19.2% of VOCs from oil and gas.

Proven, [cost-effective solutions](#) are readily available – in the form of requirements like better leak management practices and other control technologies – and a comprehensive package of policies could reduce emissions by about 56% by 2030, saving more than \$1.6 billion worth of natural gas.



Value of natural gas saved by 2030 if comprehensive regulations are enacted – total: \$1,600,000,000

Source: see [methodology](#).

Methane and Air Toxics

EDF analyzed New Mexico emissions using a combination of satellite readings from the Permian Basin – collected from the European Space Agency’s Tropospheric Monitoring Instrument – and peer-reviewed data and methods from a 2018 [Science](#) study. The complete [methodology](#) for this analysis is available for review.

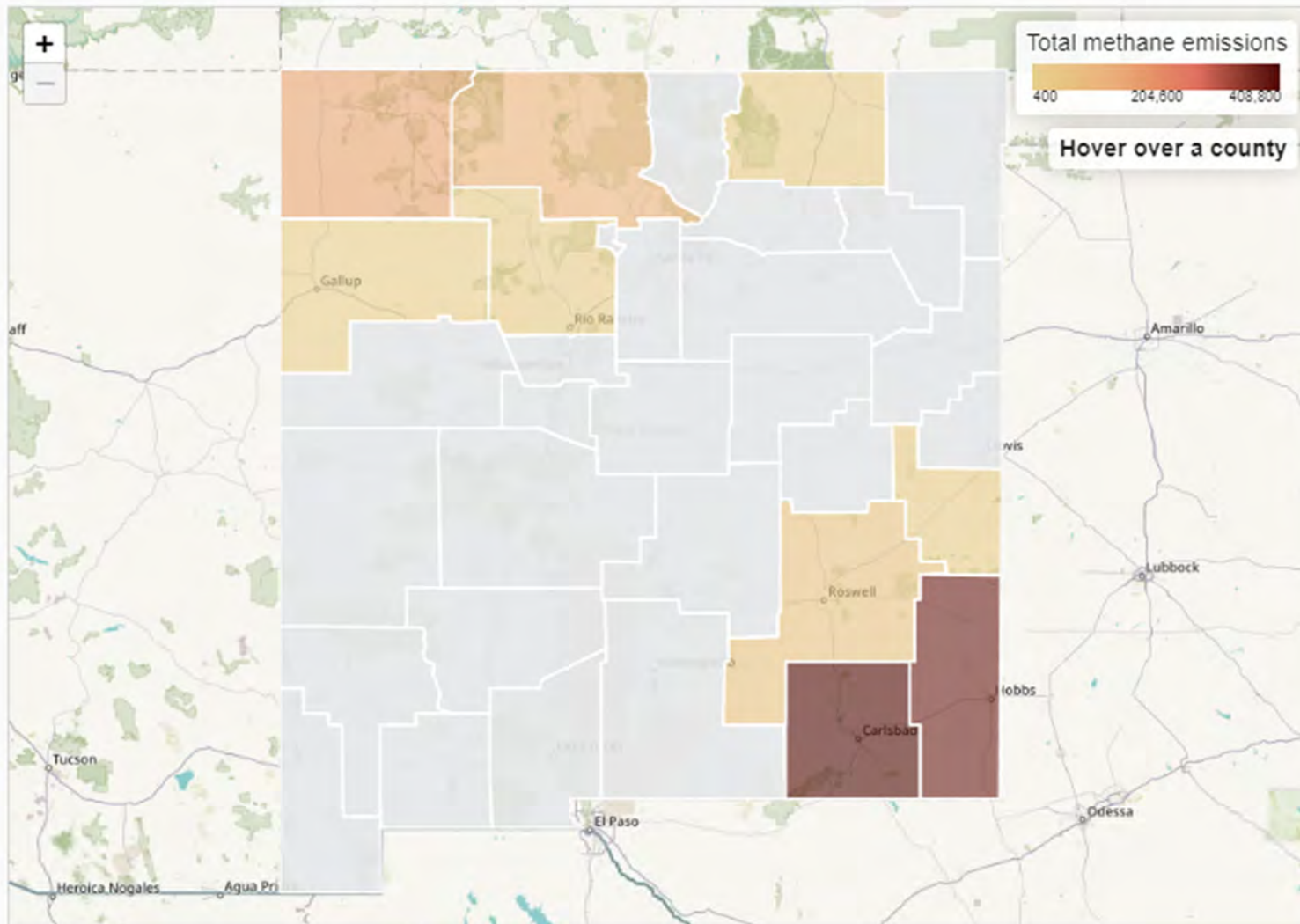
Total methane emissions - 1,116,000 metric tons in 2019



EPA estimates are calculated from basin-level emissions reported by operators to the EPA Greenhouse Gas Reporting Program. They are based primarily on emission factors and engineering equations rather than measurement data.

