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Orphan and Idle Wells in Louisiana

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List of Abbreviations and Acronyms

API American Petroleum Institute
BEA Bureau of Economic Analysis
BOE Barrels of Oil Equivalent
BSEE Bureau of Safety and Environmental Enforcement
CDF Cumulative Distribution Function
DENR Department of Energy and Natural Resources
EPA Environmental Protection Agency
FLIR Forward Looking Infrared
GDP Gross Domestic Product
GIS Geographic Information System
H_2S Hydrogen Sulfide
IIJA Infrastructure Investment and Jobs Act
IOGCC Interstate Oil and Gas Compact Commission
IRA Inflation Reduction Act
LAC Louisiana Administrative Code
LDAR Leak Detection and Repair
LUW Lease, Unit, Well
MAC Marginal Abatement Cost
MD Measured Depth
NORM Naturally Occurring Radioactive Material
NO_x Nitrogen Oxides
NRTA Natural Resources Trust Authority
OC Office of Conservation
OGI Optical Gas Imaging
OSR Oilfield Site Restoration
P&A Plug and Abandon
RIMS Regional Input-Output Modeling System
SCVF Surface Casing Vent Flow
SCM Social Cost of Methane
SO_2 Sulfur Dioxide
SONRIS Strategic Online Natural Resources Information System
SSTA Site Specific Trust Account
TIGER Topologically Integrated Geographic Encoding and Referencing
USGS United States Geological Survey

Executive Summary

Researchers at LSU were tasked by the Louisiana Department of Energy and Natural Resources (DENR) to estimate the costs of plugging orphan and idle wells and assess methane emissions from orphan wells. This report provides background on the Louisiana Oilfield Site Restoration (OSR) Program created in 1993 and estimates the total cost to plug orphan and idle wells. In 2023, the OSR Program's efforts were augmented by federal funds from the Infrastructure Investment and Jobs Act (IIJA), which allocated $4.7 billion for orphan well site plugging, remediation, and restoration across the U.S. Louisiana has received an initial $25 million grant and anticipates receiving approximately $156 million in additional grant funds over the next several years.

Orphan well funding is allocated under Section 40601 of the IIJA, which aims to mitigate methane emissions. This analysis estimates the total methane emissions from orphan wells and assesses the economic impact of the program.

Below are the key findings of the report:

- While the vast majority of Louisiana's 224,000 oil and gas wells drilled are either currently producing or have been plugged and abandoned (P&Aed), there are approximately 19,500 idle wells and 4,900 orphan wells in the state as of March 2025 that are yet to be P&Aed. For perspective, approximately 4% of wells ever drilled in Louisiana have been declared orphaned.
- The rate at which new orphan wells are being added to the orphan well list has outpaced the rate of well plugging in recent years. Further, wells drilled over the past decade are still being added to the orphan well list, indicating that this is not simply a legacy issue for the state. Although IIJA funds will assist with plugging a meaningful share of the state's orphan wells, these funds are not estimated to be sufficient to plug the state's backlog of orphan wells.
- Despite the current backlog of orphaned wells continuing to grow as plugging operations lag behind new additions, the scheduled increase in OSR fees in July 2025 is expected to provide additional funding to support plugging activities. Specifically, the Legislative Fiscal Office (LFO) estimated that the increased fee will boost OSR fund collections by approximately 18 percent.
- The estimated cost to P&A all orphan and idle wells in Louisiana's Monroe and Shreveport districts is about $860 million. For comparison, Louisiana is slated to receive approximately $156 million in IIJA funds. Note that costs for the wells located in Lafayette district, which account for approximately 41% of the state's orphan and idle wells, are not included in this report, and will thus add costs.
- Methane emissions from orphan and idle wells vary widely, with a small number of wells contributing disproportionately to total emissions. Contractors detected methane at 23% of measured wells using the Hi-Flow method, while LSU researchers using the chamber method detected methane at 96% of measured wells. This difference is logical, as the chamber measurement has a much lower detection threshold.

- The analysis estimates that the initial $25 million federal grant received in 2023 through IIJA supported approximately 120 jobs and generated $16.4 million in value added to the state's economy from well decommissioning activities conducted since approximately January 2023.

- Utilizing the remainder of the funding through the IIJA is estimated to support approximately $11 million in wages, $23 million in value added, and 167 jobs per year over the estimated five years it will take to utilize the funds.

- Potential methane abatement from plugging all orphan wells in northern Louisiana is estimated at 868 to 1,171 t CH_4/yr based on our measurement techniques. For perspective, at current natural gas prices, these annual emissions represent approximately $217–292 thousand worth of natural gas. Put another way, these emissions have the energy content equivalent to approximately 435–585 thousand gallons of gasoline per year. Note that these estimates do not include orphan wells in southern Louisiana, which would further increase the abatement potential.

- Analysis of different plugging strategies under various scenarios suggests that quantifying emissions before plugging could significantly improve the methane abated for a given program cost. In other words, if the goal of the program is methane emissions reductions, the most plausible effective strategy is to measure many wells and plug the large leakers. The tradeoff of this strategy is that fewer wells will ultimately be plugged for a given budget.

1. Introduction

Louisiana has had over a century of oil and gas activity, with the first well beginning production in 1901. There have been approximately 224,000 oil and gas wells drilled in Louisiana, and since 1977, the first year in which modern oil and gas production records are available, approximately 5.5 billion barrels of oil and 99 trillion cubic feet of natural gas have been produced from these wells.[1]

All wells will eventually reach the end of their life. At that time, state law requires that the well be plugged and abandoned (P&Aed).[2] As will be highlighted later in this document, the vast majority of oil and gas wells drilled in Louisiana over this century have been P&Aed, but there are also currently an estimated 19,500 or so idle (or inactive)[3] wells in Louisiana that are not being utilized for any economic purpose[4] and have not been P&Aed. There is a risk that some idle wells will not be properly P&Aed, especially if owners are financially unable to do so. There may also be emissions coming from idle wells, which are addressed in this report.

An "orphan well" is an oil or gas well for which a responsible party cannot be located, or such party has failed to maintain the site in accordance with state rules and regulations.[5] While all orphan wells are idle (for the purposes of this report), there are many idle wells that are not on the state's orphan well list. For perspective, in January of 2023 Louisiana had approximately 4,600 orphan wells and over 16,000 idle wells.

Over thirty states with oil and gas activity also track orphan wells. As of 2022, there were more than 117,000 documented unplugged orphan oil and gas wells in the U.S. (Merrill et al. 2023). According to the Interstate Oil and Gas Compact Commission (IOGCC) (IOGCC 2021), the number of documented orphan wells has increased in recent years due largely to the efforts of states to identify and document orphan wells. When considering all abandoned idle and orphan oil and gas wells in the U.S., the estimate rises to more than 2.1 million (U.S. Department of the Interior Orphaned Wells Program Office 2023). For perspective, there are approximately 1.6 million P&Aed wells in the U.S. Thus, there are estimated to be more idle wells in the U.S. today than wells that have been P&Aed. In sum orphan, idle and plugged wells are predominantly located in Texas (22%), Pennsylvania (15%) and Kansas (11%), with Louisiana ranking sixth, accounting for 6% nationwide. Regionally, 28% fall in the Midwest, 25% on the East Coast, 30% on the Gulf Coast, 12% on the Rocky Mountains, and 5% on the West Coast (U.S. Environmental Protection Agency 2023; Williams, Regehr, and Kang 2020).

Note that there is another category of wells that are undocumented, meaning these wells were drilled and abandoned before regulatory programs were established. Undocumented wells are beyond the scope of this report, although the IOGCC estimates that the number of undocumented orphan wells in the U.S. ranges between 310,000 and 800,000.

Recently, orphan and idle wells have received national attention through the Infrastructure Investment and Jobs Act (IIJA)[6] that was signed into law in November of 2021. Section 40601 of the IIJA included $4.7 billion for orphan well site plugging, remediation and restoration. In 2023, Louisiana received a $25 million initial grant and is slated to receive significantly more over the next several years. This work is funded through the Louisiana DENR and is made possible due to these IIJA funds.

[1] This only includes production from state lands and water bottoms from 1977 through June 2024. Significantly more oil and natural gas has been produced in federal waters more than three miles from Louisiana's coastline.

[2] LAC 43:XIX §137.

[3] In this analysis, the term "inactive" and "idle" are used interchangeably.

[4] Some non-producing wells maintain economic value by serving other purposes, such as injecting brine from active nearby wells.

[5] R.S. 30:82.11.

[6] The IIJA is also known as the Bipartisan Infrastructure Law.

This report begins with a discussion of relevant state (Section 2) and federal (Section 3) policies. Next, it provides context on orphan and idle wells in Louisiana (Section 4). It reviews the geological and well characteristics that likely affect methane leakage from wells (Section 5), examines the methane measurements conducted by contractors and researchers at LSU (Section 6) and estimates the amount of methane potentially leaking from these wells (Section 7). The report also estimates the cost to P&A all orphan and idle wells in Louisiana (Section 8). Utilizing the social cost of greenhouse gases (EPA 2023a) it then provides an economic valuation of the emissions reductions achieved from the program (Section 9). The economic impacts from well decommissioning in terms of employment and gross state product are outlined in Section 10.

2. Louisiana Rules and Regulations

This section outlines the key components of Louisiana's regulatory framework, including P&A requirements, financial securitization measures, and the Oilfield Site Restoration (OSR) Program. Readers should note that this report was written concurrently with legislative changes to the Louisiana Department of Energy & Natural Resources. Effective October 1, 2025, the Department will be renamed the Department of Conservation and Energy. While a full discussion of this reorganization is beyond the scope of this report, readers are encouraged to consult Act 458 of the 2025 Regular Legislative Session for more information. The section below provides background on the foundational structure of Louisiana's current rules and regulations.

2.1 P&A Requirements

Before drilling an oil and gas well, an operator is required to apply for a permit to drill.[7] Once drilled, some wells will produce commercial quantities of hydrocarbons and can produce for many years. In fact, Louisiana has producing wells that began operation more than 50 years ago. Once a well reaches the end of its useful life, state regulations require the well to be P&Aed.[8]

When a well is P&Aed, cement plugs are placed in the wellbore to seal depleted reservoirs. The upper portion of the well adjacent to the freshwater reservoir (typically thousands of feet shallower than the zone where oil and gas was produced) is also cemented. The well casing is then cut typically 6 feet below the surface, and the surface hole is filled with the surrounding sand or dirt. Once completed, vegetation can grow back or farming can continue, and the well is not visible from the surface. P&Aing a well is also intended to permanently ensure that hydrocarbons or other gases and fluids do not escape from the wellbore into the atmosphere (or water in the case of a submersed well).

Louisiana laws and regulations have several programs and mechanisms aimed at reducing the risk of operators making the economic decision (either explicitly or due to insufficient prior planning) of not properly P&Aing a well at the end of its life. Section 2.2 discusses the state's securitization requirements. Section 2.3 discusses site specific trust accounts (SSTAs). Finally, Section 2.4 provides an overview of the state's OSR Program, which manages wells that are not properly P&Aed.

2.2 Securitization Requirements

Before a well is drilled, financial securitization is required by the operator of record (hereafter simply referred to as "operator") for oil and gas wells in Louisiana.[9] The financial security requirement can be provided by a certificate of deposit, a performance bond, or a letter of credit issued in the sole favor of the Office of Conservation (OC). Operators can alternatively choose to create a site specific trust account (SSTA), which will be discussed further in Section 2.3.

Financial securitization amounts are shown in Table 1. As shown in Panel A, the amount of the security required depends on the measured depth and whether the well is on land, inland lakes & bayous, or offshore. For example, land wells from 3,000 to 10,000 feet in depth (which includes the majority of wells) have a securitization requirement of $5 per foot. As will be discussed later, the cost to P&A a well is significantly higher than this amount, and thus the securitization requirement is not intended to fully cover the cost to P&A the well, but instead provide an incentive for the company to complete the P&A work.

7 LAC 43:X.

8 LAC 43:XIX. Statewide Order No. 29-B.

9 LAC 43:XIX §104.

Operators can also obtain blanket financial securitization as shown in Panel B. These blanket financial securitization amounts vary from $50,000 for operators with less than 10 wells on land to $5 million for operators with more than 100 wells offshore.

Note that financial securitization rules were promulgated in June of 2000 and only apply to newly permitted wells. Since that time, approximately 33,700 wells have been drilled, but to date, there are around 44,600 wells that were drilled before the promulgation of the securitization rules, but have not been P&Aed. These regulations have been amended four times since the initial promulgation.

Table 1: Financial securitization amounts

Panel A: Individual Wells			
Measured Depth	Land	Inland Lakes & Bays	Offshore
≤3,000 ft.	$2/foot	$8/foot	$12/foot
3,001 ft.–10,000 ft.	$5/foot	$8/foot	$12/foot
≥10,001 ft.	$4/foot	$8/foot	$12/foot
Panel B: Blanket Financial Securitization			
Wells / Operator	Land	Inland Lakes & Bays	Offshore
≤10 wells	$50,000	$250,000	$500,000
11-99 wells	$250,000	$1,250,000	$2,500,000
≥100 wells	$500,000	$2,500,000	$5,000,000

Source: Louisiana Administrative Code. Title 43, Part XIX, §104.C.

2.3 Site Specific Trust Funds (SSTAs)

Another tool created to reduce orphan well risk is SSTAs.[10] Unlike securitization, which is now required for all newly permitted wells, SSTAs are optional and can be established only after an oilfield site is transferred from one party to another in order to avoid potential future liability in case that well is not P&Aed by the new operator.

To see why an operator would choose to do this, consider a scenario where a responsible company (Company A) has properly maintained productive wells and is now selling to a different company (Company B). Company A might be interested in mitigating risk if, after selling the field, Company B does not properly maintain and decommission the field.

For this reason, Company A can choose to set up a SSTA when selling and be provided legal protection in case Company B (or perhaps a company that purchases the wells from Company B) does not properly P&A the wells and decommission the related infrastructure in the future.

Companies could also choose to utilize the SSTA program as a way to meet securitization requirements (See Section 2.2) for newly drilled wells. Thus, if a site has a sufficiently funded SSTA, the operator is not required to have additional financial securitization.

Unlike securitization, which is typically a relatively small share of the actual P&A costs, a SSTA is based on the estimated cost to complete the work. At the time of this writing, there are approximately 80 SSTAs containing approximately 1,900 wells for a total value of over $255 million. Although SSTAs are not the focus of this analysis, they are a notable component of the state's strategy to reduce orphan well risk.

[10] R.S. 30:88.

2.4 Oilfield Site Restoration Program

If wells are not properly P&Aed at the end of their useful life, the wells might eventually end up designated as "orphaned".[11] Perhaps the ultimate deterrent for an operator to avoid having wells orphaned is that parties responsible for orphan well sites cannot receive permits to drill future wells.[12] The Louisiana OSR Program was created by Act No. 404 of the 1993 Regular Session of the Louisiana Legislature.[13] The OSR Program is overseen by the Oilfield Site Restoration Commission (R.S. 30:83). The Commission comprises of the Secretary of the DENR (Chair), the Commissioner of Conservation (Vice Chair) and eight additional members appointed by the governor.[14]

The OSR Program oversees orphan sites across the state and is facilitated through a fee. No general fund tax revenues have been used to fund the OSR Program.[15] There is a fee on oil and gas production and a yearly fee for wells that have been inactive for more than five years. Table 2 provides an overview of the fee structure.

