A High-Level Cost-Benefit Analysis of Methane Leaks From Oil and Gas Wells in the San Joaquin Valley

A Cost-Benefit Analysis by the Central California Environmental Justice Network Air and Climate Justice Team, in partnership with the UC Davis Master's Program of Environmental Policy and Management, authored by Alexander Liesegang

Executive Summary

Based on this analysis, plugging California's idle and low-producing wells is very likely to be a cost-effective program that will improve the health of residents and combat climate change. Using some of the best available research and data, it is estimated that the average leaking oil or gas well in California's San Joaquin Valley causes approximately **$37,586** annually in climate change and health damages through methane leaks alone. While the cost of remediating a well has an upfront cost of approximately $100,000-$186,000 per well,[1,2] Using a central estimate, this cost-benefit analysis found that plugging a well will pay for itself in 3-6 years, depending on the discount rate and the exact upfront cost. Thus, in the long run, California will reap both significant financial and public health benefits from creating policies that require the companies that have, or are currently, operating wells to properly monitor high production wells and close wells that produce less than 15 barrels of oil equivalent per day.

Alternatively, since research suggests that a small percentage of oil and gas wells account for the majority of methane emissions,[3] if enforced properly, focusing on increasing monitoring infrastructure and identifying/plugging oil and gas wells that are leaking the most could be more cost-effective than requiring all idle wells to be plugged; especially since installing most leak detection sensors is far below the cost of remediation.[4] Detection systems also have the benefit of helping to ensure that wells that have been remediated are sealed properly, as even plugged wells have been known to leak.[5]

Background

With 8% of California residents living within one kilometer of active oil and gas development,[6] properly remediating wells is the start of a vital transition to protect residents, rather than treating the health impacts communities face as just the cost of doing business. While every policy decision has trade-offs, the best ones maximize benefits while minimizing costs. One of the most common ways policymakers measure

[1] (Purvis 2023, 20)
[2] (Sierra Club 2026)
[3] (Duren et al. 2019)
[4] (Draft Evaluation of Potential Performance Standards for Continuously Operating Emissions Detection Systems for Upstream Oil and Gas Production Sites in California Appendix a Review of Commercially Available Continuously Operating Emissions Detection System Technologies Designed for Use at Oil and Gas Production Sites ***Draft -October 14, 2025*** 2025)
[5] (Ferrar 2019)
[6] (Casey et al. 2024)

the impact of a particular decision is through an economic lens, which estimates the benefits and costs of a policy in dollars.

How much does X policy cost, and how much economic benefit is expected to come of it? This paradigm is great for getting a rough idea of how beneficial or costly a policy might be, but it also has drawbacks. One of the biggest ones is estimating complex things that do not have a direct market value, such as clean air, clean water, or a quiet space to live, and the distribution of costs and benefits. That is to say, the damage estimates of oil and gas wells (wells) found in this cost-benefit analysis are an underestimate and do not capture the full damage that wells cause from other impacts such as groundwater contamination, co-emitted air pollutants, increased hospital visits, higher asthma rates, etc.

In the context of this cost-benefit analysis (CBA), what is being evaluated is whether the environmental and health harms from wells leaking methane in the San Joaquin Valley (SJV) are greater or less than the cost of monitoring and/or sealing them. This CBA also compares the cost of running the Identifying Violations Affecting Neighborhoods (IVAN) network to the estimated benefits it provides.

To evaluate this question and monetize things that are extremely complex, such as the cost of leaking wells in a specific region, a myriad of assumptions have to be made, and the scope narrowed. While this certainly makes one's estimates less precise, it makes them more grounded, as they are based on more robust prior research and real-world data.