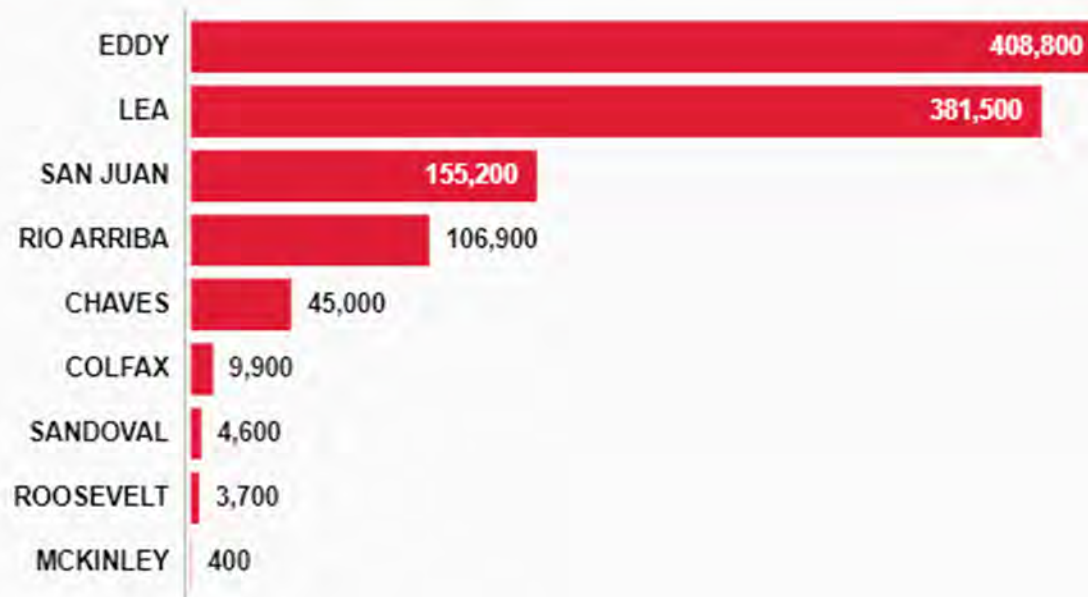
Source: 2019 emissions estimates, see [methodology](#).

Emissions per county, methane & VOCs (in metric tons)



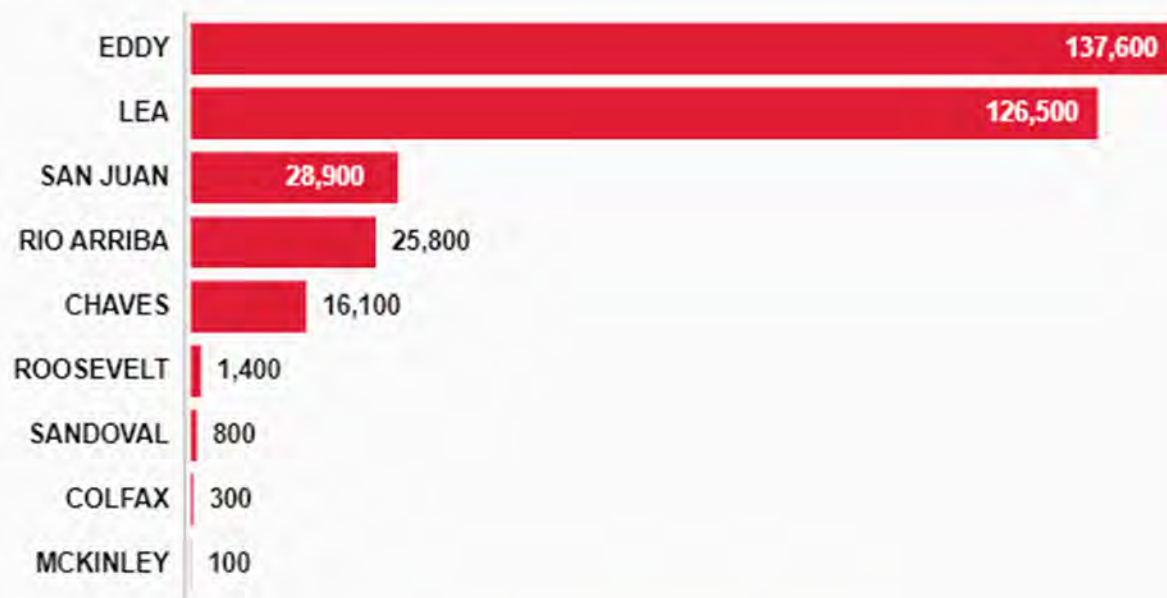
Source: 2019 emissions estimates, see [methodology](#).