The fee schedule for full rate wells in Panel A distinguishes between current fees and those effective from July 2025. Currently, the fee for oil and condensate is 3 cents per barrel when the price of oil is between $60 and $90 per barrel, which accounts for an effective rate of 0.04 percent at $75 per barrel. The natural gas tax rate is currently 3 tenths of a cent per thousand cubic feet (mcf), representing an effective rate of 0.1 percent at $3 per mcf, making the fee for natural gas more than twice the rate for oil at current price levels. Thus, the OSR fee is higher (as a share of value) for natural gas than for oil. Also, unlike oil, natural gas is taxed at the same rate regardless of the price. The graduated fee schedule for oil (but not natural gas) was added in 2016.[16] Beginning July 2025, the new fee schedule will range from 2 to 6 cents per barrel, depending on price tiers: 2 cents per barrel for prices below $60, 4 cents per barrel for prices between $60 and $90, and 6 cents per barrel for prices above $90. For natural gas, the current flat rate of 3 tenths of a cent per thousand cubic feet will be replaced with a graduated structure: 3 tenths of a cent per mcf for prices up to $2.50, 4 tenths of a cent per mcf for prices between $2.50 and $4.50, and 5 tenths of a cent per mcf for prices above $4.50.

As shown in Panel B of Table 2, fees are reduced for stripper and incapable wells. Stripper oil wells are incapable of producing an average of more than 10 barrels of oil per day during the entire taxable month.[17] Incapable oil wells are incapable of producing an average of more than 25 barrels of oil per day during the entire taxable month and also produce at least 50 percent saltwater per day.[18] Stripper and incapable wells also have reduced severance tax rates.[19] These fees have not changed and remain in effect.

The inactive well fee structure is shown in Panel C of Table 2 and this remains unchanged. For wells between 3,000 and 10,000 ft in depth that have been inactive for 5-10 years, the annual fee is $250. Once the well has been inactive for ten years, the fee increases to $375 per year. For perspective, the average cost to P&A a well is over $40,000 (See Section 8). Thus, although the fee represents a relatively small percentage of the cost to P&A a well, it is designed to incentivize an operator to avoid delaying the work.

The OSR fund historically has been capped, with fee collection as shown in Table 2 suspended when the fund exceeded this amount until the unobligated balance falls below a threshold.[20] Legislation in 2016 raised the cap from $10 million to $14 million. Legislation in 2024[21] removed this cap entirely beginning in July of 2025, allowing for continuous fee collection.

11 1R.S. 30:91.
12 R.S. 30:94. Note, though, that throughout the research process, anecdotal feedback suggests that this is difficult to enforce in all situations.
13 R.S. 30:86 986.
14 Note that the DENR Secretary and Commissioner of Conservation are also gubernatorial appointees.
15 Although the Legislature of course could do so in the future if it so chose.
16 Act No. 666 (HB 819). 2016 Regular Legislative Session.
17 R.S. 47:633(7)(c).
18 R.S. 47:633(7)(b).
19 For more information on severance taxes, see Upton and Richardson (2020).
20 R.S. 30:86(c).
21 Act 16 of the 2024 Third Extraordinary Session.

2.5 Recent Institutional Changes

Note that Louisiana's 2024 Act 727 established the Natural Resources Trust Authority (NRTA) to work alongside the OC. While the OC maintains operational regulatory oversight, the NRTA manages financial assurance mechanisms from operators. Operating under the State Mineral and Energy Board, which conducts monthly public reviews of financial matters, this structure separates financial oversight from operational regulation.

As noted previously, Louisiana's 2025 Act 458 has reorganized the Department of Energy and Natural Resources, which will also potentially impact the NRTA.

Table 2: Fee on oil and gas production for OSR fund

Panel A: Full Rate Production (Current and July 2025)			
Commodity	Price Threshold	Current Fee	Fee After July 2025
Oil	<$60/bbl	$0.015/bbl	$0.02/bbl
Oil	$60-90/bbl	$0.03/bbl	$0.04/bbl
Oil	>$90/bbl	$0.045/bbl	$0.06/bbl
Natural Gas	≤$2.50/mcf	$0.003/mcf	$0.003/mcf
Natural Gas	$2.50-4.50/mcf	$0.003/mcf	$0.004/mcf
Natural Gas	>$4.50/mcf	$0.003/mcf	$0.005/mcf
Panel B: Reduced Rate Production			
Commodity	Price Threshold	Fee	
Incapable Oil	<$60/bbl	$0.0075/bbl	
Incapable Oil	$60-90/bbl	$0.015/bbl	
Incapable Oil	>$90/bbl	$0.0225/bbl	
Stripper Oil	<$20/bbl	$0/bbl	
Stripper Oil	$20-60/bbl	$0.00375/bbl	*No change*
Stripper Oil	$60-90/bbl	$0.0075/bbl	
Stripper Oil	>$90/bbl	$0.01125/bbl	
Incapable Oil Well Gas	none	$0.0009/bbl	
Incapable Gas Well Gas	none	$0.00039/bbl	
Panel C: Inactive Well Yearly Fee			
	Years Inactive		
Depth (ft)	5-10 Years	>10 Years	
≤3,000	$125	$188	
3,001-9,999	$250	$375	*No change*
≥10,000	$500	$750	

Panel A Source: R.S. 30:87 and R.S. 47:633 (current fees) and Act 16 of 2024 Third Extraordinary Session (fees after July 2025). Oil includes condensate. Natural gas includes casinghead gas. Panel B and C Source: R.S. 47:633 and LAC 43:XIX.§137.

3. Federal Rules and Regulations

Section 2 covers Louisiana's rules and regulations. This section discusses federal policies on orphan wells that also affect the state. Louisiana has approximately 4,370 wells[22] drilled on federal lands within the state's boundaries. These federal lands include national wildlife refuge areas, national parks, national forests, national wilderness areas, military bases, national monuments, etc.[23] Detailed statistics on federal land wells, including their depths and characteristics by status, are provided in Table C9 in the Appendix. In addition, wells drilled more than three miles from Louisiana's coast are in federal waters and thus are not under the jurisdiction of Louisiana's laws and regulations.

Rules regarding well abandonment on federal lands are found in the Code of Federal Regulations.[24] Wells on federal lands, but within a state's boundary, are typically required to meet both state and federal regulations.[25] Although state and federal P&A rules have technical differences, operators are required to promptly P&A wells after the well is no longer capable of producing oil or gas in paying quantities unless exceptions are approved (e.g., utilized for injection or some other purpose).

The federal government does not have an OSR program nor an official orphan well list similar to Louisiana (and other states). But the federal government has taken actions regarding orphan wells. President Biden's January 2021 "Executive Order on Tackling the Climate Crisis at Home and Abroad"[26] simultaneously called for "plugging leaks in oil and gas wells" and directed the Secretary of the Interior to "pause new oil and natural gas leases on public lands or in offshore waters pending completion of a comprehensive review and reconsideration of federal oil and gas permitting and leasing practices."[27] Cleanup of orphan wells was then prioritized in the Infrastructure Investment and Jobs Act (IIJA) discussed in Section 3.1. Note that President Trump rescinded the prior mentioned executive order in January of 2025.[28]

Although not the focus of this analysis, wells in federal waters (more than three miles from Louisiana's coast) are regulated by the Bureau of Safety and Environmental Enforcement (BSEE). Prior owners of wells in federal waters (deeper and farther from shore) can be held liable for P&A costs if the current owner does not P&A them, and Agerton et al. (2023) find that 88% of outstanding P&A liability in federal waters is associated with wells currently or formerly owned by one of the large, financially stable 'supermajor' companies. This same analysis concludes that shallower wells closer to shore present larger environmental risks than deeper wells farther offshore. In this analysis, unless stated otherwise, all discussion and analysis references wells on land and in waters closer than three miles offshore.

3.1 IIJA Funds for Orphan Wells

Although Louisiana's OSR Program has been operational for more than thirty years, recently the program has received a significant increase in funding from the IIJA. In November of 2021, President Joe Biden signed the IIJA into law, also known as the Bipartisan Infrastructure Law. Section 40601 of the IIJA included $4.7 billion for orphan well site plugging, remediation and restoration. In 2023, Louisiana received a $25 million initial grant and is slated to receive significantly more.

[22] This number is estimated by intersecting well locations with federal land polygon shapefiles.

[23] A brief description of federal land wells and summary statistics are included in Appendix Section C.6.

[24] CFR Title 43, Subtitle B. Chapter II, Subchapter C, §3162.3-4.

[25] This is generally what has been reported by various authorities, although none of the authors are legal experts.

[26] EO 14008. January 27, 2021.

[27] Note that oil and gas leasing was re-continued with the passage of the Inflation Reduction Act (IRA). See Upton, Dismukes, and Albrecht (2023) for a more specific timeline of events surrounding offshore leasing.

[28] EO 14148 by President Trump entitled "Initial Rescissions of Harmful Executive Orders and Actions," revoked 78 executive orders from the Biden administration, including EO 14008.

The LSU Center for Energy Studies submitted a progress report in March of 2023, in anticipation of the 2023 Regular Legislative Session. Another progress report was provided in December of 2023, timed with the completion of the formula-based grant that ended in September of 2023. A third progress report was published in March of 2024, before the beginning of the 2024 Regular Legislative Session. While this report offers in-depth analysis and insights based on current data, it should be noted that the program remains active, and future updates to the analysis are anticipated as new data becomes available. Data in this report is current as of March 2025. This report is designed to provide information that can be utilized in reporting to the federal government for purposes of determining future rounds of funding through the program.

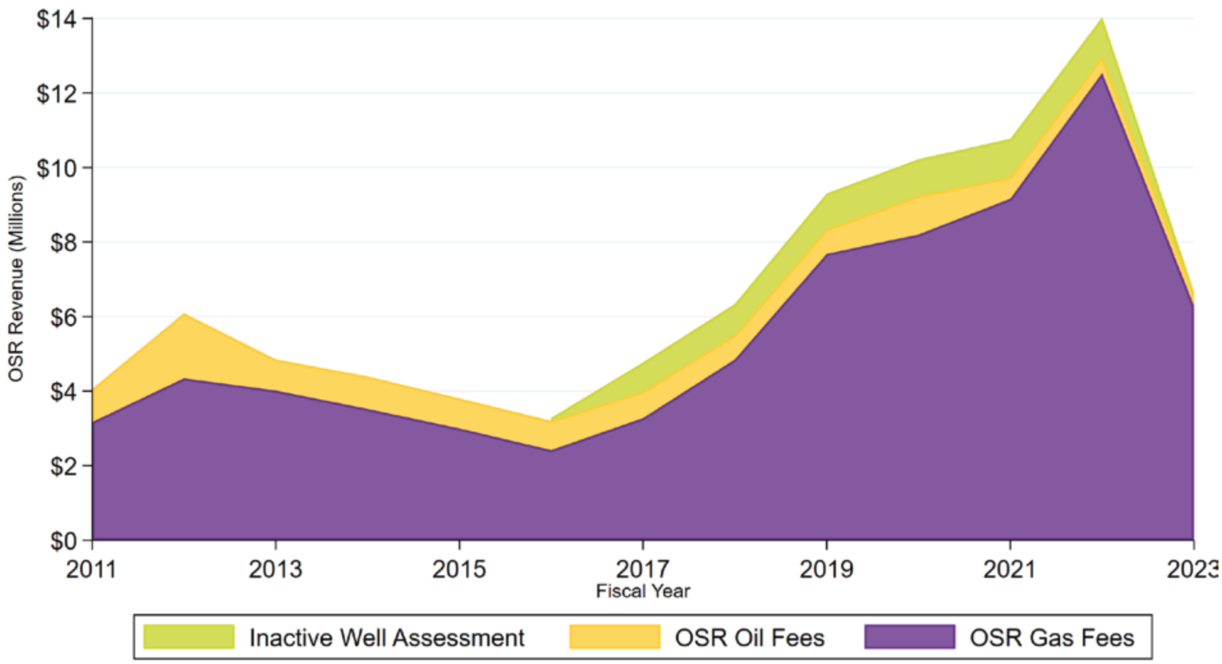
4. Orphan and Idle Wells in Context

This section considers the historical context of the state's oil and gas industry, focusing on the evolution of the OSR Program, trends in production and program finances, and shifting patterns of well productivity. It also outlines the methodology for identifying idle wells.

4.1 Historical Overview of the OSR Program

The Louisiana OSR Program has been operational for more than three decades, designed to address the state's orphan wells. Since FY 2011,[29] the OSR fund has collected $88.5 million (Figure 1). Of this, $10.4 million has come from oil, $72.4 million from natural gas, and $5.7 million from the inactive well assessment. Notably, approximately 82% is funded by natural gas. This is unsurprising given the disparity in the fee for natural gas and oil and that natural gas production has grown over the past decade to historic levels while oil production has declined over this same time period.

Figure 1: History of OSR revenues



4.2 OSR Program Activities

Although the focus of the OSR Program is P&Aing orphan wells, OSR projects range in size and scope from the repair of small wellhead leaks to P&Aing wells and the removal of associated facilities and structures on the site. Figure 2 provides a historical overview of the program's operations.

Since the program's inception, there have been more than 4,000 orphan wells P&Aed. In November 2021, the IIJA was signed into law, allocating significant funds for P&Aing orphan wells across the U.S. This legislation

[29] State fiscal year running from July 2010 to June 2011.

adds federal funds to Louisiana's existing OSR Program, boosting efforts to address orphan wells. Since January 2023, which marks the approximate start of OSR activity funded by IIJA, 535 wells have been P&Aed using IIJA funds. During the same time,[30] 1,519 wells have been added to the orphan well list.[31] Note that the influx of new orphan wells into the program is likely because the states were incentivized by the federal program to identify all orphan wells to receive increased funding.