Assumptions

To account for unknown factors where little to no prior research had been done, such as quantifying per-well emissions rates, it was assumed that:

- Wind plays no significant impact on the *distribution* of where health effects occur, so health impacts from wells are localized and not blown to other counties or states.
    - Geography and climate conditions such as temperature inversions in the San Joaquin Valley (SJV), which Kern County is a part of, lead to pollution getting trapped for long periods of time and not being quickly flushed out as it does in a coastal city such as San Francisco.[7]
        - At the same time, atmospheric conditions can strongly influence pollutant *concentrations* depending on the time of the year or if it is day or night.[8]

[7] (Fernández-Bou 2024)
[8] (Ca.Gov 2024)

    - In other words, a community near wells will likely always be experiencing some amount of adverse health impacts, but the time of year and other climatic conditions can influence the extent to which the nearby community experiences health impacts on any given day.
        - The impacts of a well leaking methane are not felt right away; they are cumulative, and often manifest in outcomes like chronic health issues such as cancer from decades of exposure.
- Wells that are leaking methane have identical emissions rates over their lifetimes, from the day they are drilled to when they are plugged and abandoned.
- If an unmonitored well is leaking, it will continue to damage the environment the same way every year for 50 years.
    - Some wells can start leaking years after being plugged; leaks may be constant or intermittent, and last a few years or a few hundred years. The 50-year assumption is a best guess; there is a major lack of data and research on the long-term impacts of unplugged idle wells and plugged wells.
        - Likely because wells problematic enough to be noticed are plugged, rather than left to pollute so that they can be researched
- Well status and production level do not impact leakage rates, *with the exception that plugged wells are assumed to not be leaking*
- The chemical composition of all wells' emissions is uniform and has the same health and global warming impact.
- Data on oil and gas wells' status and counts change frequently; all data used was pulled between 07/01/2026-10/01/2026

A few other things should be noted:

1. The cluster of red found in the center of MethaneSAT's map can likely be attributed to dairy and livestock emissions, as the heat map shows the intensity of all methane emissions in the San Joaquin Basin (SJB), not just those from oil and gas.[9] This CBA uses only the MethaneSAT estimate of hourly methane emissions from oil and gas sources from the SJB.
    a. The SJB is a region defined by the authors of the MethaneSAT report; it is *not* the same as the geographic region that the United States Geological Survey defines as the SJB.[10] When this report says SJB, it will be referring to the geographic region defined by the MethaneSAT report.
2. The number of wells in the SJB region could not be accurately calculated as it is a rather unusual geographic region. Instead, the number of unplugged wells in the

[9] (Williams et al. 2026)
[10] (California Water Science Center, U.S. Geological Survey 2026)

SJV, 75,789,[11] was used as a proxy to estimate per-oil-well emissions in the SJB region. The SJV was chosen as a proxy because it is a very established geographic region that has robust data on well counts. Moreover, both the SJB and SJV contain Kern County, where more than 74% of all unplugged wells in the state are located.[12]

3. The past 10 years of inflation-adjusted North American oil prices were used to calculate the central estimate of a barrel of oil,[13] and compared to the break-even prices needed in CA for oil extraction to be profitable for operators after estimated production costs were accounted for. [14]
    a. The time frame chosen plays a large part in determining the average price of oil and subsequently if it's worth extracting. For instance, if the time frame had been 30 years, the average price of oil would be far lower, and if the time frame had been the last 5 years, the average price of a barrel of oil would be much higher.
4. CA has densely populated coastal cities, which makes it more exposed to methane-driven global warming impacts than a landlocked state like Colorado.[15] Meaning that the central estimates provided in this CBA are very likely below the true cost for a coastal area such as CA, and an estimate closer to the upper bound should likely be used for decision-making.

Finally, three notable factors that were not included in this CBA were:

1. The impact of wells on water supplies
2. Harmful co-pollutants from wells leaking methane
3. The cost of general discomfort to community members such as bad smell, headaches, migraines, dry eyes, sore throat, etc.

Now with all these caveats out of the way, onto the analysis.

Methods

The total estimated damages from methane gas were broken into two categories. The first being the social cost of methane (SCM) and the more direct ozone-related mortality impacts from methane emissions. The SCM provided was taken from the U.S. Environmental Protection Agency, which used a 2.0% "Near-Term" discount rate and encompasses "climate change damages driven by changes in annual average

[11] (Ca.Gov 2026)
[12] (Ca.Gov 2026)
[13] (Macrotrends.Net 2026) Crude Oil Prices (1946-2026)
[14] (Erickson and Lazarus 2018) *Breakeven prices reflect estimated investment and operating costs based on locations in CA using Rystad Energy UCube data, and assuming a 10% nominal discount rate. They do not include externalities such as CO2 emissions damage.*
[15] US EPA,OA (2017)

temperatures or sea level rise".[16] The central estimate of $2,800 was then adjusted to account for inflation; $3,624 per ton was used in the CBA.[17]