Methane emissions by county (metric tons)



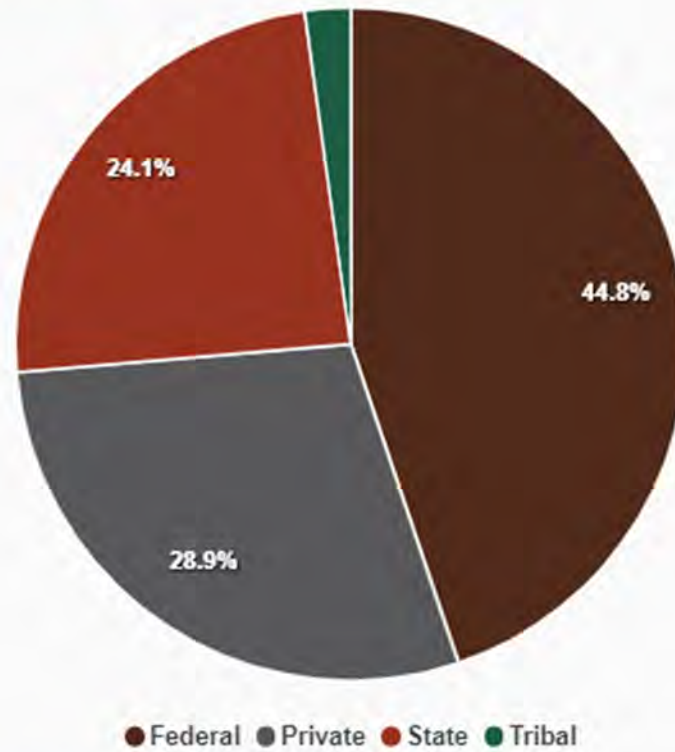
Source: 2019 emissions estimates, see [methodology](#).

VOC Emissions by county – total: 337,500 metric tons



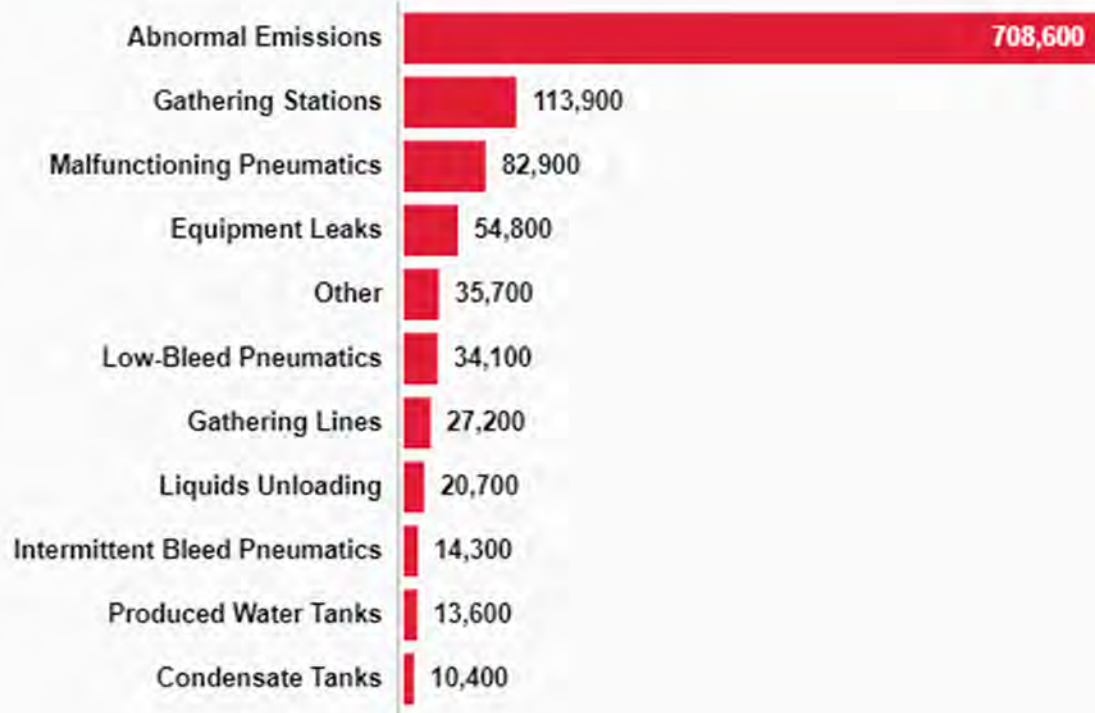
Source: 2019 emissions estimates, see [methodology](#); [Western Regional Air Partnership \(WRAP\)](#)