Figure 2: History of OSR activity

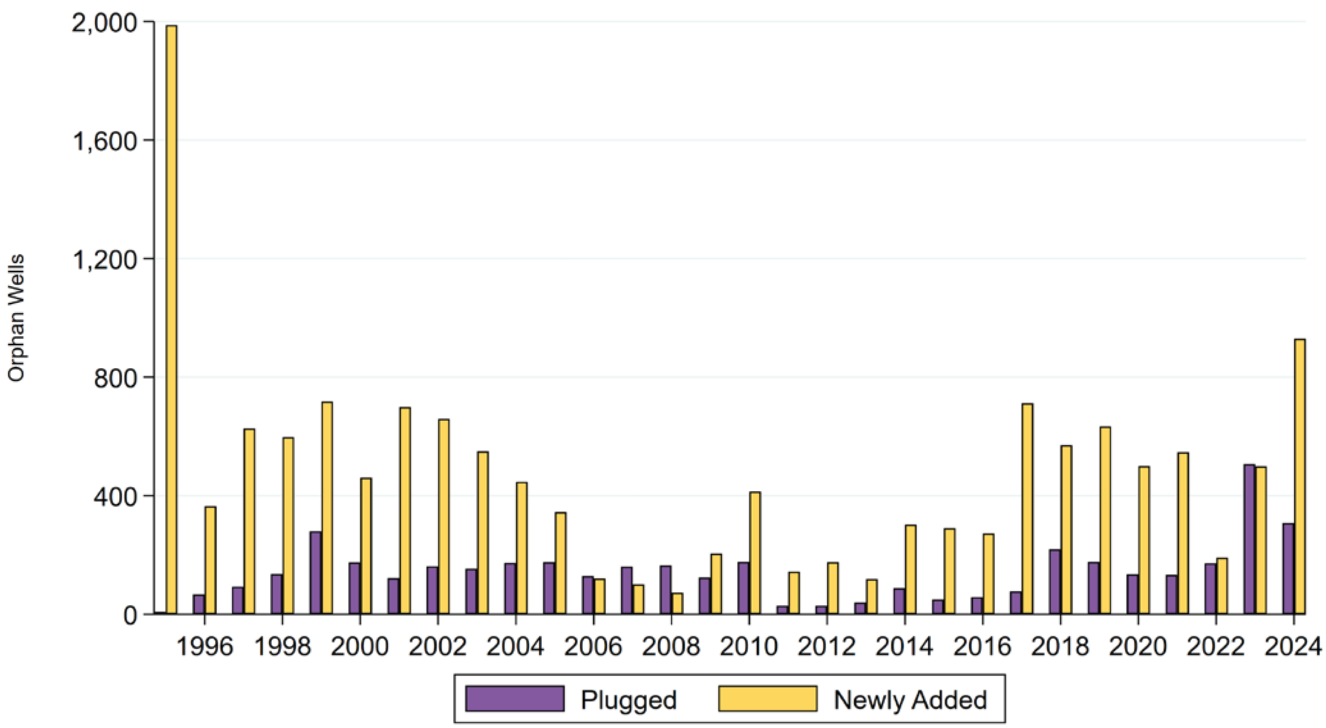


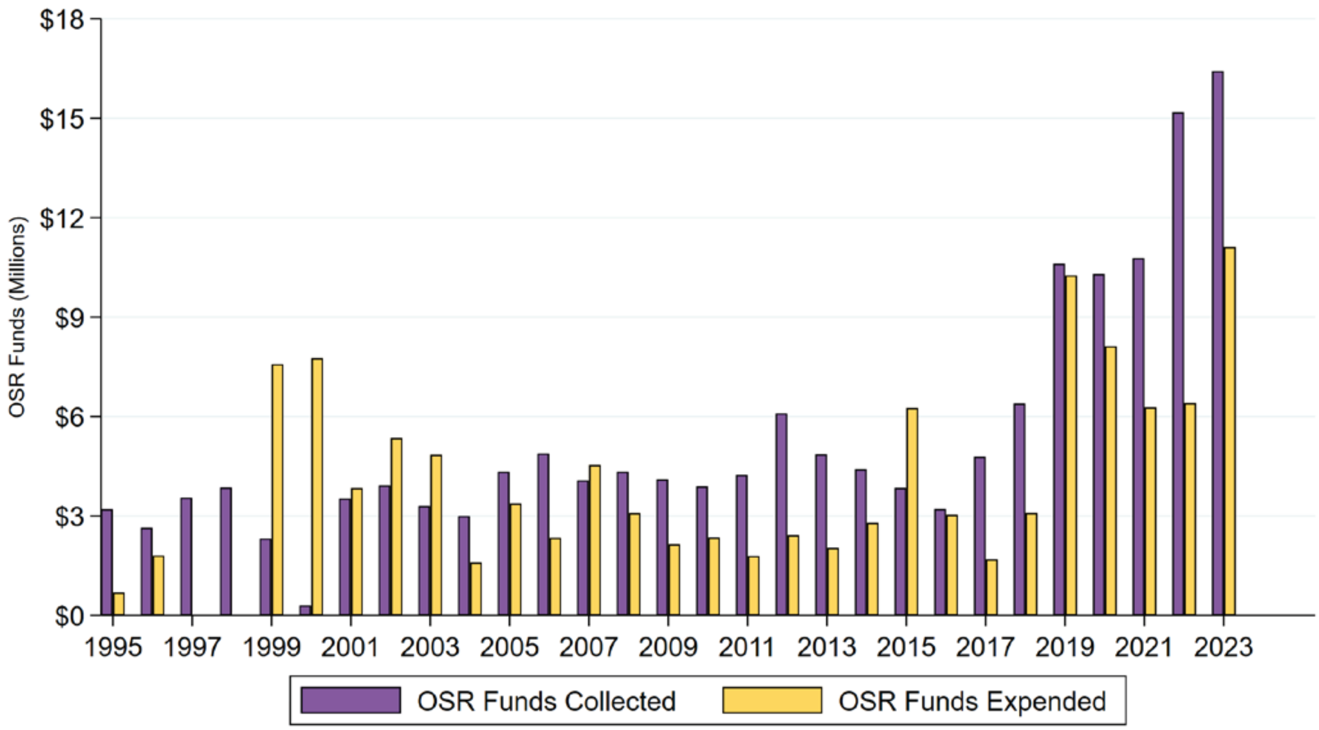
Figure 3 shows the trends in OSR funds collected and expended from 1995 to 2023.[32] A sustained growth in OSR fund collection is observed from around $3 million in the 1990s to over $16 million in 2023. The expended funds have followed a similar upward trajectory, although with some fluctuations, with the collected funds generally exceeding the expended funds.

[30] Between January 2023 and March 2025.

[31] Tabulated from monthly Louisiana Register tables of DENR Office of Conservation Oilfield Sites declared as orphan according to Section 91 of Act 404, R.S. 30:80 et seq.

[32] At the time of this writing, complete data post 2023 was not yet available.

Figure 3: OSR fund statistics



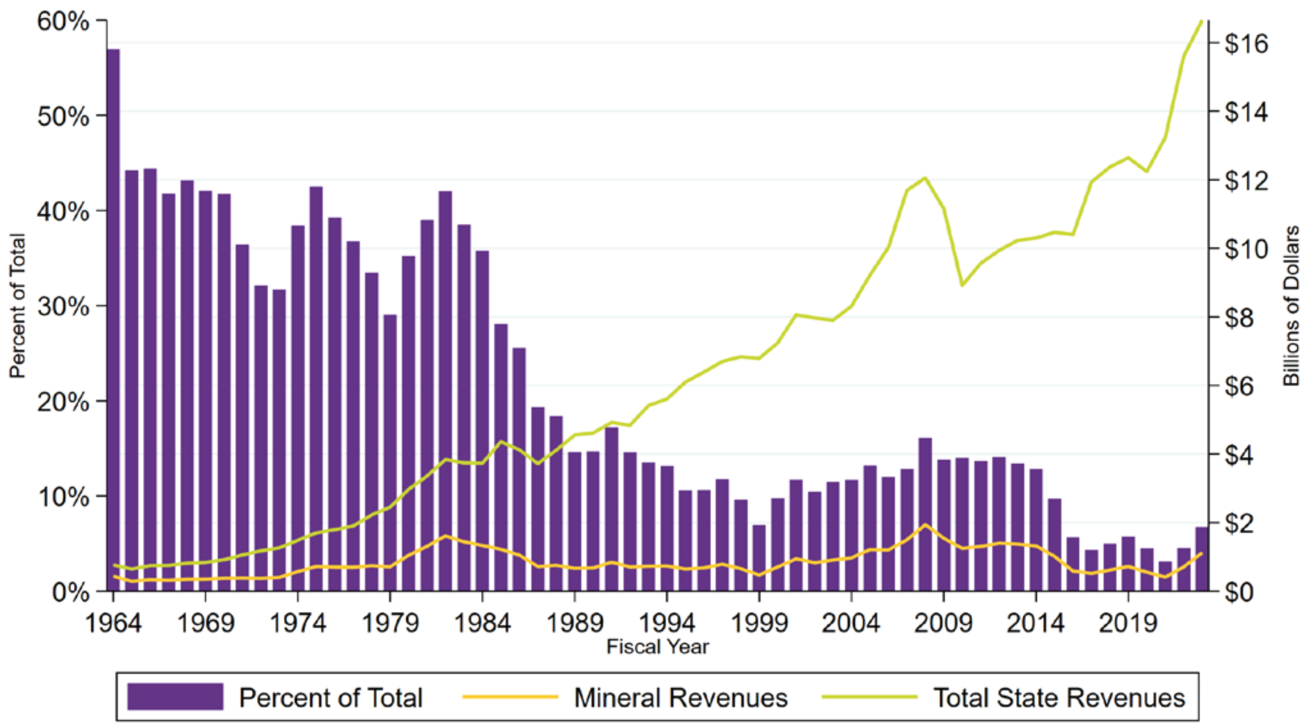
4.3 Changing Dynamics of Oil and Gas Production

To contextualize orphan wells within the broader landscape of Louisiana's oil and gas industry, the following sections examine the evolving patterns of mineral revenues and production across different well age groups.

4.3.1 Mineral Revenues

Figure 4 illustrates the relationship between mineral revenues, total state revenues, and the percentage of state revenues derived from minerals over time. Over the past decade, the contribution of mineral revenues to total state revenues has fluctuated, declining from about 13% in 2014 to a low of 3.1% in 2021, before increasing to 6.8% in 2023. During this period, while total state revenues grew from $10.3 billion to $16.7 billion, mineral revenues have shown more volatility, ranging from about $409 million to $1.3 billion.

Figure 4: Mineral revenues



4.3.2 Oil and Gas Production Trends

Figure 5 and Figure 6 show the trends for oil and gas production, as well as the age of wells contributing to production, over almost the past half century.

A few trends are noticeable. First, oil production has followed a steady decline. While fluctuations occur (mainly in response to price changes), oil production has continued to decline. More specifically, total oil production declined from about 0.78 MMbbl/d in 1978 to about 85,000 bbl/d in 2023, an 89% decline.

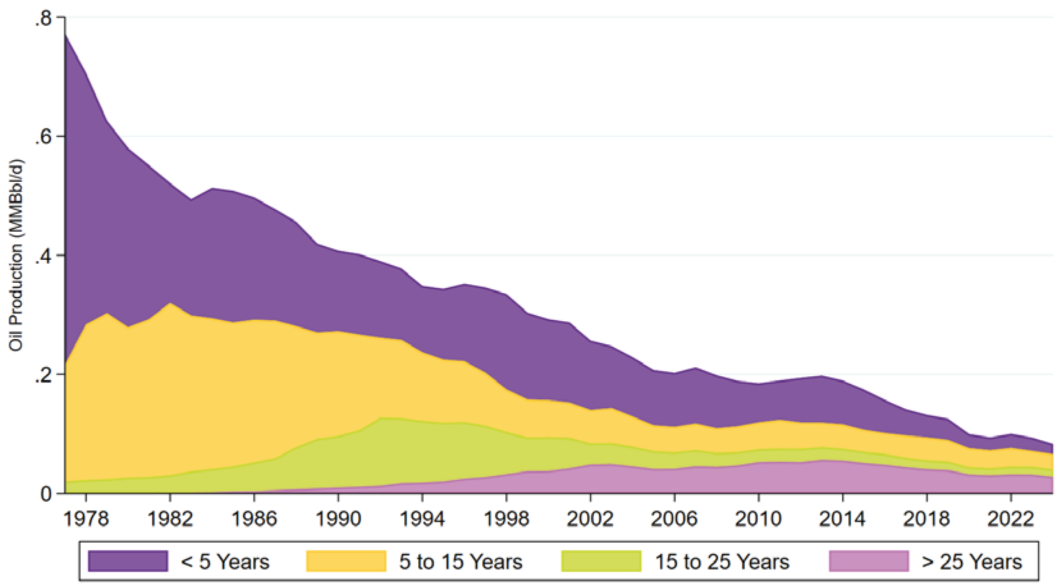
The trend in gas production is very different. Although gas production declined throughout the 1980s and 1990s, this trend has reversed with the advent of the Haynesville shale in northern Louisiana. In 2023, Louisiana produced 11.3 bcf/d of natural gas, more natural gas than any year since 1974. For perspective, the state's record for natural gas production was in 1970 when it produced 15.1 bcf/d.

Also notable in the comparison of Figure 5 and Figure 6 is the age of wells contributing to this production. Perhaps unsurprisingly, the share of oil production coming from older wells has steadily increased as production has declined. In 2023, less than 24.0% of oil production came from wells that had been drilled in the past 5 years, and more than 33.9% of oil production came from wells that are over 25 years old. Natural gas production, on the other hand, primarily comes from newer wells. In 2023, approximately 84.4% of natural gas production came from wells that had been drilled in the past 5 years, and 1.2% of natural production came from wells that are over 25 years old.

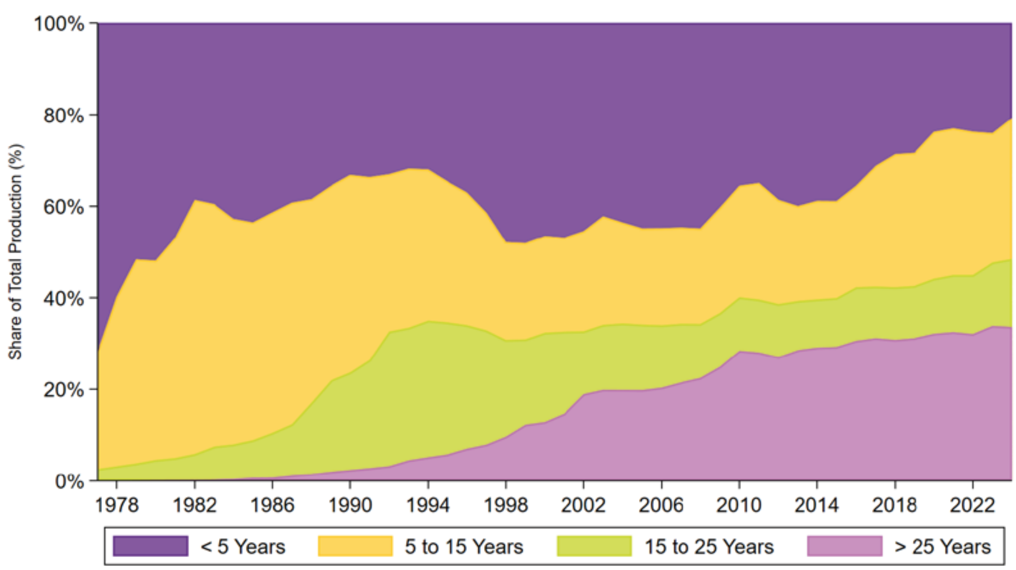
4.4 Implications for Orphan Wells

The trends observed in production and mineral revenue data may have implications for the OSR Program. As older wells contribute less to overall production and state revenues, they become more likely to be abandoned if not properly managed. As wells age, their production typically declines, making them less economically viable for operators. Mechanically, when the costs of operating and maintaining low-producing wells exceed their revenue potential, operators are more likely to abandon them, especially if they lack the financial resources for proper well P&A. Understanding these production and revenue trends can assist policymakers in anticipating future orphan well risks and assessing the adequacy of the OSR fund.