The second damage category used was the ozone-related mortality health impacts (ORMHI), which encompass one of the largest direct health impacts caused by methane. Specifically, the central estimate of $1,800 accounts for "damages related to deaths associated with changes in exposure to background ozone, resulting from increases in atmospheric methane."[18] Once again, the estimate was adjusted to account for inflation, and a central estimate of $2,337 per ton of methane was used in this CBA.[19]

To apply these methane damages, an estimate of how many tons of methane from SJV had to be calculated. According to a MethaneSAT report, "Based on a spatiotemporal aggregation of the MethaneSAT observations, the total oil and gas methane emissions are estimated at 18 tonnes of methane emissions every hour (95% confidence interval: 12 – 26) tonnes per hour (t/h)" in the SJB. With this estimate of methane leakage per hour from oil and gas operations in the SJB, a yearly leakage rate for the SJV was estimated at 157,680 metric tons of methane released per year by all wells in the SJV.[20] Since this CBA makes no distinction between the type of well, active, idle, orphan, etc.[21] It was assumed that wells leak a constant amount every day and never fluctuate.

Then, by multiplying both the inflation-adjusted dollar estimates for the yearly methane damages caused by the SCM and the ORMHI by the amount of methane estimated to leak annually, and then summing them, a total damage estimate from all leaking wells in the SJB of$940,032,972 was calculated.

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[16] ("Supplementary Material for the Regulatory Impact Analysis for the Final Rulemaking, 'Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review' EPA Report on the Social inactive;duringmaintenance,Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances" 2023)
From the EPA report, *the upper 2030 bound estimate used was $3,700.00 using a 1.5% Near-Term Rate, and the lower bound was $2,300.00 using a 1.50% Near-Term Rate, in 2020 dollars.*
[17] (Bureau of Labor Statistics, n.d. Adjusted to 08/01/2026 dollars)
[18] (McDuffie et al. 2023) The lower bound health damage estimate for a ton of methane being released was $760 and the upper bound estimate was $2,800.00, in 2020 dollars
[19] (Bureau of Labor Statistics, n.d.) Adjusted to 08/01/2026 dollars
[20] The central estimate of tons of methane leaked per hour from the SJB was 18. Then multiplying that by (365x24)=157,680 metric tons of methane released per year. The lower emissions bounds were calculated using doing the same thing, only the methane leaked per hour was changed to 12, and 26 for the lower and upper bound respectively. This resulted in a lower bound estimate of: 105,120, and an upper bound estimate of 227,760 for tons of methane leaked per year.
[21] Except plugged wells, plugged wells were not included in this analysis.