Emissions by Land Ownership



Source: 2019 emissions estimates, see [methodology](#); [U.S. Bureau of Land Management](#)

Top methane emission sources (metric tons)



Abnormal emissions were determined from the difference of total site-level emissions and our best estimate of emissions by source category. This category includes emissions from malfunctions and otherwise avoidable conditions that may be associated with other source categories.

Source: 2019 emissions estimates, see [methodology](#).

Methodology

EDF Estimate: Method for estimating upstream oil & gas methane emissions

Environmental Defense Fund estimated total annual methane emissions from upstream oil and gas (O&G) sites in New Mexico, including well pads, gathering stations and gathering pipelines. Emissions were estimated for the year 2019 using a combination of site-level measurement data from previously published studies and satellite measurements from a recent paper.

Emissions were estimated using two different methods: a basin-level (or top-down) estimate and a source-level (bottom-up) estimate.

Basin-level production emissions

Production emissions were estimated for the Permian, San Juan and Raton basins using different methods.

For the San Juan and Raton basins, baseline emissions estimates were developed for 2017, described here, and then adjusted for 2019. We obtained 2017 active well counts and production data from Enverus/DrillingInfo, a subscription database that compiles well data from regulatory agencies including the New Mexico Oil Conservation Division. We grouped wells into production sites based on reported surface wellhead locations and a 50-meter cluster radius. Total production-site emissions by county were estimated by multiplying site counts by site-level emission factors (EFs).

EFs were calculated with a gas production dependent, log-normal equation based on the methods outlined in [Alvarez et al 2018](#), section S.1.1. The underlying data are from >400 site-level measurements from six U.S. basins (Barnett, Fayetteville, Marcellus, Uintah, Upper Green River, Denver-Julesburg). In summary, maximum likelihood, analysis was used to integrate site-level data into a lognormal, two-term power law function that accounts for the weak effect of gas production on emissions. This previously published analysis resulted in a national average EF of 1.5 (1.1 – 1.9) kg CH₄ h⁻¹. Although the underlying data do not include site-level measurements from New Mexico, Alvarez et al 2018 reports that analogous estimates of San Juan Basin 2015 emissions agree closely with basin-level, aircraft-based measurements from the region ([Smith et al 2017](#)), suggesting that this combined dataset is broadly representative of the region. For the San Juan and other smaller basins, the central estimate EF of 1.5 kg CH₄ h⁻¹ was applied

This process yielded basin-level emissions for the San Juan and Raton basins for 2017. Emissions for 2019 were calculated by multiplying the 2017 basin-level emissions by the ratio of 2019 to 2017 gas production (production was relatively constant in both basins).

For the Permian, emissions estimates were based on satellite measurements from the Tropospheric Monitoring Instrument (TROPOMI) (Zhang et al. 2020). Zhang et al. found a natural gas leakage rate of 4.1% for the Delaware sub-basin of the Permian from May 2018 to March 2019. We assume this leakage rate is constant for all of 2019. Using 2019 production data from Enverus/DrillingInfo and an assumed methane content of 78.8%, we calculate basin-wide emissions for the Permian to be 740,000 metric tons of methane in 2019.

Emissions by source category

Emissions by source category had previously been calculated for each basin for 2017, incorporating EPA Greenhouse Gas Reporting Program (GHGRP) data as described below. When the 2019 inventory was being compiled, GHGRP was not yet available for 2019 (it has since been released). Therefore, to update this analysis to 2019, the relative contribution of each source category to the total basin-wide emissions was assumed to remain constant between 2017 and 2019. Thus, the 2019 emissions totals were multiplied by the percent contributions for each source category to yield source-level estimates for 2019 for each basin.