Figure 5: Oil production trends by well age (a) and the corresponding percentage contribution to total oil production (b)

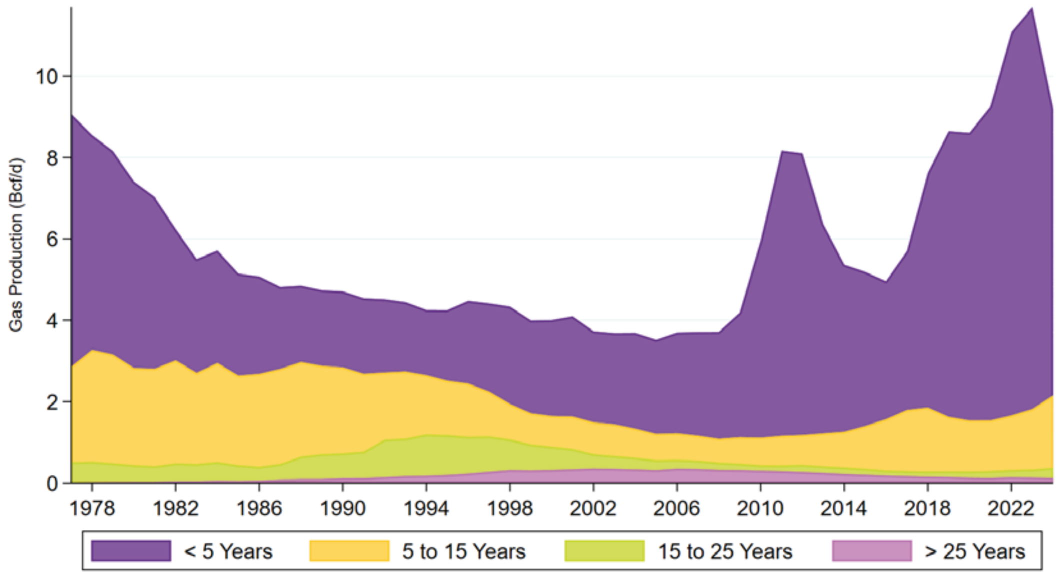


(a) Oil production by well age

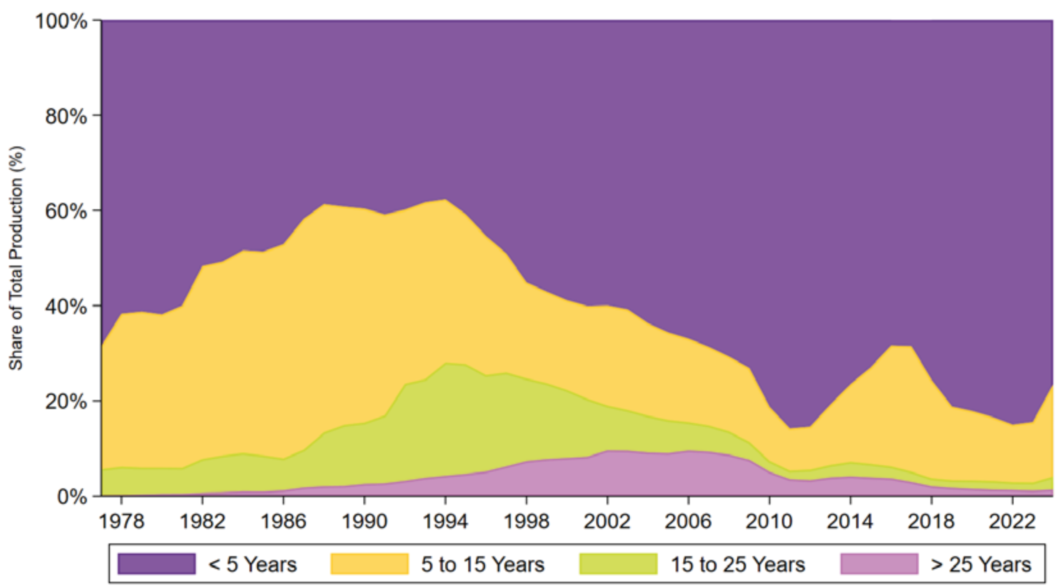


(b) Oil production percentage by well age

Figure 6: Gas production trends by well age (a) and the corresponding percentage contribution to total gas production (b)



(a) Gas production by well age



(b) Gas production percentage by well age

4.5 Orphan Well Trends

This section examines the age distribution of orphaned wells to better understand the long-term trajectory of the orphan well problem in Louisiana. A common presumption is that most orphaned wells are "legacy" wells—those drilled prior to the establishment of state programs such as the OSR fund, financial assurance requirements, SSTAs, and idle well fees. If this is the case, then as the state addresses the existing inventory of orphaned wells, the risk of modern wells becoming orphaned in the future should decline.

However, this outcome is not guaranteed. It is possible that even with these programs in place, they may not be sufficient to prevent future orphaning at scale. In that case, additional policy or regulatory reforms may be warranted to reduce long-term liabilities.

While a full assessment of program effectiveness is beyond the scope of this analysis, the following data offer context on well ages and highlight key trends that may inform future policy discussions.

More specifically, an analysis was conducted to examine the relationship between when wells were drilled (spud years) and when they were designated as orphaned. Figure 7 shows the spud years of wells that were added to the state's orphan well list between 2011 and 2024.

The median spud year of all orphan wells is 1976, meaning that half of the orphaned wells were spudded before this year. Thus, many of the orphaned wells are older wells. But also noticeable from Figure 7 is that there are still orphaned wells that were drilled recently. For example, the five "youngest" wells orphaned since 2023 were all spudded after 2021.

From 2011 to 2024, most orphan wells plugged and abandoned (P&Aed) were drilled around 1980, with some exceptions in 2022 and 2023 (Figure 8).

Figure 7: Spud year distribution of wells by their orphan designation date, 2011-2024

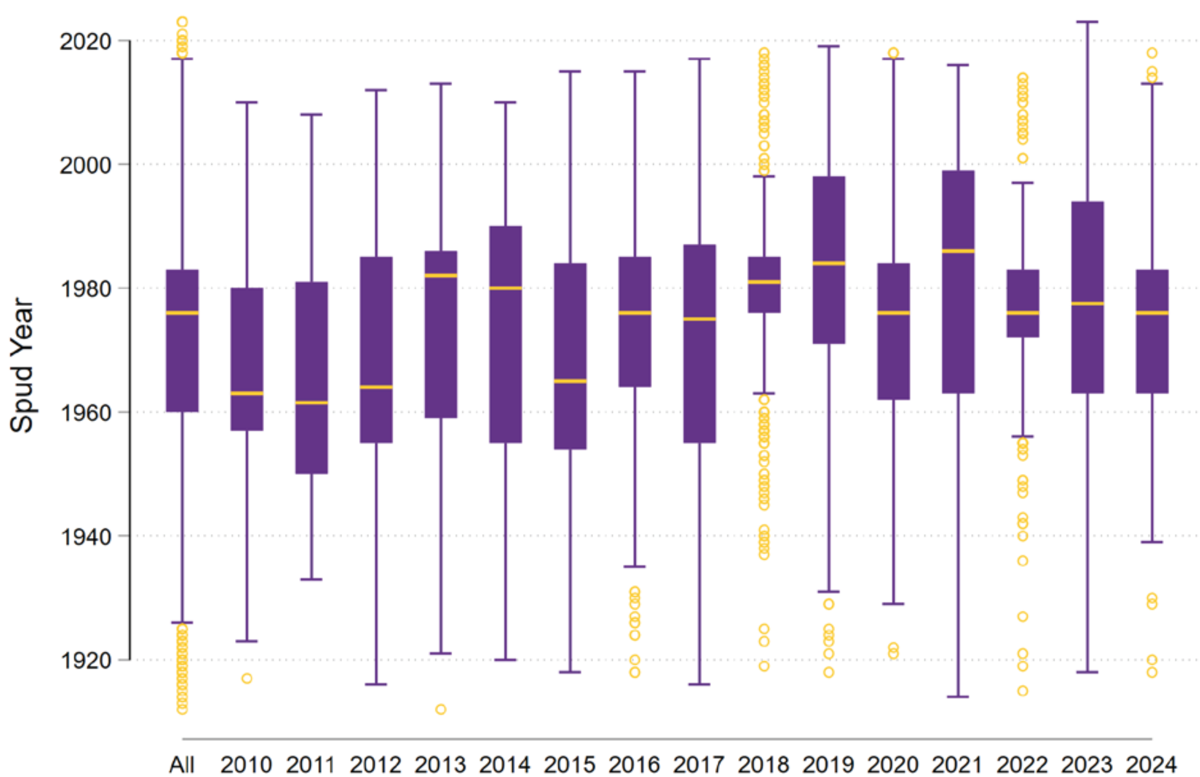
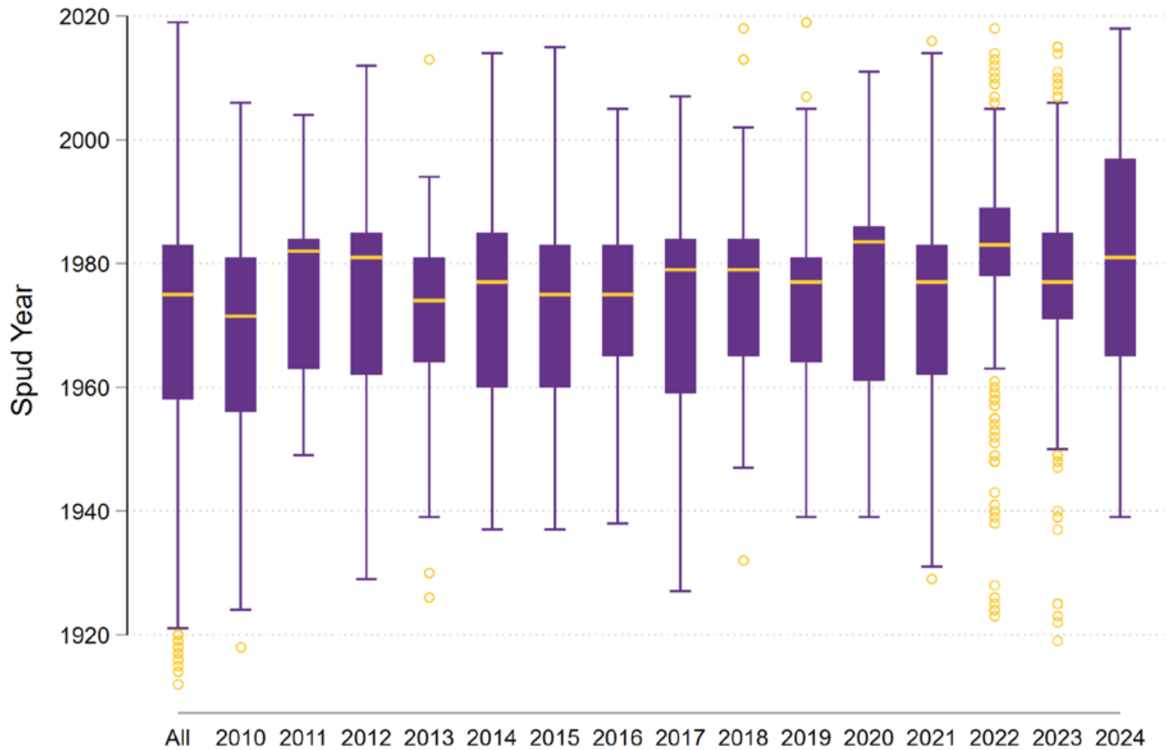


Figure 8: Spud year distribution of orphan wells by their P&A date, 2011-2024



4.6 Idle Wells

In this section, we estimate the number of idle wells in Louisiana. As of March 2025, Louisiana has approximately 19,500 idle wells (Table 3). The idle well category encompasses a range of well statuses[33] that are considered non-active but have not been officially designated as orphaned and have not been P&Aed. For the purposes of this study, we also classify a well as idle if it has not produced in the past five years. A comprehensive overview of all well counts by location and status is provided in Table C7 in the Appendix, while regional summary statistics including well depths and spud years are detailed in Table C8 in the Appendix. The spatial distribution of wells by category is illustrated in Figure B1 in the Appendix.

Table 3 presents an overview of idle well counts across different regions and idle duration categories. The table categorizes idle wells into six geographical regions (Offshore, Coastal Zone Wetlands, Haynesville, Federal Lands, Onshore North, and Onshore South) and four idle duration categories (5-10 years, 10-20 years, 20+ years, and never produced). Notably, the Onshore North region has the highest number of idle wells (10,366), accounting for over half of the total. The data also reveals that wells idle for more than 20 years form the largest category (5,881), followed closely by those idle for 5-10 years (5,660). Figures 9 and 10 graphically illustrate data presented in Table 3.

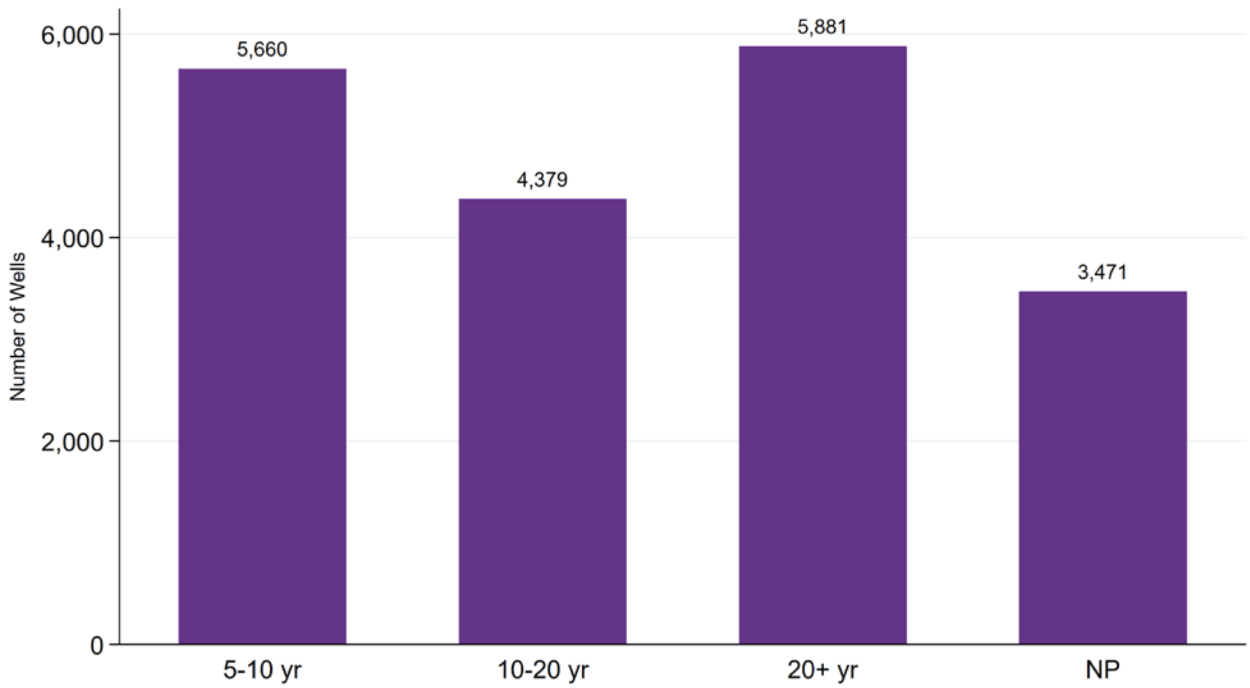
[33] A complete list of idle status codes and the idle well classification methodology can be seen in Section C.4.

Table 3: Well counts by region and idle category

Region	5-10 yr	10-20 yr	20+ yr	NP	Total
Offshore	115	113	287	162	677
Coastal Zone Wetlands	942	1,237	2,218	365	4,762
Haynesville	195	33	0	47	275
Federal Lands	121	50	51	22	244
Onshore North	3,798	2,239	2,102	2,227	10,366
Onshore South	489	707	1,223	648	3,067
Total	5,660	4,379	5,881	3,471	19,391

Note: NP stands for wells that have never produced.

Figure 9: Distribution of idle wells by duration. Includes wells idle for 5+ years and wells that have never produced



The well history of orphan wells, which tracks the different well statuses throughout a well's life, reveals the common pathways through which wells enter the state's orphan well inventory. As shown in Table 4, of the 4,887 wells currently designated as orphaned, the largest share (38.0%) were in shut-in status (with and without future utility) immediately before being orphaned. The second largest category consists of wells classified as active (33.5%), though this high percentage suggests these wells' status codes may not have been updated to reflect their true non-operational condition before being designated as orphaned. Notably, 744 wells (15.2%) were already in an inactive status, while 376 (7.7%) had been plugged and abandoned. A small fraction of wells (0.6%) were temporarily abandoned, while the remaining 5.0% were classified as unknown or other, which includes water supply, geothermal, permitted, and various miscellaneous statuses. Note that idle wells, which include both shut-in and inactive statuses, contribute to 53.2% of the total statuses before being designated as orphaned.