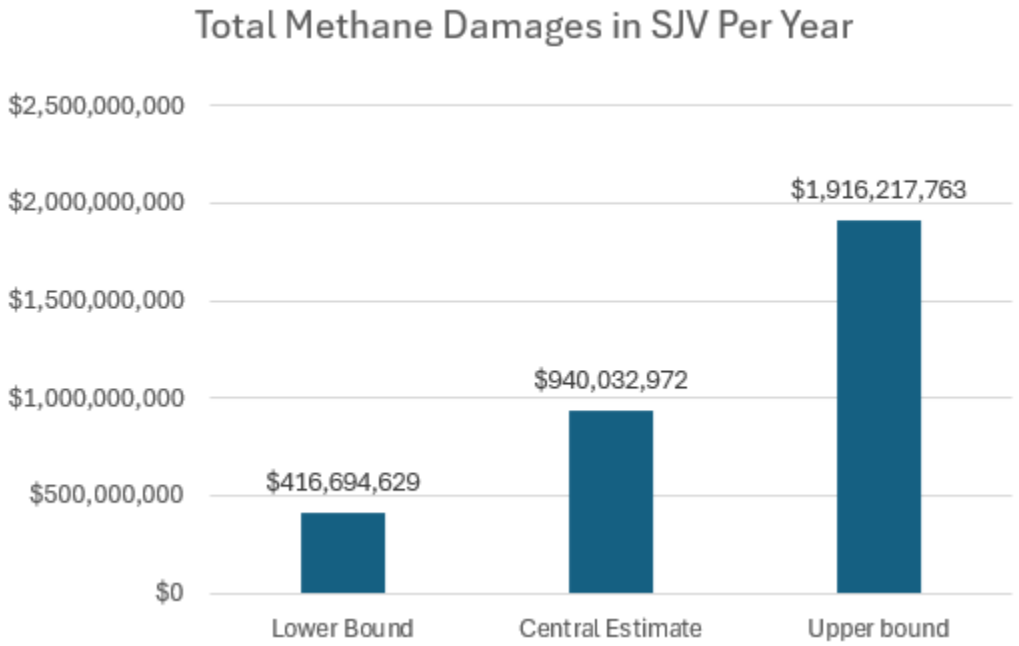


Figure 1. A bar graph showing the combined damage estimates from all leaking wells in the SJV.

Dividing $940,032,972 by 75,789, which is the number of all oil and gas wells in the SJV excluding plugged wells, results in $12,403, which is a central bound monetary estimate of the average damage done by a well in the SJV when accounting for the SCM and ORMHI. The spreadsheet used for all calculations is linked at the end of the report, but here is the math as well.

157,680*$3,624[22]=$571,482,778 (Annual SCM damages).
157,680*$2,337[23]=$368,550,194 (Annual ORMHI damages).
$571,482,778 +$368,550,194= $940,032,972 (Combined Damages).

The methodology for calculating the lower and upper bound estimates was the same; the only thing that changed was the numbers used. Lower bound and upper bound estimates were used for the SCM, ORMHI, and tons of methane leaked per year by all wells in SJV, and then summed together. The respective results yield the lower and upper bound total damage estimates. [24]

[22] $3,624 is the 2026 inflation adjusted estimate for the SCM from a ton of methane.
[23] $2,337 is the 2026 inflation adjusted estimate for the ORMHI from a ton of methane
[24] More details can be found in the excel sheet linked under data analysis

Findings and Recommendations

Prior research,[25,26] and CCEJN community science suggest that only 33%-66% of wells leak, but because the MethaneSAT observations do not provide insight into which wells are leaking or the type they are active, idle/orphan, plugged, abandoned, etc, this CBA made the estimate that 1/3 of wells in the SJV account for all recorded methane emission leaks. Thus, only 1/3 of wells are assumed to be leaking, but since they account for all leaks, they cause three times as much damage. In other words, the average *leaking* well in the SJV causes **$37,586**[27] through the SCM and ORMHI.

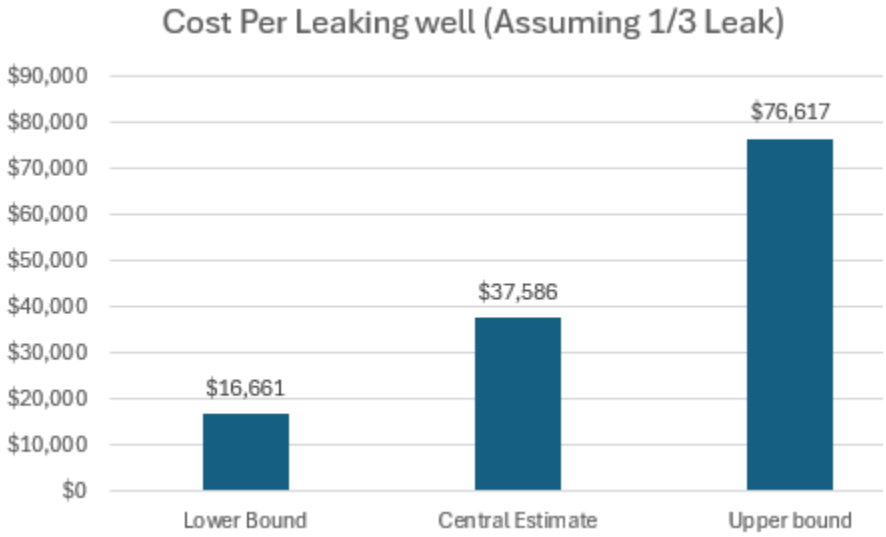


Figure 2. A bar graph showing the individual damage estimates for a single well leaking in the SJV, assuming 1/3 are leaking.[28]

When trying to capture the value of future benefits of plugging just one well in the SJV today, a net present value (NPV) estimate can be helpful. With a 50-year time horizon, uniform benefits of $37,586 each year, and using a central estimate with a 2% discount rate, plugging a single well in the SJV has an NPV of $995,079, and an NPV of $500,162 and $1,693,286 with a discount rate of 5% and 0%, respectively.