EDF estimated production emissions by source category using a combination of data sources, including the EPA GHGRP and previously published measurement studies. Source-level emissions were estimated using similar methods as reported in Alvarez et al 2018 for the alternative inventory (section S1.4). In summary, GHGRP data were analyzed with a statistical model that uses production data and reported basin-level emissions to estimate county-level emissions from both reporters and non-reporters. For some sources, we use GHGRP activity data and other emissions data to estimate emissions. For example, pneumatic controller emissions are based on adjusted GHGRP controller counts and emission factors from Allen et al. 2014.

The difference between basin-level and aggregate source-level emissions was attributed to “abnormal process conditions” (see Zavala-Araiza et al. 2017). This includes malfunctions and other issues that lead to high emission rates that are not accounted for by traditional source-level inventory methods. It is important to note that our source-level emission estimates are intended to approximate how empirically derived total emissions are allocated among sources based on independent, source-level data. Our “abnormal process conditions” category may include additional emissions that are released from reported source categories like tanks due to potential issues with GHGRP data, such as systematically underreported control efficiencies.

Gathering and boosting

For the gathering and boosting segment, total methane emissions from gathering stations, pipelines, and blowdowns were estimated according the methods outlined in Alvarez et al 2018, section S.1.1. In summary, we estimated station emissions from gas production and percentage loss rates based on ~100 previously published site-level measurements (Marchese et al 2015). As reported in Alvarez et al, the loss rates from Marchese et al were adjusted slightly upward (~17%) to account for sites above the sampled range. Gathering blowdown emissions were based on episodic emissions reported in Marchese et al. Gathering pipeline emissions were based EPA Greenhouse Gas Inventory EFs; these EFs are based on data from local distribution pipeline leaks and are highly uncertain.

Estimating VOCs

EDF estimated the total annual emissions of volatile organic compounds (VOCs) based on the estimated methane emissions inventory. In order to account for variations in gas composition across the state, EDF converted methane to VOCs using basin and source-specific CH₄:VOC ratios from a 2016 Western Regional Air Partnership (WRAP) report.

Additional documentation on this analysis is available.

EPA estimates: Method for identifying state-level estimates from basin-level reporting

Oil and gas companies are required to report methane emissions annually to the US EPA Greenhouse Gas Reporting Program if their annual greenhouse gas emissions exceed 25,000 metric tons CO₂e. For onshore production and gathering and boosting (G&B), emissions are reported at the basin level. As basins often cross state boundaries, the US EPA is unable to provide precise state-level emission estimates. For the 2019 reporting year, there were 83 onshore production and 62 G&B facilities reporting emissions in three basins located at least partially within New Mexico counties: the Permian, San Juan, and Las Vegas-Raton. EDF estimated reported emissions attributable to New Mexico by allocating basin-level emissions by the fraction of 2019 O&G energy production from the New Mexico portion of each basin (35%, 68% and 23%, respectively).

Lost Revenue: Method for estimating lost revenue from methane emissions and flared natural gas

Well sites were categorized based on land ownership: federal, state, private, or tribal (using BLM New Mexico surface ownership data). Well sites were further classified to identify sites on state trust lands. (Not all state lands are included in the state trust, and the state trust includes wells where subsurface ownership belongs to the state trust and surface ownership to a different entity. See New Mexico State Land Office).

Site-level production emissions were then summed for each land type (federal, state, private, tribal and state trust) to generate production percentages by land type. Because flared gas volumes are included in the revenue calculation (described below), vented and flared production emissions are set to zero to avoid double counting. Combustion emissions are also set to zero as these emissions are often seen as necessary. Methane emissions are converted to volumes of natural gas using a volumetric-methane content value of 78.8% for production emissions.

Flared gas volumes are from the NOAA VIIRS 2018 dataset (2019 data is not yet available. As flaring has increased from 2018 to 2019, the choice of 2018 is conservative). Flare locations were categorized based on land ownership, using the same methodology and land ownership data described above. Flared volumes were then summed for each land type: federal, state, private, tribal, and state trust. The volumes of wasted natural gas from production emissions (categorized by land type) were added to the flared volumes of natural gas, also classified by land type.