Figure 10: Distribution of idle wells by region

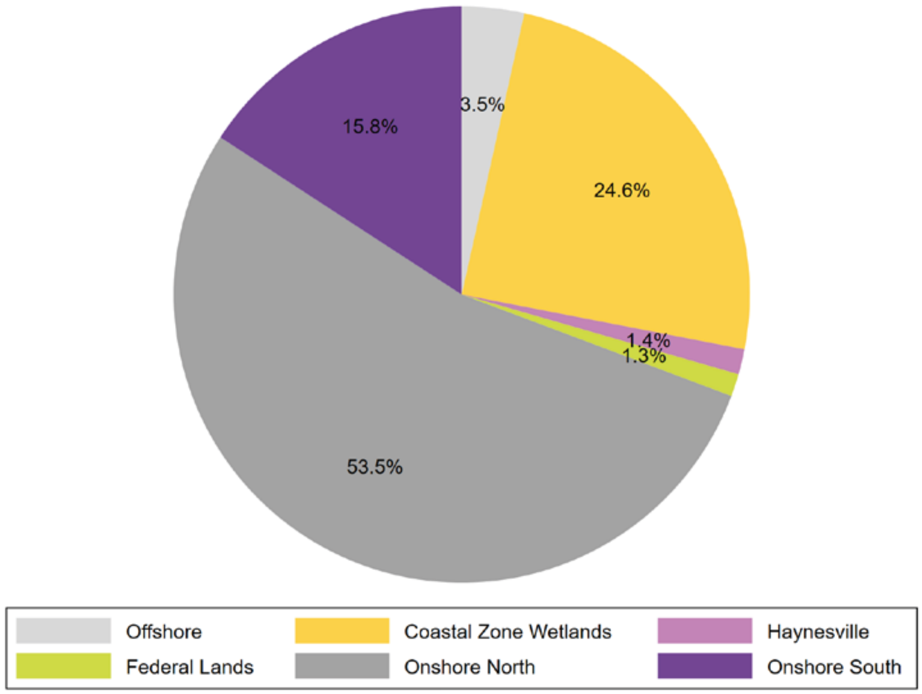


Table 4: Previous well status of orphan wells

Status	Number of Wells	Percent
Inactive	744	15.2
Plugged & Abandoned	376	7.7
Active	1,636	33.5
Shut-in	1,859	38.0
Temporarily Abandoned	30	0.6
Unknown or Other	242	5.0
Total	4,887	100.0

Notes: Distribution of well status classifications immediately prior to wells being designated as orphaned under Act 404. Status groups are defined as follows: Inactive includes inactive injection wells and wells with no responsible party; Plugged & Abandoned includes dry holes and plugged wells; Active includes producing wells and wells with active injection; Shutin includes wells with future utility, no future utility, waiting on pipeline or market; Temporarily Abandoned includes wells classified as temporarily abandoned; Unknown or Other includes water supply, geothermal, permitted, expired permits, educational, service company, observation, and miscellaneous statuses.

5. Well Geology and Other Characteristics

The scope of Louisiana's orphan and idle well challenge raises questions about environmental risks, particularly methane emissions. Both the geological setting and engineering characteristics of wells influence their potential to leak methane into the atmosphere. This section examines the geological factors and well characteristics that influence how methane might migrate from abandoned wells, providing context for the emissions measurements and cost estimates that follow.

5.1 Well and Geological Characteristics

The geologic conditions surrounding wells play a role in understanding the risks associated with methane leakage and the costs of P&A activities (Jordan 2020). Louisiana's subsurface geology is notably diverse, with variations in lithology, reservoir depth, and fluid content influencing well integrity and methane migration pathways. Louisiana's oil and gas wells penetrate various geologic formations, including unconsolidated sediments, clay-rich shales, sandstone, and carbonate reservoirs (Fails 1990). The nature of these formations influences well stability and the risk of leakage. For example, clay-rich formations, such as shales, are more prone to borehole instability and collapse. In contrast, sandstone formations provide more stable boreholes but can exhibit permeability that facilitates fluid migration if not properly sealed (Caenn, Darley, and Gray 2011; Chen, Tan, and Haberfield 1996).

Wells drilled into deeper formations encounter higher pressures and temperatures, which may increase the complexity and cost of P&A operations. Pressure gradients can also influence methane migration, with higher-pressure reservoirs posing a greater risk of leakage through pathways such as casing failures, annular spaces, or natural fractures (Opara and Okere 2024).

Regional variability in geology across Louisiana's oil and gas fields affects leakage risks and P&A costs. For example, wells in the Monroe and Shreveport districts are typically shallower than those in the Lafayette district, which are deeper and more costly to P&A. Differences in geologic conditions also affect well accessibility, the ease of remediation, and the selection of appropriate plugging materials.

The type of hydrocarbon produced (oil, gas, or a combination) also affects wellbore integrity (Normann 2024). Gas wells, which operate under higher pressure and involve larger gas volumes, are often at a higher risk for methane leakage than oil wells (El Hachem and Kang 2023). Furthermore, a well's production history—including the duration and intensity of production—can affect the stress on well casings and cement bonds, potentially leading to mechanical failures over time (Deighton et al. 2020).

Proper casing and cementing are also important factors in well integrity. Older wells, particularly those drilled before the implementation of modern P&A standards, often have deteriorated casing and cement (El Hachem and Kang 2023). Cement shrinkage, debonding, and cracking are common issues that may allow methane to migrate (Watson and Bachu 2009). Wells that were inadequately cemented during drilling are more likely to experience casing vent flows (CVFs) or surface casing vent flows (SCVFs), which are pathways for methane emissions (Davis et al. 2023).

Shallow aquifers used for drinking water are also a key consideration for well abandonment. Wells that intersect freshwater aquifers require additional measures to prevent contamination from hydrocarbons or brine. Regulatory standards often require that wells be sealed with cement above and below the freshwater aquifer to prevent upward fluid migration (McMahon et al. 2023).

5.2 Subsurface Methane Migration

Geologic conditions also influence the rate and extent of methane leakage from orphan and idle wells (Dusseault, Jackson, and Macdonald 2014). Key factors include the permeability of overlying caprock, the presence of confining units, and the occurrence of high-permeability pathways (natural fractures or poorly sealed wells) (El Hachem and Kang 2023). The presence of confining units, such as thick clay or shale layers, can act as a natural barrier, reducing the potential for vertical methane migration. Conversely, wells located in areas with limited confinement are at greater risk of leakage, as fluids have more pathways for upward migration (Riddick, Mauzerall, et al. 2020).

Natural fractures and faults present unique challenges for P&A activities. These geologic features can act as conduits for fluid and gas migration, allowing methane to escape from reservoirs to overlying formations or even to the surface. Wells located in regions with significant faulting, such as areas near salt domes, require additional monitoring and sealing measures to mitigate leakage risks (Gianoutsos, Haase, and Birdwell 2023).

The geology of wells in Louisiana directly affects the complexity of P&A operations and the potential for methane leakage. Key geologic factors include lithology, reservoir depth, pressure regimes, and natural fractures. Important engineering factors that interact with these geological conditions include well depth (which reflects design and operational choices), and the integrity of casing and cement systems. Variations in both geological and engineering factors across Louisiana's oil and gas-producing regions require site-specific assessments and tailored P&A strategies. By being aware of these geological and engineering considerations, the state can better understand the risks of and reduce the long-term environmental impact of orphan and idle wells.

5.3 Case Study: Alberta Wells

A case study by Watson and Bachu (2009) examined more than 315,000 oil, gas, and injection wells in the province of Alberta, Canada. They recorded well leakage at the surface as SCVF within the wellbore annuli and gas migration (GM) behind the casing. However, it's important to note two key limitations of this study: first, mandatory testing for SCVF/GM only came into effect in 1995, meaning many older wells lack this data; and second, the study only considers SCVF and GM leakages.

The authors grouped oil and gas well leakage impact factors into three categories: no apparent impact, minor impact, and major impact. Factors found to have no apparent impact included well age, well-operational mode, completion interval, and H_2S or CO_2 presence. However, the authors noted that the lack of impact from well age might be due to the absence of pre-1995 data, rather than a true lack of effect.

Factors with minor impact included licensee, surface casing depth, total depth, well density, and topography. While these factors showed some influence on leakage rates, their effects were not as pronounced as those in the major impact category.

The study identified several factors with major impact on well leakage. These included geographic area, wellbore deviation, well type, abandonment method, oil price, and uncemented casing/hole annulus. Notably, wellbore deviation was found to be significant, with cementing aspects such as casing centralization potentially contributing to increased leakages in directional wells. Well type also played a role, with cased and abandoned wells showing higher leakage rates than drilled and abandoned wells.

The abandonment method was another factor, with bridge plugs and dumped cement showing higher leakage rates compared to cement plugs positioned with the balanced-plug technique or setting a cement retainer and compressing cement into perforations. Interestingly, oil price was also identified as a factor, potentially due to its influence on drilling activities and the pressure to operate faster, which may have led to relaxed primary cementing practices.

Perhaps most significantly, the study found that uncemented casing/hole annulus, characterized by a low top of cement and consequently more exposed casing section, was the most important factor for SCVF/GM. This not only provides a direct pathway for gas migration but also increases the chance of casing corrosion, which can result in leaks through the casing wall.

The concern about this study, however, was that SCVFs were missing from provincial databases (Seymour, Xie, and Kang 2024) used in the Alberta study, bringing into question the reliability of the estimates and correlations. Bowman, El Hachem, and Kang (2023) had also demonstrated that the emissions were likely underestimated in the Alberta study (Watson and Bachu 2009). They included both SCVF and non-SCVF measurements (Bowman, El Hachem, and Kang 2023).

This review of well geology and other characteristics influencing methane leaks from abandoned and orphaned oil and gas wells highlights the complexity of the issue. While significant research has been conducted, there is still much to be understood about the interplay of these factors and their long-term effects on well integrity and methane emissions.

6. Methane Measurements

With an understanding of the factors that can influence methane leakage, this section focuses on actual measurements of these emissions. The following analysis presents the methodologies and results of methane measurements conducted on orphan wells in Louisiana by DENR contractors and researchers at LSU.

5.1 Hi-Flow Measurements

Hi-Flow measurements were carried out by DENR contractors—The Lemoine Company, LLC and Dynamic Group, LLC (hereafter referred to as Lemoine and Dynamic, respectively)—using a two-step procedure. An initial survey was done using a cooled-core optical gas imaging (OGI) camera (Teledyne FLIR GFx320) to detect leaks at each well site. These cameras have varying detection limits depending on environmental conditions and operator experience (Ravikumar, Wang, and Brandt 2017; Ravikumar, Wang, McGuire, et al. 2018; Zimmerle et al. 2020). Under field conditions, experienced operators can detect 50% of leaks under about 17 g/hr, with detection thresholds dropping to about 3 g/hr at close range (1.5 m) (Ravikumar, Wang, McGuire, et al. 2018; Zimmerle et al. 2020).

Methane emission rates were measured at the detected leak points using high-flow component sampling (SEMTECH® HI-FLOW 2). The high-flow sampler uses a high flow rate of air and a modified enclosure to completely capture the gas leaking from an individual component.

Tunable Diode Laser Absorption Spectroscopy based CH_4 measurements were used to record the exit concentration in the air stream of the system. The sampler essentially makes rapid vacuum enclosure measurements so that emissions are calculated as:

$$Q_{CH4} = F_{sampler} \times (C_{sample} - C_{background}) \quad (1)$$

Where Q_{CH4} is the leak rate of methane from the leaking component (scfm),[34] $F_{sampler}$ is the sample flow rate (scfm), C_{sample} is the concentration of the methane in the sample (as a percent), and $C_{background}$ is the concentration of methane in the background near the component (as a percent).

6.2 Chamber Measurements

Detailed methane emission rate measurements were made by the LSU research team at each wellhead using the static flux chamber technique (Driscoll et al. 2025). At each site, wellheads were "sniffed" with the Bascom-Turner Gas Rover II to determine the location and intensity of methane leaks (Townsend-Small and Hoschouer 2021). The Rover is a handheld gas detection instrument that utilizes a dual catalytic combustion system for CH_4 readings from 0-50,000 ppm and a thermal conductivity system for CH_4 readings from 5%-100%.[35] This preliminary measurement informed which instrument would perform best for the chamber technique. The initial emission threshold used to designate between low/moderate and high emitters was 300 ppm on the Rover "sniff" test (Driscoll et al. 2025).

Methane flow rate was measured in a closed chamber system by placing plexiglass chambers over the wellhead (Kang et al. 2016). The setup consisted of modular components: multiple base units (60x60x60 cm) open at both ends, and a top unit (60 x 60 x 60 cm) open only at the bottom. These units could be stacked to fully enclose wellheads during methane measurements. The top chamber has three ports, two of which can be connected to a measurement instrument in a closed loop. The third port allows for collecting additional

[34] Standard cubic feet per minute.

[35] www.bascomturner.com/documentation.

gas samples that can be analyzed in the laboratory using gas chromatograph or other analytical techniques. The chambers are also fitted with battery-powered fans for air recirculation. The gas analyzer's inlet and outlet were attached to each end of the top chamber, and methane concentration was measured continuously in this closed-loop configuration. For wells below the initial leak threshold, the Picarro GasScouter TM G4301 Mobile Gas Concentration Analyzer was connected to the chamber system. This instrument utilizes a cavity ring-down spectroscopy method to measure CH_4.[36] A 0.1 ppb precision and 0-800 ppm range allowed for more precise readings of methane concentration. An Aeris Technologies MIRA Ultra LDS: Natural Gas (Methane and Ethane) Leak Detection System was also introduced later in the campaign for low-emission wells due to its ability to measure concentrations from 0-4,000 ppm. The Aeris measures methane through Mid-Infrared Laser Absorption Spectroscopy to a precision level of <1 ppb. The higher detection limit of this system allowed for the use of a high-precision instrument at higher concentrations. Because the Aeris can measure higher concentrations than the Picarro, the Rover "sniff" test threshold was increased to 1,000 ppm. For wells above the initial leak threshold, the Rover was connected to the closed chamber system. A 1 ppm precision within the concentration range of 1-10,000 ppm and 100 ppm precision within the concentration range of 1%-100% allowed for measurement at high concentrations.

The methane emission rate was calculated as follows:

$$F = (V - w) \times dC/dt \qquad (2)$$

Where F is the emissions rate, V is the chamber volume, w is the approximate wellhead volume, and *dC/dt* represents the change in CH_4 concentration over time, determined from the slope of the best fit line through the continuous methane instrument data. Appropriate conversion factors were utilized to present final emissions rates at the measured atmospheric temperature.

6.3 Results

Table 5 summarizes the methane measurements using both methods. HiFlow measurements found leaks at 23% of wells, while the more sensitive chamber method detected emissions at 96% of wells. For wells with detected leaks, the average leak rate was 119.6 g/hr (Hi-Flow) versus 36.3 g/hr (chamber method). The overall average emissions rate across all measured wells was 27.1 g/hr (Hi-Flow) versus 34.8 g/hr (chamber method), reflecting differences in both detection thresholds, measurement approaches, and the set of wells measured. Detailed summary statistics by measurement method and district are provided in Tables A1 and A2 in the Appendix. The spatial coverage of methane measurements is illustrated in Figure B2 in the Appendix, while the distribution of wells by leak status is shown in Figure B3 in the Appendix.

[36] www.picarro.com/products/gas-scouter-g4301.

Table 5: Methane emission measurements in Monroe and Shreveport districts

Well type	Hi-Flow			Chamber		
Metric	Not leaking	Leaking	Overall	Not leaking	Leaking	Overall
Wells measured	653	191	844	8	186	194
Percent	77%	23%	100%	4%	96%	100%
Implied total emissions (t/yr)	0.0	200.2	200.2	0.0	59.2	59.2
Max emission observed (g/hr)	0.0	2,888.7	2,888.7	0.0	1,379.2	1,379.2
Min emission observed (g/hr)	0	.12	0	0	8.5e-06	0
Median	0.0	17.3	0.0	0.0	0.1	0.1
Mean emission rate (g/hr)	0.0	119.6	27.1	0.0	36.3	34.8
SD emission rate (g/hr)	(0.0)	(318.5)	(159.3)	(0.0)	(164.2)	(160.9)

Note: Table only includes measurements of wells in the Monroe or Shreveport districts. 16 wells were measured multiple times with the chamber technique. These measurements are averaged together. Calculation of total emissions assumes that emissions rates are constant for the entire year.

U.S. EPA (2018) emissions factors for unplugged orphaned wells are 30.57 g/hr for wells in Appalachia based on Kang et al. (2016) and 10.02 g/hr for wells elsewhere in the U.S. based on Townsend-Small, Ferrara, et al. (2016).

Both measurement methods revealed highly skewed emission rate distributions, where a small subset of high-emitting wells accounted for a disproportionately large percentage of the total emissions. These distributions can be seen in Figure B4 in the Appendix.