Based on this CBA, there is strong evidence to suggest that increased investment in robust leak detection technology that helps find and properly remediate leaking wells in the SJV would have benefits that far outweigh the costs. Especially in Kern (a part of

[25] (Sierra Club 2026)
[26] (California Air Resources Board 2022)
[27] $12,403 /.33= $37,586, The lower bound estimate was $16,661, and the upper bound estimate was $76,617 (using the same assumption that 1/3 of wells leak and also accounting for 3x the damages as their respective per-well estimate).
[28] Graphs of damage estimates with different assumptions on what percentage of wells leak can be found in the appendix

the SJV), where approximately 3/4 of all unplugged wells in CA, 71,294,[29] are located. Some might, though, ask: what about the lost value from missed production of oil?

The 59,095 active wells in CA produce, on average, about 7.7 barrels of oil equivalent (BOE) a day,[30] which, at $64.99 a barrel,[31] and a break-even price of 65$ a barrel,[32,33] results in well operators annually *losing* about $22.[34] When a barrel of oil is $73, which is the 2030 prediction from the U.S. Energy Information Administration (EIA),[35] well operators would annually *earn* about $22,484.[36] When a barrel of oil is $60, which is the estimated price if the world transitions away from fossil fuels at a pace on track to meet the 2030 2-degree Celsius warming limit defined by the Paris Climate Agreement, well operators would annually *lose* $14,053.[37] Based on these estimates, the average ***actively producing*** well's cost to operators alone exceeds any economic benefits the well would have. Thus, leaking idle/orphan wells pose even greater costs because they provide no oil generation benefits, only health and environmental damages. On the other hand, according to this CBA, a scenario where extracting oil is profitable is when the price is greater than 65$ a barrel, but the benefits only start to exceed the health and environmental costs of a leaking well at about 78$ a barrel.[38] Given that oil is about $100 a barrel at the time of writing, it makes sense why extraction is continuing.[39]

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[29] (Ca.Gov 2024)
[30] (Ferrar 2026)
[31] (Macrotrends.Net 2026) Average inflation adjusted cost of a barrel of oil in North America. Data taken from 01/01/2016-08/01/2026.
[32] (Erickson and Lazarus 2018) *Breakeven prices reflect estimated investment and operating costs using Rystad Energy UCube data, and assuming a 10% nominal discount rate. They do not include externalities such as CO2 emissions damage. 65$ is the breakeven price for Kern River in Kern county, and likely a conservative estimate of the average cost to operators for extracting a barrel of oil in Kern broadly.*
[33] The competitive market price of a barrel of oil is generally seen to encompass all benefits it provides, so it is unlikely that this report underestimated the value of a barrel of oil. Whereas health and climate benefits are not subject to a competitive market and thus more likely to be underestimated.
[34]This is a central estimate. The range depends on where the oil is extracted in CA.See figure 3.
Central estimate calculation using the last 10 years of oil production: $64.99 a barrel -65 (the breakeven price)=-0.01*365*7.7=-28.
7.7 (BOE) a day, multiplied by 365 days yields the yearly BOE output, see reference 28 for more details on average well BOE production. Lower bound estimate:$112,398. Upper bound estimate:-84,337. All other lower and upper bound estimates for different oil prices follow the same formula, the only thing that changed was the breakeven price to $25 for the lower bound, and $95 for the upper bound.
[35] (EIAgov 2021)
[36] This is a central estimate using the EIA 2030 estimate of $73 a barrel. Lower bound estimate:$134,904. Upper bound estimate:-61,831 *See reference 33 for more calculation methodology.*
[37] This is a central estimate using an oil price estimate that would keep the world on track with the Paris Climate agreement: Lower bound estimate:$98,368. Upper bound estimate:-98,368. *See reference 33 for more calculation methodology.*
[38] At about 78$ a barrel the economic benefit exceeds that of a leaking well, assuming 1/3 leak.
[39](Macrotrends.Net 2026) Price for September 2026