The lost revenue from these volumes of natural gas was calculated based on the following assumptions (see Oil and Natural Gas Taxing in New Mexico):

- The royalty rate for production on federal lands is 12.5%, of which 49% is returned to the state.
- The royalty rate for production on state trust lands varies by lease. An economist for natural resources on the New Mexico Legislative Finance Committee estimated (via a private phone call) that on average, the royalty rate is 19% for natural gas.
- The following taxes are assessed on gas production on all land types:
 - 4% emergency school tax
 - 3.75% severance tax
 - 0.24% conservation tax
 - Approximately 1% ad valorem tax (slight differences based on land type)
- Any allowable deductions (of which there are many) are ignored in this analysis, and the lost revenue values should be viewed as estimates.
- Federal royalties (of which 49% are returned to the state) are already assessed on flared gas from federal lands in the Permian basin. This value was subtracted from the federal lost state revenue estimate.
- Revenue is calculated based on a \$2.57/MMBtu natural gas price (the average 2019 Henry Hub gas price) using a heat value of natural gas of 1,037 Btu/ft³ to convert natural gas volumes (Henry Hub U.S. natural gas heat content).

Projecting emissions through 2025

Using the EDF estimated inventory, we projected emissions forward under a Business as Usual (BAU) scenario, using the Rystad oil and gas production projections for New Mexico, to generate the best available representation of future changes in BAU methane emissions.

We then assigned a growth profile (Oil, Gas, or Oil & Gas) for each source category based on the most representative resource projection. For example, fugitive leak emissions were tied to total oil & gas projections, while compressors were tied to the natural gas projections. Using this method, we were able to project forward the estimated emissions for each source category under a BAU scenario.

Additionally, we used DrillingInfo to establish a turnover rate of existing to new wells year-to-year by examining recent well turnover rates in New Mexico. We calculated an estimated annual turnover rate of 2%. This allowed us to assess the allocation of emissions (by year and source category) between new sources and existing sources in order to model those reductions for new wells.

In addition to the updates to the inventory and underlying data, an earlier version of the tool (released July 2019) contained an error in emissions projections that has been corrected in this version.

Calculating reductions from the state's proposed rules

EDF conducted an analysis of the potential impacts of the proposed New Mexico Environment Department (NMED) and Oil Conservation Division (OCD) rules. Percent reductions were estimated for each source category. However, the NMED rule contains two exemptions for wells that apply to both those with a potential-to-emit (PTE) of less than 15 tons per year (TPY) of VOCs and stripper wells on both the number of facilities that would be subject to the rule's control requirements. Per our analysis, the exemptions carve out 95% of wellheads and production sites in the six counties subject to the proposed NMED rule and a significant percent of emissions. This percent exempted was applied in the model when determining the impact of the state's proposed rules.

EDF analyzed the impact of the low producing well exemption by examining the number of facilities in the NMED permit/NOI database (<https://gis.web.env.nm.gov/oem/?map=methane>) and calculating the number of facilities that fall below the proposed PTE threshold. NMED requires facilities with regulated emissions above 25 TPY to have an air permit. Oil and gas facilities are required to submit a Notice of Intent (NOI) if they have regulated air contaminant emissions above 10 TPY. The permit and NOI database includes potential to emit (PTE) for VOC emissions; use of these data shows that 2,398 wellheads and production sites have a VOC PTE above 15 TPY VOC. Using data from DrillingInfo, EDF determined the total number of oil and gas facilities in New Mexico to be roughly 43,100. Therefore, roughly 95% of wellheads and production sites in NM will be below the 15 TPY VOC threshold and will be exempted from the rule.

To calculate the impact of the stripper well exemption on the number of covered facilities, EDF pulled well data from Enverus/DrillingInfo. Wells were clustered into well sites based on a 50 m radius. Average oil production (bbl/day) and average gas production (Mcf/day) were calculated on a per well basis. If the average oil production was less than 10 bbl/day/well or the average gas production was less than 60 Mcf/day/well, a well site was determined to be a stripper well. Virtually all stripper wells also fall under the 15 TPY threshold.

Covered and exempt well sites are shown in the Explorer tab of this digital report. Location data for covered well sites were taken directly from the NMED permit/NOI database for those well sites with PTE above 15 TPY. These data were overlaid with the well site location data from Enverus/DrillingInfo in order to display both covered and exempted well sites.