Recent comprehensive measurements from Driscoll et al. (2025)—the first study to report such measurements from orphan wells in Louisiana (n = 132)—provide additional context for these findings. Their data range from 0 to 1,368 g/hr, with a mean of 57.4 g/hr. The distribution is right-skewed, with a small subset of high-emitting wells accounting for a disproportionate share of total emissions. Specifically, the top 10% of wells contributed nearly 87% of the cumulative estimated emissions. This pattern aligns with findings from other regions (Pekney et al. 2018; Riddick, Mbua, et al. 2024; Saint-Vincent et al. 2020; Townsend-Small, Ferrara, et al. 2016).

6.4 Summary and Implications

These measurements highlight two scientific questions. First, how do emissions from unplugged orphan and idle wells evolve over time? If emissions are short-lived events, then P&Aing a leaking orphan well may have different implications than if they are long-lived. Further, if leaks fluctuate significantly over shorter time periods, then a point-in-time measurement might not be representative of the average over the course of a year. Understanding short and long-term fluctuations in leakage is an important question for future research.

Second, what are the detection thresholds, biases, and measurement errors inherent in measurement techniques relative to actual leak rates and the distribution of leaks? For example, if the majority of emissions come from "super-emitters", then low-cost measurements that can quickly and inexpensively screen for large emissions may be more appropriate tools than highly sensitive methods like the chamber methods.

While this study design is unable to answer both questions definitively, the results provide insights into the distribution and characteristics of methane emissions from orphan wells. Future research would benefit from increasing the sample size and expanding the geographic coverage to improve the precision of emission estimates and allow for a more detailed assessment of emission drivers. The current measurements, while providing valuable insights into emission patterns, would benefit from broader spatial and geologic representation to enhance the statistical robustness and generalizability of emission models. These findings inform the subsequent modeling and estimation work.

7. Estimating Methane Emissions

Using direct measurements from both the Hi-Flow and chamber techniques, orphan well emissions are estimated for the total population of orphan wells in northern Louisiana. This section outlines the approach to generating these estimates and presents the findings and their implications for policy decisions.

7.1 Well Leakage Factors

Numerous studies have identified factors impacting well leakage. According to a comprehensive review by El Hachem and Kang (2023), certain factors consistently affect leakage, while others yield conflicting results.

Consistent factors associated with well leakage: Geographical area (11 studies[37]), well deviation (6), plugging status (4), well type (conventional vs. unconventional) (4), construction period (4), and well status (active or abandoned) (4) are reliable indicators of potential methane emissions.

Conflicting factors: Formation fluids (11 studies), well age (9), production volume (8), operator (7), well depth (6), and well density (6) show mixed results, indicating context-dependent effects.

Empirical evidence from Louisiana orphan wells indicates that emission rates vary systematically with well age, time since last production, and hydrocarbon type (Driscoll et al. 2025). These findings contribute to the understanding of which factors consistently versus inconsistently influence leakage across different contexts and regions.

Recent research has identified key mechanisms of methane emissions at well sites, with Omara, Zavala-Araiza, et al. (2022) noting emissions that are detectable through sounds, visible plumes, or distinctive odors. These characteristics indicate that standard leak detection and repair (LDAR) practices could effectively address these leaks.

Broadly, emission sources can be categorized into two main types:

Intentional or equipment-related sources: These include vented emissions from normal operations, leaks from wellheads, casings, pneumatic devices, separators, dehydrators, compressors, flare stacks, and storage vessels (Deighton et al. 2020; Omara, Sullivan, et al. 2016; Rutherford et al. 2021).

Maintenance and infrastructure issues: These encompass leaks at fittings and joints, emissions from rusted pump jacks and tanks, neglected infrastructure, and damage from overgrown vegetation or fallen trees (Deighton et al. 2020).

Understanding these factors provides context for measurement strategies and plugging program design. The variation in factors affecting leakage illustrates the complexity of methane emissions from wells. The measurement approach focuses on directly quantifying emissions, providing empirical data on actual emission rates without attempting to identify specific underlying causes.

7.2 Modeling Methane Emissions

A key goal of this study was to understand the distribution of emissions from orphan wells in Louisiana's Monroe and Shreveport conservation districts, and then predict emissions at unmeasured wells specifically in these two districts. It is important to note that emissions prediction is not conducted for the Lafayette

[37] Numbers in parenthesis refer to the number of peer-reviewed research articles and reports that have investigated the relationship between various factors and methane leakage from wells.

conservation district, as measurements were only taken in the Monroe and Shreveport districts. Emissions e_i from well i were modeled as the product of whether the well is leaking or not ($L_i \in \{0, 1\}$) and the leak size ($\bar{e}_i \in (0, \infty)$) so that $e_i = L_i \times \bar{e}_i$. The model allows for well characteristics to be correlated with L_i. Given a vector of well characteristics X_i^L and unknown parameter vector β_L, we assume that the probability well i leaks is

$$\Pr(i \text{ is leaking}) = E\,[L_i \mid X_i^L] = \Phi\,(X_i^L \cdot \beta_L) \quad (3)$$

where Φ is the standard normal CDF.

7.3 Distribution of Leak Probabilities

The parameters are collected for (3) along with the vector of leak-sizes and their probabilities into vector θ. Given the estimates $\hat{\theta}$ the study proceeded to estimate the distribution of emissions from unmeasured orphan wells in the Monroe and Shreveport districts. The sum of unmeasured emissions is denoted $i = 1, \ldots, n$ as $E = \Sigma^{n}_{i=1}\ L_i \bar{e}_i$. Because E does not have a closed form, its distribution is simulated using Monte Carlo integration with 10,000 draws. This approach uses repeated random sampling to obtain a range of possible outcomes and their probabilities. For each simulation run, we:

1. For each unmeasured well, estimate the probability of leakage based on its characteristics.
2. Randomly determine whether each well is leaking using these probabilities.
3. For wells predicted to leak, randomly assign emission rates based on the observed distribution.
4. Add up the total emissions across all wells.

Several statistics of this distribution are computed, including mean, standard deviation, the CDF, and various quantiles. The estimates of θ are subject to sampling uncertainty, so to obtain confidence intervals, statistics are bootstrapped with 1,000 bootstrap replications. This involves repeatedly re-sampling from the measured data to create many slightly different datasets, then applying the model to each one. The combination of bootstrapping the measured data and Monte Carlo simulation for unmeasured wells provides a more robust picture of the total emissions and the uncertainty in the estimates.

The estimates are based on our sample of data from 844 wells measured by contractors using a Hi-Flow instrument, and 194 wells measured by LSU using a chamber. Detailed summary statistics comparing measured and unmeasured wells by district are provided in Tables A1 and A2 in the Appendix.

7.4 Analysis Results

A summary of statistical results are as follows:

- Well age and production history are statistically significant predictors of leak probability, with older wells and those with low historical production more likely to leak.
- Wells in coal-bearing regions, which might be hypothesized to have higher leak rates due to additional methane sources, actually show statistically significant lower leak probabilities in our sample according to Hi-Flow measurements ($p < 0.05$), though this pattern is not confirmed by chamber measurements.
- We do not find a statistically significant relationship between well characteristics and leak size.
- Chamber measurements detect leaks in nearly all wells measured (96%), suggesting that very small emissions are common.
- The distribution of emission rates follows a pattern commonly observed wherein a small number of large emitters account for a disproportionate share of total emissions.

Table 6 presents the distribution of plugged wells by leak status across the Monroe and Shreveport districts. Among the wells that have been plugged and measured with Hi-Flow instruments, approximately 21% were found to be leaking at the time of measurement. The leak rates are relatively consistent between districts, with 23% of Monroe wells and 19% of Shreveport wells showing detectable emissions. This distribution provides important context for understanding the prevalence of methane emissions among wells selected for P&A operations.

7.5 Emission Estimates

Utilizing the Monte Carlo simulation and bootstrapping techniques detailed in Section 7.3, we estimate the likely emissions from unmeasured wells and total emissions from all orphan wells in northern Louisiana. This analysis method accounts for both the uncertainty regarding which specific wells are emitting and the variability in emission rates when leakage occurs. This approach acknowledges the inherent uncertainty in determining emissions from unmeasured wells while providing statistically robust estimates of the probable range of total emissions.

Table 6: Number of plugged wells with and without leaks

	District		
	Monroe	**Shreveport**	**Total**
Count			
Not leaking	137	285	422
Leaking	42	69	111
Share			
Not leaking	0.77	0.81	0.79
Leaking	0.23	0.19	0.21

Note: Excludes two wells without Hi-Flow measurements.

Table 7 presents estimated methane emissions from plugged and unplugged orphan wells in northern Louisiana. We present two sets of estimates— those based on the larger number of Hi-Flow measurements, and those based on the smaller number of detailed chamber measurements. As discussed elsewhere, the Hi-Flow and chamber measurements are not readily comparable since the set of wells measured are different, as well as the measurement techniques and measurement dates. Work is ongoing to decompose the differences between the two sets of estimates into differences in (a) long term average leak-rates of the wells sampled, (b) day-to-day variability in actual leak rates, (c) systematic measurement bias, (d) random measurement error, and (e) false zeros, e.g., non-detection of small emissions by the Hi-Flow instruments.

We do not observe how much unmeasured wells emit, so there is significant uncertainty around what the total emissions of these will be. This is particularly true because emissions are dominated by a small number of large leakers. For this reason, we calculate three numbers—a P10, P50, and P90—which represent quantiles of the distribution of total emissions. The P50 number can be interpreted as meaning that there is a 50% probability that total emissions are below that threshold. The figures presented in the table add the P10, P50, and P90 estimates for unmeasured wells to the actual measured emissions of the measured wells. The full distributions are graphed in Figure 11. While the table shows that there is large uncertainty over total emissions, emissions are highly likely to exceed the lower EPA emissions estimates, as this falls outside the confidence intervals. For reference, US and Appalachia EPA emissions factors for orphan wells are 10.02 and 30.57 g/hr, respectively.

The analysis indicates that the P10, P50, and P90 of total methane emissions from all orphan wells in this region are 779, 868, and 967 t/yr based on Hi-Flow measurements. When we use chamber measurements, these increase to 1,062, 1,171, and 1,283 t/yr.

Figure 11: Cumulative distribution function (CDF) of estimated total methane emissions for orphan wells in northern Louisiana

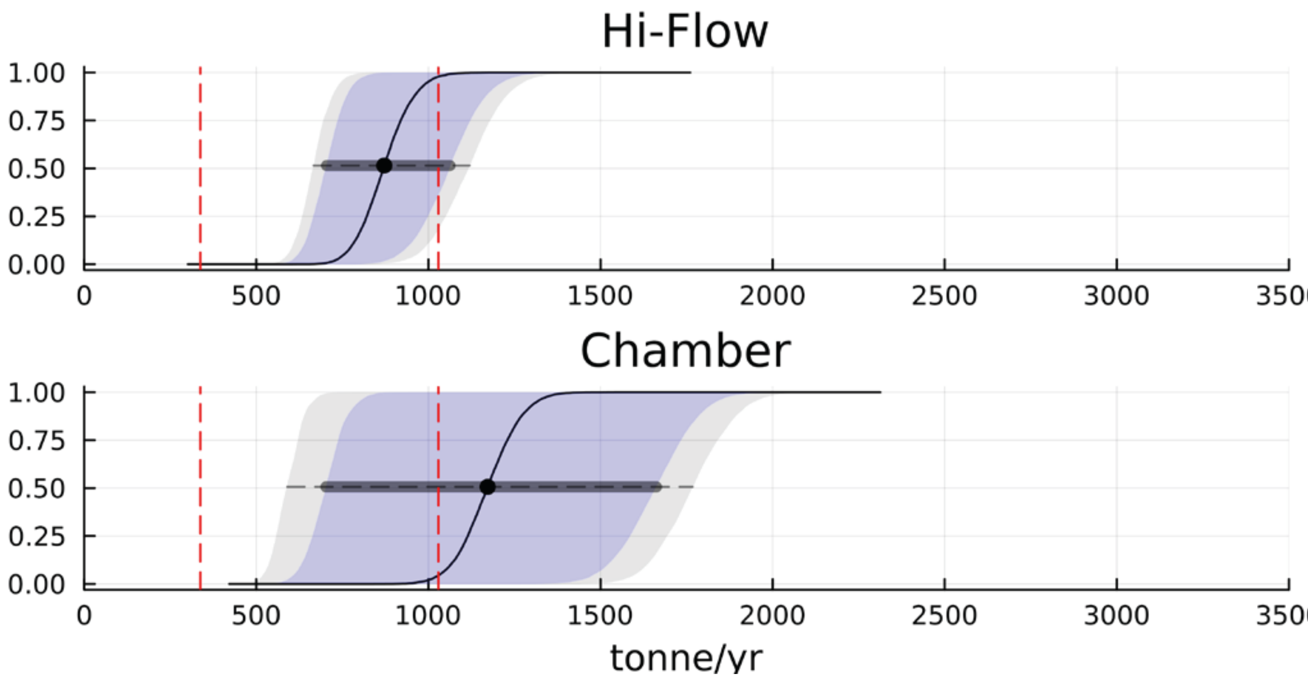


Figure 11 illustrates the statistical distribution of emissions from the orphan well inventory in northern Louisiana, with the upper panel depicting emissions from the Hi-Flow measurements, while the lower panel presents the distribution from the chamber measurements. The solid black curves represent the estimated cumulative distribution functions, with blue shaded regions indicating 80% confidence intervals and gray regions denoting 90% confidence intervals. The horizontal dashed lines identify the distribution medians, and vertical red lines represent emission estimates derived from EPA emission factors. The empirical measurements conducted in this study yield substantially higher emission estimates compared to EPA factor-based calculations, suggesting that standardized factors significantly underestimate the actual climate impact of orphan wells in the studied region. The chamber methodology generates higher and more variable estimates relative to Hi-Flow measurements, reflecting its enhanced sensitivity in detecting minimal emissions. The cumulative distribution functions demonstrate considerable uncertainty in total emissions, particularly for the chamber methodology, though even the lower confidence bounds exceed the EPA-derived values. This finding indicates that standardized emission factors may under-represent the climate implications of orphan wells, highlighting the necessity for region-specific measurements to accurately quantify methane emissions. In the context of highly variable emission rates across the well inventory, information regarding emission rates at individual sources becomes particularly valuable for optimizing abatement efforts in a costeffective manner. An economic valuation of these emissions is presented in Section 9.

Table 7: Distribution of emissions from measured and unmeasured orphan wells

	Well Count	Total emissions (t/yr)		
		P10	P50	P90
Hi-Flow				
Unplugged	3,305	684	775	877
Plugged	535	94	94	94
Total	3,840	779	868	967
Chamber				
Unplugged	3,305	913	1,008	1,112
Plugged	535	121	161	204
Total	3,840	1,062	1,171	1,283

Note: Table shows predicted total emissions for orphan wells in northern Louisiana. We add empirical measurements to simulations of unmeasured wells from that instrument. Wells measured by Hi-Flow only are treated as unmeasured in chamber simulations since measurements are not directly comparable, and vice versa.

8. Estimating Costs to P&A Orphan and Idle Wells

In this section we estimate the costs associated with plugging orphaned and idle wells. This analysis provides perspective on the magnitude of the future liability facing the state and industry, incorporating both physical well characteristics and emissions data in the cost assessment.

8.1 Cost Allocation

The cost analysis utilizes accounting data provided by two contracting entities— Lemoine and Dynamic—as submitted to the Louisiana Department of Energy and Natural Resources (DENR) accounting firm, EisnerAmper, which administers the financial oversight for the broader project. While certain costs are directly attributable to individual wells, other expenditures require allocation across multiple wells. This allocation process was executed as follows. Initially, pre-plugging methane measurement costs were segregated from well-specific plugging and abandonment (P&A) expenses, as methane quantification represents a distinct operational phase. P&A costs encompass permitting and inspection fees, Naturally Occurring Radioactive Material (NORM) surveys, supervisory personnel, contingency funds, and additional post-construction expenditures. Subsequently, contract-level general conditions, bonding and insurance requirements, and overhead costs were allocated proportionally to each well based on its relative cost basis. Construction management fees were then incorporated (12% for Dynamic and 12.5% for Lemoine). Additionally, for wells where P&A operations were initiated but not completed, the associated costs were aggregated and distributed across both completed and incomplete P&A projects proportionally to their respective shares of total project costs.