Depending on where the oil is extracted in CA, the break-even price estimate varies, as the location of the oil has a large impact on how damaging extraction is. In places like South Belridge in Kern County, where oil is harder to extract and more energy is needed to pump it out of the ground, the break-even price is $95 a barrel due to higher operating costs.[40]

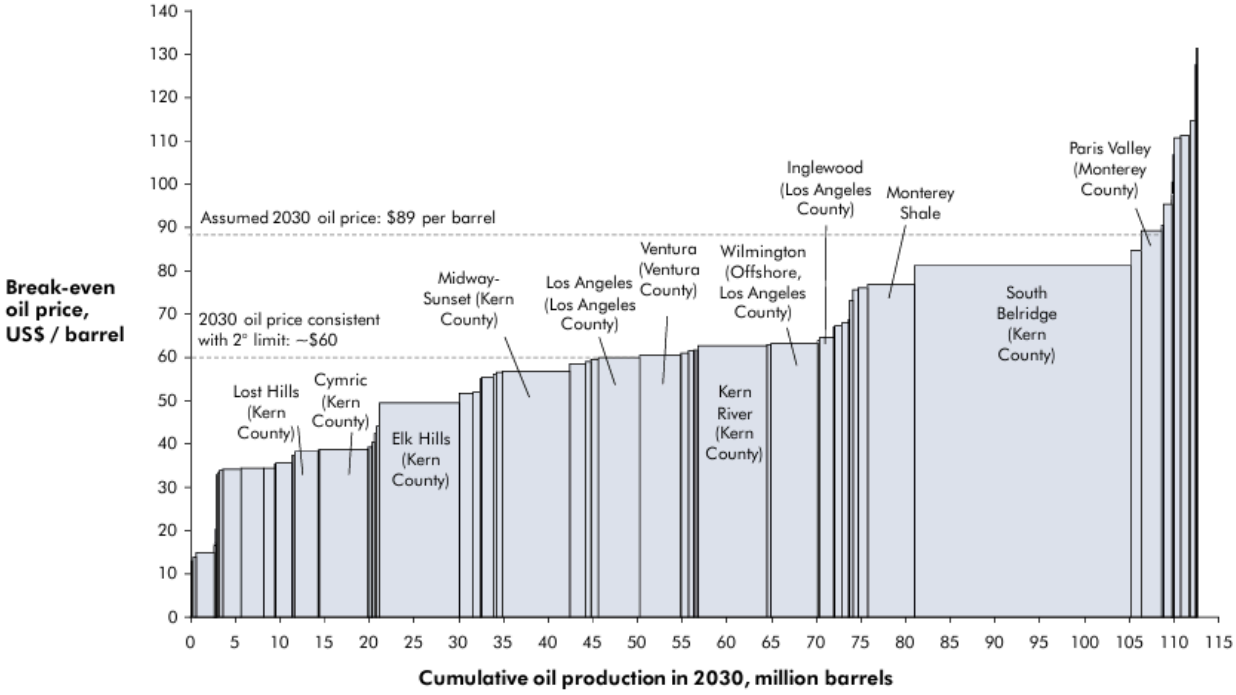


Figure 3, A bar graph estimating the break-even price of a barrel of oil and production levels from various locations in California for crude oil production by 2030[41]

All in all, based on this CBA, CCEJN recommends that:

1. Stringent monitoring technology be installed on all wells that are deemed economically viable enough to keep online to ensure that they do not leak, and adhere to strict methane and air pollution emissions performance standards that minimize harm to nearby communities.
2. Use low-flying planes and/or satellites to gather data and ensure that idle wells that are waiting to be plugged are not leaking, and that orphan/plugged wells are not leaking.

[40] (Erickson and Lazarus 2018) More energy intensive oil extraction not only makes things more expensive for operators, it also results in more carbon dioxide equivalent (CO_2e) being released.
[41] (Erickson and Lazarus 2018)

3. Have CARB or another regulatory agency re-inspect all idle and orphan wells, have them certify their proper sealing, and conduct re-sealing when methane leaks are detected.

CCEJN does not have an issue with oil extraction itself; it has an issue with the negative health impacts that occur from unregulated, unmonitored, and callous extraction methods that leak methane and other harmful pollutants into the environment. Research suggests that only a small percentage of oil and gas infrastructure is responsible for the majority of methane emissions.[42] So with focused efforts and good policy, CCEJN is confident that the vast majority of harms from oil and gas extraction could be mitigated effectively.

Impacts of CCEJN's Identifying Violations Affecting Neighborhoods Program

It is far more cost-effective to focus on remediating wells that are known to be leaking than blindly closing wells. The Identifying Violations Affecting Neighborhoods (IVAN) program does just that, and it's very cost-effective. The IVAN community monitoring program costs approximately $11,056 a year to run.[43] So based on this CBA, if the IVAN network leads to even *one* well being properly sealed each year, its long-term benefits exceed its costs by more than 89x.[44] If the IVAN program led to three wells being sealed, it would have a return on investment of over 260x. Therefore, it is clear that investments in increased monitoring programs such as IVAN will be of great benefit to both local communities and the state of California.

Author's Note

As stated earlier, an important limitation of CBA's is that they rarely take into account the distribution of benefits and costs. In the context of this analysis, the costs of leaking wells are borne mainly by less affluent regions like Kern County, which are particularly vulnerable to climate change.[45,46,47] Juxtaposed, the vast majority of the benefits from operating wells are shared with just a few people and companies.[48] This

[42] (Duren et al. 2019)
[43] This cost estimate includes staff time and associated wages, website costs, outreach material costs, and business phone line costs.
[44]After adding upfront IVAN expenses to the cost of sealing a well the NPV becomes $984,023. This divided by the yearly cost of running the IVAN network gives an estimate of the return on investment in the long run of about 89x.$983,475/11,056=88.95
[45]("Statewide Summary Report" 2019)
[46] *Kern is the most burdened county by oil and gas wells in the state (Ca.Gov 2026)*
[47]*Kern County is the third most impoverished county in CA (Nih.Gov 2026)*
[48] (Sierra Club 2026)

disconnection between affected people and oil operators (the primary decision makers for well management) is a large reason why the issue of properly remediating unproductive wells has gotten so large. Well operators hold almost all of the benefits and have to face virtually no direct personal costs from operating wells. Thus, they rationally do everything in their power to maintain the status quo and minimize how much responsibility they will have to take for their business actions. Even though oil is about $91 a barrel at the time of writing,[49] increased profit margins only benefit oil operators; the communities living nearby still face the same consequences, if not greater ones, from increased production.

On average, this report has found that historically, the average CA well does not pass a CBA, but on an individual operator level, continuing to extract oil and gas is still far more beneficial than facing closing costs. Moreover, the price of oil is unlikely to stay significantly elevated above the average for long,[50] as CA and the world transition off of fossil fuels.[51] Thus, strong regulations are needed to ensure that the long-term well-being of California's residents is not sacrificed for the short-term benefits of a few oil and gas operators.

Lastly, it should be noted that if the sole goal of CA is to reduce overall methane emissions as much as possible, then the state should focus on reducing emissions that come from dairies and livestock, as those sectors account for about 55% of the state's overall methane emissions.[52] Nevertheless, this paper focused on the impacts of methane emissions from oil and gas wells in the SJV; the most effective way to reduce overall methane emissions in CA is the topic of another report.

More information about the impact of oil and gas wells can also be found in this CCEJN Loophole Report.

Recommendations for Future Research

- How much does it cost to monitor and enforce SB 1137's health protection zones versus remediating wells outright and avoiding ongoing program implementation costs?[53]

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[49] (Macrotrends.Net 2026)
[50] (Macrotrends.Net 2026) (Agust 2026 West Texas Intermediate (WTI or NYMEX) crude oil prices per barrel.
[51] (California Energy Commission 2026)
[52] (Ca.Gov 2018)
[53] More information on health protection zones and their impact can be found in another report, The Oil and Gas Well Swan Song: How Loopholes in California's Regulations Harm Kern County and the State. Central California Environmental Justice Network.

- Do most methane leaks come from wells, or are other parts of oil and gas extraction, like pipelines connected to storage tanks, major contributors to methane leaks?
    - Would LDAR detect leaks that don't come directly from the well, and how many components can it monitor?