8.2 Cost Summary

Table 8 presents the distribution of wells by classification status (orphan vs. idle) and conservation district. The data indicates that all wells in the Monroe district have been P&Aed by Dynamic, while all wells in the Shreveport district have been P&Aed by Lemoine. Table 9 provides a detailed financial summary, with the upper portion displaying aggregate P&A costs incurred and the lower section presenting mean P&A cost per well with corresponding standard deviations. As of the analysis date, 535 wells have been successfully P&Aed in the Monroe and Shreveport districts (Table 8) utilizing IIJA funds at an average expenditure of $42,000 per well (Table 9). The spatial distribution of wells plugged using IIJA funds is shown in Figure B5 in the Appendix. P&A costs demonstrate significant regional variation, with wells in the Monroe district requiring approximately $19,000 more per well compared to those in the Shreveport district.

Well characteristics differ substantially between districts, with Monroe wells having uniform measured depths around 2,270 ft compared to Shreveport's highly variable depths. Detailed well characteristics by district and status are presented in Table A3 in the Appendix.

Table 8: Well counts by district and P&A status

	Lafayette	Monroe	Shreveport	Total
Orphan				
Not P&Aed	1,725	1,603	1,676	5,004
P&A In Progress	0	24	2	26
P&A Completed	0	179	356	535
Total	1,725	1,806	2,034	5,565
Idle				
Total	8,381	3,089	7,851	19,321
Total				
Total	10,106	4,895	9,885	24,886

Table 9: Summary of actual P&A costs to date

	Monroe	Shreveport	Total
Number of wells			
P&A Completed	179	356	535
P&A In Progress	24	2	26
Not P&Aed	1,603	1,676	3,279
Total	1,806	2,034	3,840
Total cost (million $)			
P&A Completed	$9.8	$12.7	$22.5
P&A In Progress	$0.1	$0.0	$0.1
Total	$9.9	$12.7	$22.7
Average cost (1,000 $)			
P&A Completed	$54.8	$35.8	$42.1
	($8.9)	($13)	($15)
P&A In Progress	$5.1	$0.0	$4.7
	($3.2)	($0)	($3.4)
Minimum (1,000 $)			
P&A Completed	$23.1	$8.6	$8.6
P&A In Progress	$2.5	$0.0	$0.0
Maximum (1,000 $)			
P&A Completed	$107.8	$76.9	$107.8
P&A In Progress	$17.5	$0.0	$17.5

Note: Standard deviations in parentheses.

8.3 Regression Model

Next, a linear regression is used to understand how costs systematically vary with well characteristics. This is useful for two reasons. First, it allows for controlling well characteristics when comparing costs across districts (and contractors). Second, this cost model allows for predicting out-of-sample P&A costs for orphan and idle wells that have not yet been plugged under the assumption that—conditional on observable characteristics—wells that have been P&Aed look like wells that have not yet been P&Aed. Note that the analysis uses the actual cost values instead of transforming costs into logs because the primary interest is in summing the costs, not in understanding how much they change in relation to each other. Formally, the model of P&A costs c_i is

$$c_i = X_i^{c\prime} \beta c + \epsilon_{ci} \quad (4)$$

where X_i^c is a vector of observable characteristics, βc is a vector of regression coefficients, and ϵ_{ci} is an unobserved shock.

The regression analysis (detailed in Table A4 in the Appendix) reveals that P&A costs increase with well depth, distance from roads, and historical production, while decreasing for wells in coal-bearing regions or those designated specifically as oil or gas wells. About $6,000 of the $19,000 difference between Monroe and Shreveport districts is attributable to observable well characteristics.

8.4 Predicted Costs

The linear regression estimates—model (4) in Table A4—are used to predict P&A costs in the Monroe and Shreveport districts for all wells given observed well characteristics. Because well characteristics in the Lafayette district differ substantially from those in the north of the state, and because no cost data is available for Lafayette, predictions cannot be validated there, and Lafayette wells are not included in the analysis of costs, methane emissions, or P&A policies.

The predicted costs are summed to arrive at the total P&A cost for all orphan and idle wells in the Monroe and Shreveport districts, and these predicted costs are also averaged to understand which groups of wells are projected to be more expensive. These results are displayed in Table 10. The first three columns display the sum of actual costs incurred to date. The second three columns show predicted total costs to P&A all wells. By assumption, these totals must perfectly match for wells that have already been P&Aed (in sample observations). The perfect fit is not a sign that costs can be perfectly predicted (e.g., unrealistically good model fit). To date, the program has spent around $22.5 million on completed plugging jobs, with another $0.1 million on wells in progress. Using this model of current costs to estimate future costs, the remaining in-progress and unplugged 3,305 orphan wells in the Monroe and Shreveport districts are estimated to require around $170 million to P&A. The population of idle wells in Monroe and Shreveport is larger relative to the number of orphans—10,940 wells—and is projected to require $691 million to P&A. The last three columns display predicted average costs per well. They show that the P&A cost per well for unplugged wells (orphans, but especially idle wells) are likely to be higher than costs for plugged wells. This is largely being driven by much higher cumulative production and longer wellbores in the unplugged orphan and idle wells.

Table 10: Predicted final vs actual P&A costs to date

	Total cost (million $)						Predicted avg. cost (1,000 $/well)		
	Actual			Predicted					
	M	S	M+S	M	S	M+S	M	S	M+S
Orphan									
P&Aed	9.8	12.7	22.5	9.8	12.7	22.5	54.8	35.8	42.1
In Progress	0.1	0.0	0.1	1.3	0.1	1.4	52.6	55.0	52.8
Not P&Aed	0.0	0.0	0.0	97.3	71.8	169.0	60.7	42.8	51.6
Total	9.9	12.7	22.7	108.3	84.6	193.0	60.0	41.6	50.2
Idle									
Total	0.0	0.0	0.0	191.8	499.5	691.3	62.1	63.6	63.2
Total	9.9	12.7	22.7	300.2	584.1	884.3	61.3	59.1	59.8

"M" represents the Monroe District, and "S" represents the Shreveport District.

Note: All costs converted from 2023 USD to 2020 USD using the GDP Implicit Price Deflator from US BEA.

Predicted costs calculated using linear cost model (4) from Table A4.

OLS sets predicted total and average well costs equal to actual values by construction. All wells in Monroe District P&Aed by Dynamic, and all wells in Shreveport, by Lemoine.

9. Economic Valuation of Emissions Reductions

This section presents an economic analysis of methane emissions reductions achieved through well plugging activities, focusing on methane abatement benefits as quantified through the social cost of methane (SCM). This provides a framework to estimate environmental benefits from well plugging and informs policy decisions regarding the OSR Program.

9.1 Benefits from Emissions Reductions

Our economic valuation focuses on methane abatement benefits, which we calculate using the SCM established by the EPA. The SCM helps us put a dollar value on the harm caused by global warming due to methane emissions, including effects on farming, human health, property damage from flooding, and harm to ecosystems. Following the EPA's 2023 report on the Social Cost of Greenhouse Gases (EPA 2023b), we examine several time periods for our SCM calculations, assuming that if left unplugged, orphan wells would keep emitting at the same rates we measured before plugging them. While wells may also leak other pollutants that could impact local air quality (such as Hydrogen Sulfide (H_2S), which converts to Sulfur Dioxide (SO_2) in the atmosphere, and volatile organic compounds), these compounds have not been encountered in the wells measured to date. This analysis therefore focuses on the quantifiable climate benefits of reduced methane emissions. Other potential benefits from localized air quality are not included in this analysis. All our monetary values are in 2020 dollars, and we discount future benefits at 2% per year, following Office of Management and Budget guidelines (Office of Management and Budget 2023).

Plugging activities for measured wells generate first-year benefits of approximately $0.37 million from SCM benefits (Table 11).[38] These benefits increase substantially over extended time horizons, reaching approximately $8.62 million over a 20-year period.

Table 11: Social cost of methane benefits from plugged orphan wells

Duration (yrs)	Social Cost Benefits (million $)
1	$0.37
5	$1.94
10	$4.04
20	$8.62
30	$13.53
40	$18.46
50	$23.20

Notes: All values in USD2020. Social cost benefits based on Hi-Flow measurements of 200 t CH_4/yr from 535 plugged wells, assuming constant emission rates prior to plugging. Benefits are calculated using EPA's SCM estimates with a 2% discount rate.

[38] For wells subject to both Hi-Flow and chamber measurement techniques, the average of these measurements was used to calculate SCM benefits.

9.2 Marginal Abatement Costs

Marginal abatement cost (MAC) refers to the cost of reducing one additional unit of emissions. In this context, it represents the cost of preventing each additional ton of methane from being released by plugging orphan wells. The MAC is typically expressed as dollars per unit of emissions reduced (e.g., $ per ton of CH_4).

The concept of MAC is crucial for understanding the economic valuation of methane emissions reductions for two primary reasons. First, in a climate policy with a limited budget, a MAC curve identifies which abatement opportunities should be prioritized to maximize emission reductions, based on the joint distribution of costs and emissions. Second, when paired with the SCM, a MAC curve determines which abatement opportunities are economically justified. Economic theory suggests that society should pursue methane reductions only when the MAC is less than the SCM, as beyond this threshold, abatement costs outweigh societal benefits.

The analysis of plugging costs and emission rates reveals substantial variation that significantly affects abatement efficiency. Estimated plugging costs range from $8,574 to $107,772 per well, while emission rates measured with a Hi-Flow instrument demonstrate much greater variation, spanning from 0.12 g/hr to 2,889 g/hr. This heterogeneity in emission rates creates opportunities for more cost-effective targeting: with a $10 million budget, using Hi-Flow emissions data to prioritize the highest-emitting wells could achieve approximately 658 t/yr of methane abatement compared to only 56 t/yr under non-targeted approaches, assuming equal costs per well in both scenarios. Similarly, using chamber-measured emissions data would yield 961 t/yr of methane abatement versus 86 t/yr under current practices.

9.3 Benefit-Cost Analysis

The benefit-cost analysis of plugging orphan wells is based on SCM benefits from reduced methane emissions. Leak duration is a critical factor, as longer-lasting leaks generate more cumulative damages over time. The breakeven emission rates at which plugging becomes economically justified are presented in the Appendix (Table A5).

For a well that costs $50,000 to plug, the analysis references a dataset of 844 wells measured by contractors:

- If the leak would only last 1 year, the well needs to emit at least 3,044 g/hr for plugging to be justified based on SCM benefits alone. None of the measured wells had a leak rate this high.
- If the leak would persist for 10 years, the required breakeven emission rate drops to 282 g/hr for SCM benefits alone. 20 wells exceeded this threshold.
- For a 50-year leak duration, plugging becomes cost-effective at emission rates of just 49 g/hr when considering only SCM benefits. 61 wells exceeded this threshold.

Emission rate significantly impacts program cost-effectiveness, with targeted plugging yielding greater efficiency. Using the SCM ($1,874 per metric ton), plugging an average well measured by Hi-Flow method (119.6 g/hr) is economically justified if leaks persist 15 years, while chamber-measured wells (36.3 g/hr) require 45 years. For a 50-year leak duration, SCM benefits would justify plugging only about 220-250 wells—less than 10% of the 3,000 remaining unmeasured orphan wells in north Louisiana.

10. Economic Impacts of the Program

This section examines the economic impacts of the OSR Program on Louisiana's economy, employment, earnings, and contributions to the gross domestic product (GDP) from well-plugging activities.

10.1 Economic Impacts

The economic impacts of both completed and projected OSR activity are estimated using the Louisiana Economic Impact Model (LEIM), which is based on the Regional Input-Output Modeling System (RIMS II) tool developed by the Bureau of Economic Analysis (BEA).[39] For completed activities, the inputs for this model are the reported well-level P&A costs by two contractors, Lemoine and Dynamic. For projected activities, the expected impacts from the remaining IIJA funds in the amount of $156 million are modeled. Using the RIMS II multipliers for the "Support activities for mining" sector, both sets of impacts are estimated in terms of employment, earnings (wages and salaries), and overall value added to the GDP.

Panel A of Table 12 shows the economic impacts from completed OSR activity. The $22.5 million spent in plugging orphan wells during the first phase of IIJA funding is estimated to support $8.1 million in earnings, 120 jobs/yr, and $16.4 million in value added.

Panel B shows projected impacts from the remaining $156 million in IIJA funds for future OSR activities over 5 years. This spending is projected to support $56.3 million in earnings, 167 jobs/yr, and $114.4 million in value added to the regional economy.

Panel C presents the total combined economic impacts from both completed and projected activities, showing that the overall program is expected to support $64.4 million in earnings, 159.5 jobs/yr, and $130.8 million in value added to the regional economy.

[39] U.S. Department of Commerce.

Table 12: Combined economic impacts of OSR activities

	Earnings (million $)	Value Added (million $)	Employment (jobs/yr)
Panel A: Economic Impacts from Completed Plugging Activities			
Direct	4.0	11.1	42
Indirect	2.0	1.5	32
Induced	2.0	3.8	46
Total	8.1	16.4	120
Panel B: Projected Economic Impacts from Remaining IIJA Funds			
Direct	28.1	77.5	58.9
Indirect	14.1	10.3	44.1
Induced	14.1	26.6	64.3
Total	56.3	114.4	167.4
Panel C: Total Combined Impacts			
Direct	32.1	88.6	56.1
Indirect	16.1	11.8	42.0
Induced	16.1	30.4	61.3
Total	64.4	130.8	159.5

Notes: Panel A shows economic impacts from completed IIJA plugging activities. Panel B shows projected economic impacts from remaining $156 million in IIJA funds for OSR activity. Panel C presents the total combined impacts. Employment figures are presented as average annual jobs. All estimates based on RIMS II multipliers for the "Support activities for mining" sector.

Table 13 shows the top 10 parishes with the highest economic impacts from completed OSR activities in terms of earnings, jobs and value added.

The individual parish impacts are allocated based on gravity models of trade, for which a parish's share of total impacts is based on both its distance[40] from the P&Aed well location and the sectoral employment, total employment and population in that parish. Therefore, parishes that are closer to well decommissioning activity with larger labor markets and higher population will be allocated larger shares of the economic impact. For these completed activities, Caddo Parish experienced the largest economic impact across all three metrics, followed by Bossier and Ouachita parishes.

[40] Distance is measured from the parish centroid to each P&Aed well location in the OSR Program.

Table 13: Parish economic impacts

	Earnings (million $)	Value Added (million $)	Employment (Jobs)
Bossier	0.93	1.88	13.77
Caddo	2.47	5.03	36.78
Claiborne	0.17	0.35	2.58
East Baton Rouge	0.26	0.53	3.87
Lafayette	0.43	0.87	6.39
Lincoln	0.25	0.51	3.72
Orleans	0.18	0.37	2.69
Ouachita	0.77	1.56	11.43
Union	0.20	0.40	2.93
Webster	0.21	0.44	3.19
All Other Parishes	2.19	4.46	32.62
Total	8.07	16.40	119.97

Notes: Parish economic impacts from OSR activity using IIJA funds in Monroe and Shreveport districts. Top 10 parish totals and totals of all other parishes combined are shown.

The OSR activities also generate significant tax revenue impacts across parishes. Analysis of the completed OSR activities shows that certain parishes benefit more than others, with Caddo Parish receiving the highest tax revenue impacts, followed by Bossier and Calcasieu parishes.

Beyond the completed activities, the projected OSR activity is expected to generate substantial local tax revenues across various categories, with a total local tax impact of approximately $4.46 million.

Conclusions

This report provides an overview of orphan and idle wells in Louisiana, incorporating regulatory context, methane emissions data, cost estimates, and economic impact analysis. The findings offer a foundation for understanding the scope of the state's well inventory and the implications of current and anticipated efforts to manage associated environmental and economic risks.