Data Analysis

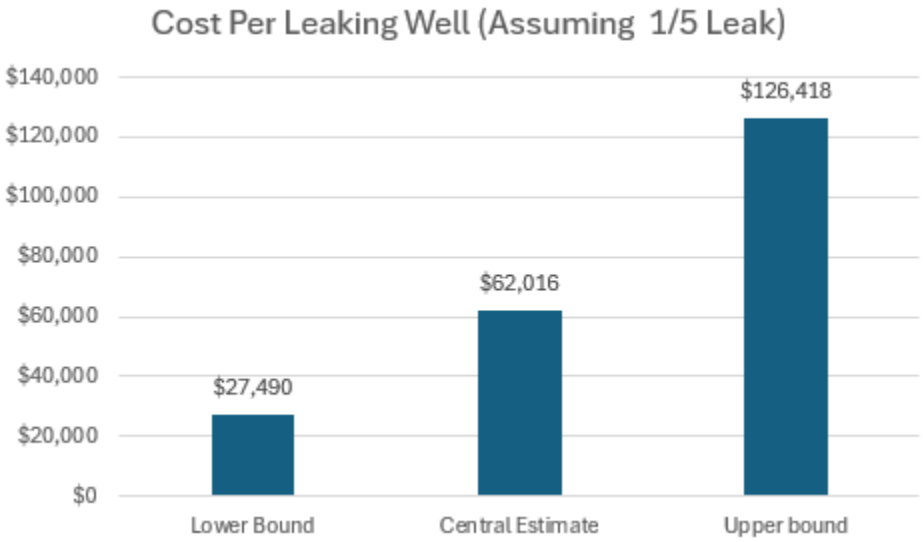
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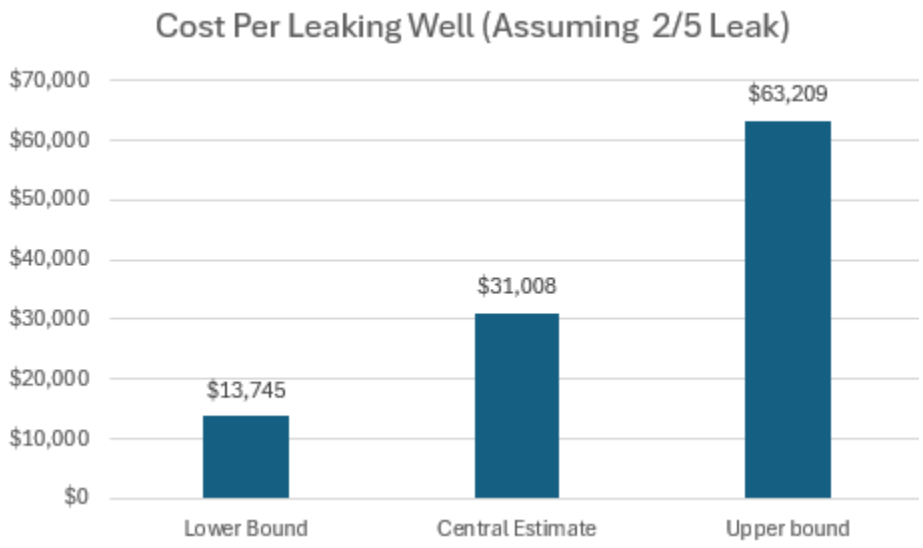
This analysis mainly focused on estimating methane damages, so if an estimate of methane releases from dairy and livestock in Kern County can be made, then the analysis method used for oil and gas wells could easily be applied to other sectors' methane damages.

Caveats

Data on oil and gas wells' status and counts change frequently; all data used was pulled between 07/01/2026-10/01/2026

Appendix




Cost Per Leaking Well (Assuming 2/5 Leak)
$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
$13,745
$31,008
$63,209
Lower Bound
Central Estimate
Upper bound

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Authorship

This Cost-Benefit Analysis was written by Alexander Liesegang, in partnership with the Central California Environmental Justice Network (CCEJN) Air and Climate Justice Team, and the Master's Program of Environmental Policy and Management at UC Davis. This report benefited greatly from the expertise of Dr. Michael R. Springborn. Alexander can be contacted at alex.c.liesegang@gmail.com

For CCEJN, please contact the Air and Climate team via Cesar Aguirre at cesar.aguirre@ccejn.org.