As of March 2025, Louisiana has approximately 4,900 orphan wells and 19,500 idle wells. Recent data show that the number of orphan wells added to the state's inventory in recent years has exceeded the number of wells plugged annually. For perspective, approximately 4% of wells ever drilled in Louisiana have been declared orphaned. Additionally, some wells drilled within the past decade have been designated as orphaned, suggesting that well orphaning continues to occur across a range of vintages. These patterns provide context for evaluating the scale and trajectory of Louisiana's orphan well inventory.

Cost estimates developed in this report indicate that plugging all orphan and idle wells in the Monroe and Shreveport districts would require approximately $170 million. For comparison, Louisiana is projected to receive about $156 million in federal funding through the IIJA. Notably, this estimate does not include wells in the Lafayette district, which accounts for roughly 41% of the state's orphan and idle well count, and would further increase total costs. While the IIJA funds are expected to support a significant portion of plugging activities, these estimates suggest that additional resources may be required to address the entire inventory.

Methane emissions measurements conducted by DENR contractors and LSU researchers reveal that a small number of wells contribute disproportionately to total emissions. This concentration of emissions among a limited subset of wells may have implications for how plugging efforts are prioritized, depending on whether environmental, economic, or inventory-reduction objectives are emphasized. Different approaches may yield different outcomes with respect to emissions abatement, cost efficiency, and the number of wells addressed.

The use of the IIJA funding has also generated measurable economic activity in the state. The initial $25 million grant supported an estimated 120 jobs and contributed approximately $16 million in value added to Louisiana's economy. Projections based on continued deployment of remaining federal funds suggest that plugging activities may continue to support local employment and economic development over the next several years.

Recent state policy developments—including scheduled changes to the OSR fee structure and the removal of the OSR Fund cap—are expected to enhance the program's capacity to respond to future well plugging needs. Continued monitoring of well inventories, emissions characteristics, and plugging outcomes will provide valuable information to inform program design and implementation going forward. This report contributes data and analysis to support ongoing efforts to evaluate and refine strategies for addressing orphan and idle wells in the state.

References

Agerton, Mark, Siddhartha Narra, Brian Snyder, and Gregory B. Upton (2023). “Financial liabilities and environmental implications of unplugged wells for the Gulf of Mexico and coastal waters”. In: *Nature Energy*.

Bowman, Lauren V, Khalil El Hachem, and Mary Kang (2023). “Methane emissions from abandoned oil and gas wells in Alberta and Saskatchewan, Canada: the role of surface casing vent flows”. In: *Environmental Science & Technology* 57.48, pp. 19594–19601.

Caenn, Ryen, Henry CH Darley, and George R Gray (2011). *Composition and properties of drilling and completion fluids*. Gulf Professional Publishing.

Chen, X, CP Tan, and CM Haberfield (1996). “Wellbore stability analysis guidelines for practical well design”. In: *SPE Asia Pacific Oil and Gas Conference and Exhibition*. SPE, SPE–36972.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague (2003). *Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems*. Technical Report. Arlington, Virginia: NatureServe.

Davidson, A. and A. McKerrow (2016). *GAP/LANDFIRE National Terrestrial Ecosystems 2011*. [Data set].

Davis, Brian, Ryan W Lamb, Susan Lee, Ted A Murphy, Gregory P Nottingham, Neil Ziemba, Forrest A Cook, Chad Meister, Erik N Vernon, Catherine Collins, et al. (July 2023). *Assessing Methane Emissions from Orphaned Wells to Meet Reporting Requirements of the 2021 Infrastructure Investment and Jobs Act: Methane Measurement Guidelines*. Technical Guidelines. Version July 2023. U.S. Department of the Interior, Orphaned Wells Program Office.

Deighton, J. A., A. Townsend-Small, S. J. Sturmer, J. Hoschouer, and L. Heldman (2020). “Measurements show that marginal wells are a disproportionate source of methane relative to production”. In: *Journal of the Air & Waste Management Association* 70.10, pp. 1030–1042.

Driscoll, Francis Stephen, Kanchan Maiti, Ipsita Gupta, K. E. Hall, and A. Arumugam (2025). “Methane Emissions from Unplugged Abandoned Oil and Gas Wells in Louisiana, USA”. In: *Journal of Geophysical Research: Atmospheres*, 130, e2024JD042486.

Dusseault, Maurice B, Richard E Jackson, and Daniel Macdonald (2014). *Towards a road map for mitigating the rates and occurrences of long-term wellbore leakage*. University of Waterloo Waterloo, ON, Canada.

El Hachem, Khalil and Mary Kang (2023). “Reducing oil and gas well leakage: a review of leakage drivers, methane detection and repair options”. In: *Environmental Research: Infrastructure and Sustainability* 3.1, p. 012002.

Enverus (2024). *DrillingInfo*. Online Datasets.

EPA (2023a). *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances*. Tech. rep. U.S. Environmental Protection Agency.

— (Nov. 2023b). *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances*. Docket ID No. EPA-HQ-OAR2021-0317. National Center for Environmental Economics, Office of Policy.

Fails, TG (1990). “The northern Gulf Coast Basin: a classic petroleum province”. In: *Geological Society, London, Special Publications* 50.1, pp. 221–248.

Gianoutsos, Nicholas J, Karl B Haase, and Justin E Birdwell (2023). “Geologic sources and well integrity impact methane emissions from orphaned and abandoned oil and gas wells”. In: *Science of the Total Environment*, p. 169584.

Homer, Collin, Jon Dewitz, Limin Yang, Suming Jin, Patrick Danielson, George Xian, John Coulston, Nathaniel Herold, James Wickham, and Kevin Megown (2015). “Completion of the 2011 National Land Cover Database for the conterminous United States–representing a decade of land cover change information”. In: *Photogrammetric Engineering & Remote Sensing* 81.5, pp. 345–354.

IOGCC (2021). *Idle and Orphan Oil and Gas Wells: State and Provincial Regulatory Strategies 2021*. Tech. rep. Interstate Oil & Gas Compact Commission.

Jordan, Preston (2020). “Chronic well leakage probability relative to basin and fluid characteristics”. In: *Proceedings of the National Academy of Sciences* 117.3, pp. 1249–1251.

Kang, Mary, Shanna Christian, Michael A. Celia, Denise L. Mauzerall, Markus Bill, Alana R. Miller, Yuheng Chen, Mark E. Conrad, Thomas H. Darrah, and Robert B. Jackson (Nov. 29, 2016). "Identification and Characterization of High Methane-Emitting Abandoned Oil and Gas Wells". In: *Proceedings of the National Academy of Sciences* 113.48, pp. 13636–13641.

Louisiana Department of Energy and Natural Resources (2023). *State Coal Profile: Louisiana*. https://www.dnr.louisiana.gov/assets/docs/energy/coal/State_Coal_Profile_Louisiana.pdf, Accessed: June 2, 2023. Louisiana Department of Energy and Natural Resources.

Louisiana Department of Energy and Natural Resources Office of Conservation (2022). *State offshore boundary*. ESRI Shapefile Format. https://dnrgisvct.dnr.state.la.us/Zip/8855.zip, Downloaded on 2022-11-07.

— (2024a). *Conservation Districts*. ESRI Shapefile Format. https://dnrgisvct.dnr.state.la.us/Zip/8870.zip, Downloaded on 2022-11-07.

— (2024b). *Haynesville Shale wells*. ESRI Shapefile Format. https://dnrgisvct.dnr.state.la.us/Zip/8873.zip, Downloaded on 2022-11-07.

— (2024c). *Injection wells*. ESRI Shapefile Format. https://dnrgisvct.dnr.state.la.us/Zip/10212.zip, Downloaded on 2022-11-07.

— (2024d). *Oil and gas wells*. ESRI Shapefile Format. https://dnrgisvct.dnr.state.la.us/Zip/8866.zip, Downloaded on 2022-11-07.

— (2024e). *State coastal zone boundary*. ESRI Shapefile Format. https://dnrgisvct.dnr.state.la.us/Zip/8893.zip, Downloaded on 2022-11-07.

— (2024f). *State owned or leased lands*. ESRI Shapefile Format. https://dnrgisvct.dnr.state.la.us/Zip/8863.zip, Downloaded on 2022-11-07.

— (2024g). *Strategic Online Natural Resources Information System, Data Subscription Service*. Web Page. https://sonris.com/, Last accessed on 2024-05-29.

McMahon, Peter B, Mathew K Landon, Michael J Stephens, Kim A Taylor, Janice M Gillespie, Tracy A Davis, and David H Shimabukuro (2023). "Fluid migration pathways to groundwater in mature oil fields: Exploring the roles of water injection/production and oil-well integrity in California, USA". In: *Science of the Total Environment* 900, p. 166400.

Merrill, Matthew D., Claire A. Grove, Nicholas J. Gianoutsos, and Philip A. Freeman (2023). *Analysis of the United States documented unplugged orphaned oil and gas well dataset*. Tech. rep. Report. Reston, VA, p. 10.

Normann, S. (2024). *The Most Common Causes for Leaks in Oil Wells and 8 Questions to Consider Before You Select Solution*. https://blog.wellcem.com/free-guide-the-most-common-causes-for-leaks-in-oil-wells-and-8-question-to-consider-before-you-selectsolution-lp. Accessed: 2024-06-26.

Office of Management and Budget (Nov. 9, 2023). *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*. Circular No. A-94.

Omara, M., M. R. Sullivan, X. Li, R. Subramanian, A. L. Robinson, and A. A. Presto (2016). "Methane Emissions from Conventional and Unconventional Natural Gas Production Sites in the Marcellus Shale Basin". In: *Environmental Science & Technology* 50.4, pp. 2099–2107.

Omara, Mark, Daniel Zavala-Araiza, David R. Lyon, Benjamin Hmiel, Katherine A. Roberts, and Steven *P. Hamburg (Apr. 19, 2022). "Methane Emissions from US Low Production Oil and Natural Gas Well Sites". In:* Nature Communications 13.1 (1), p. 2085.

Opara, Stanley U and Chinedu J Okere (2024). "A review of methane leakage from abandoned oil and gas wells: A case study in Lubbock, Texas, within the Permian Basin". In: *Energy Geoscience*, p. 100288.

Pekney, Natalie J, J Rodney Diehl, David Ruehl, James Sams, Garret Veloski, Adit Patel, Charles Schmidt, and Thomas Card (2018). "Measurement of methane emissions from abandoned oil and gas wells in Hillman State Park, Pennsylvania". In: *Carbon Management* 9.2, pp. 165–175.

Ravikumar, Arvind P., Jingfan Wang, and Adam R. Brandt (Jan. 3, 2017). "Are Optical Gas Imaging Technologies Effective For Methane Leak Detection?" In: *Environmental Science & Technology* 51.1, pp. 718–724.

Ravikumar, Arvind P., Jingfan Wang, Mike McGuire, Clay S. Bell, Daniel Zimmerle, and Adam R. Brandt (Feb. 20, 2018). ""Good versus Good Enough?" Empirical Tests of Methane Leak Detection Sensitivity of a Commercial Infrared Camera". In: *Environmental Science & Technology* 52.4, pp. 2368–2374.

Riddick, S. N., D. L. Mauzerall, M. A. Celia, M. Kang, and K. Bandilla (2020). "Variability observed over time in methane emissions from abandoned oil and gas wells". In: *International Journal of Greenhouse Gas Control* 100.

Riddick, Stuart N, Mercy Mbua, Arthur Santos, Ethan W Emerson, Fancy Cheptonui, Cade Houlihan, Anna L Hodshire, Abhinav Anand, Wendy Hartzell, and Daniel J Zimmerle (2024). “Methane emissions from abandoned oil and gas wells in Colorado”. In: *Science of The Total Environment* 922, p. 170990.

Rutherford, J. S., E. D. Sherwin, A. P. Ravikumar, G. A. Heath, J. Englander, D. Cooley, D. Lyon, M. Omara, Q. Langfitt, and A. R. Brandt (2021). “Closing the methane gap in US oil and natural gas production emissions inventories”. In: *Nature Communications* 12.1.

Saint-Vincent, Patricia MB, Matthew D Reeder, James I Sams III, and Natalie J Pekney (2020). “An analysis of abandoned oil well characteristics affecting methane emissions estimates in the Cherokee platform in Eastern Oklahoma”. In: *Geophysical Research Letters* 47.23, e2020GL089663.

Seymour, Scott P, Donglai Xie, and Mary Kang (2024). “Highly Uncertain Methane Leakage from Oil and Gas Wells in Canada Despite Measurement and Reporting”. In: *Energy & Fuels* 38.14, pp. 13078–13088.

Townsend-Small, Amy, Thomas W. Ferrara, David R. Lyon, Anastasia E. Fries, and Brian K. Lamb (2016). “Emissions of Coalbed and Natural Gas Methane from Abandoned Oil and Gas Wells in the United States”. In: *Geophysical Research Letters* 43.5, pp. 2283–2290.

Townsend-Small, Amy and Jacob Hoschouer (May 2021). “Direct Measurements from Shut-in and Other Abandoned Wells in the Permian Basin of Texas Indicate Some Wells Are a Major Source of Methane Emissions and Produced Water”. In: *Environmental Research Letters* 16.5, p. 054081.

U.S. Department of the Interior Orphaned Wells Program Office (July 2023). *Assessing Methane Emissions from Orphaned Wells to Meet Reporting Requirements of the 2021 Infrastructure Investment and Jobs Act: Methane Measurement Guidelines July 2023* Version. https ://www.doi.gov/sites/doi.gov/files/orphaned-wells-methane-measurementguidelines-july-2023-version.pdf. Accessed: 2024-06-26.

U.S. Environmental Protection Agency (2023). *Estimates of Methane Emissions by Segment in the United States*. U.S. EPA Report. United States Environmental Protection Agency.

U.S. EPA (Apr. 2018). *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2016: Abandoned Oil and Gas Wells*. U.S. Environmental Protection Agency.

U.S. Geological Survey (2014). *USGS 1:1,000,000-Scale Federal Lands of the United States 201412 Shapefile: National Atlas of the United States*. ESRI Shapefile Format. https://www.sciencebase.gov/catalog/ item/5d150464e4b0941bde5b7654, Downloaded on 2022-11-07.

United States Census Bureau (2022a). *2022 TIGER/Line@ Shapefiles: Roads*. ESRI Shapefile Format. https://www2.census.gov/geo/tiger/TIGER2022/STATE/tl2022usstate.zip, Downloaded on 2022-11-07.

— (2022b). *2022 TIGER/Line@ Shapefiles: States (and equivalent)*. ESRI Shapefile Format. https://www2.census.gov/geo/tiger/TIGER2022/STATE/tl2022usstate.zip, Downloaded on 2022-11-07.

Upton, Gregory B., David E. Dismukes, and Greg Albrecht (2023). *2024 Gulf Coast Energy Outlook*. Tech. rep. Louisiana State University Center for Energy Studies.

Upton, Gregory B. and James A Richardson (2020). *Mineral Revenues in Louisiana*. Tech. rep. Louisiana State University Center for Energy Studies.

Watson, T. L. and S. Bachu (2009). “Evaluation of the Potential for Gas and CO2 Leakage Along Wellbores”. In: *SPE Drilling & Completion* 24.1, pp. 115–126.

Williams, James P, Amara Regehr, and Mary Kang (2020). “Methane emissions from abandoned oil and gas wells in Canada and the United States”. In: *Environmental Science & Technology* 55.1, pp. 563–570.

Zimmerle, Daniel, Timothy Vaughn, Clay Bell, Kristine Bennett, Parik Deshmukh, and Eben Thoma (Sept. 15, 2020). “Detection Limits of Optical Gas Imaging for Natural Gas Leak Detection in Realistic Controlled Conditions”. In: *Environmental Science & Technology* 54.18, pp. 11506–11514.

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