STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

APPLICATION OF OIL CONSERVATION DIVISION TO ADOPT 19.15.27 NMAC AND 19.15.28 NMAC, AND TO AMEND 19.15.7 NMAC, 19.15.18 NMAC, AND 19.15.19 NMAC; STATEWIDE

CASE NO. 21528

CLIMATE ADVOCATES' PREHEARING STATEMENT

Center for Civic Policy, Conservation Voters New Mexico Education Fund, Diné C.A.R.E., Earthworks, Natural Resources Defense Council, San Juan Citizens Alliance, Sierra Club, and 350 New Mexico ("Climate Advocates"), represented by Tannis Fox and Erik Schlenker-Goodrich of Western Environmental Law Center, and Sierra Club, represented by David Baake, Baake Law, LLC, file this Prehearing Statement in accordance with the New Mexico Oil Conservation Commission's ("Commission") Amended Procedural Order in this matter and 19.15.3.11 NMAC.

I. CLIMATE ADVOCATES HAVE SIGNIFICANT INTERESTS IN THIS PROCEEDING

The Center for Civic Policy ("CCP") is a nonpartisan, non-profit organization that works to empower and amplify the voices of everyday New Mexicans, especially those who experience oppression, to shape a more inclusive, responsive, and accountable democracy — using a racial, gender, class, and equity lens to build transformative power through collective responsibility and build thriving communities in New Mexico. CCP established the New Mexico Civic Engagement Table in 2008 as a mechanism for collaboration and problem solving strategic goals, one of which is climate justice. CCP interest in this proceeding to ensure the maximum reduction of methane waste possible in New Mexico and to ensure that the Commission's rules are implemented equitably across communities.

Conservation Voters New Mexico Education Fund ("CVNMEF") is a statewide, nonpartisan nonprofit committed to engaging the people of New Mexico in its long-standing shared values of protecting our air, land, water and the health of our communities. CVNMEF is committed to creating long-term change by working with communities to address environmental issues impacting their health and quality of life. CVNMEF's interest in this proceeding is to ensure that the Commission's rules maximize reductions in methane emissions across the state in order to enhance environmental protection, public health, and communities' quality of life.

Diné Citizen Against Ruining Our Environment (Diné C.A.R.E.) is located on the Navajo Nation and is a nonprofit organization that works with many Navajo communities affected by energy and environmental issues. Since the late 1980's, community people have stood up to demand environmental protection and sustainable development practices, bringing systemic changes in tribal politics and making the grassroots voices evident in the realm of energy development. The Eastern Agency of Diné Bikeyah is important in their Creation story. And, it is also littered with oil and gas wells that has generated the most potent methane cloud in the country, detectable from NASA satellites and substantially contributing to global warming. Diné C.A.R.E.'s interest in this proceeding is to maximize reductions in methane emissions in the state to protect its community's lands, people, and way of life.

Earthworks is a nonprofit organization dedicated to protecting communities and the environment from the adverse impacts of mineral and energy development while promoting sustainable solutions. Earthworks stands for clean air, water and land, healthy communities, and corporate accountability. Earthworks works with communities and grassroots groups to reform government policies, improve corporate practices, influence investment decisions and encourage responsible materials sourcing and consumption. Earthworks' trained and certified staff have

used optical gas imaging to document oil and gas air pollution across New Mexico and nationally. Earthworks' interest in this proceeding is to maximize reductions in methane emissions around the state to reduce the health, environmental, economic, social and cultural impacts of oil and gas operations.

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The Natural Resources Defense Council ("NRDC") is a nonprofit organization that works to safeguard the earth—its people, its plants and animals, and the natural systems on which all life depends. NRDC works across the globe and in New Mexico to ensure the rights of all people to the air, the water, and the wild. For NRDC, climate change is the major environmental challenge of our time, and it works around the world and in New Mexico advocating for deep cuts to carbon pollution by ending our dependence on climate-warming fossil fuels that pollute the air and water and harm public health and communities. NRDC's interest in this proceeding is to maximize reduction of methane emissions in the state in an equitable and just manner. NRDC has over 10,000 members and activists in New Mexico.

San Juan Citizens Alliance ("Alliance") is a nonprofit organization with approximately 1,000 members that advocates for clean air, pure water, and healthy lands – the foundations of resilient communities, ecosystems and economies in the San Juan Basin. The Alliance was launched in 1986 by a group of concerned citizens to protect their families and neighbors from the impacts of unchecked oil and gas development. Over the years, the Alliance has addressed a broad array of issues concerning the quality and protection of regional air, land, and water resources, including advocating reductions in methane from oil and gas facilities in the region.

The Alliance's interest in this proceeding is to maximize reduction of methane emissions in the San Juan Basin.

The Sierra Club is a national nonprofit organization with 67 chapters and more than 837,000 members dedicated to exploring, enjoying, and protecting the wild places of the earth; to practicing and promoting the responsible use of the earth's ecosystems and resources; to educating and enlisting humanity to protect and restore the quality of the natural and human environment; and to using all lawful means to carry out these objectives. The Sierra Club's concerns encompass protecting communities across the nation and in New Mexico against pollution caused by fossil fuels, and to ensure that principles of equity, justice and inclusion are at the forefront of its work. The Club's particular interest in this case and the issues which the case concerns stem from its goal to maximize reductions of methane emissions around the state. The Club has approximately 10,000 members in New Mexico.

350 New Mexico is a nonprofit organization dedicated to building an inclusive movement in New Mexico to prevent the worst effects of climate change and climate injustice. 350 New Mexico empowers New Mexicans to take on the fossil fuel industry and steer a just transition to renewable energy for all of us. 350 New Mexico believes that the state's imperative to reduce CO^2 emissions will be severely undermined if there are not also major reductions in the state's oil and gas industry's methane leaks, venting and flaring. Our 8,000 members' interest in this proceeding is to maximize reductions of industry methane emission in the state.

II. IDENTIFICATION OF WITNESSES, THEIR QUALIFICATIONS, APPROXIMATE TIME TO PRESENT TESTIMONY, AND A CONSICE STATEMTN OF THEIR TESTIMONY

Climate Advocates will present the following technical and non-technical witnesses to this proceeding:

1. **Brenda Ekwuzel, Ph.D.**, is Director of the Climate and Energy Program for the Union of Concerned Scientists. Her resume, Climate Advocates' Exhibit 2, sets forth her qualifications. She will present direct testimony for approximately 20 minutes. Dr. Ekwuzel will provide testimony on the climate impacts of methane, the public health impacts of other volatile organic compound released with methane during oil and gas operations, the impacts of climate change on New Mexico, and economic impacts to New Mexico of climate change. A summary of her testimony is set forth in her PowerPoint presentation, Climate Advocates' Exhibit 3.

2. **Alexandra E. Teitz, J.D.**, is a Principal at AT Strategies. Her resume, Climate Advocates' Exhibit 4, sets forth her qualifications. She will present direct testimony for approximately 2 hours.

Ms. Teitz will discuss the reasons why key elements of the proposed rule are critical to reducing emissions and waste of methane, and she will identify several elements of the proposed rule that need to be strengthened to ensure that the proposed rule meets its intended purposes. Among other points, Ms. Teitz will explain why routine flaring of associated gas is wasteful, harmful and unnecessary and is appropriately prohibited by New Mexico's proposed regulations on oil and gas production. She will also explain how the proposed regulations fail to ensure that operators avoid emissions and waste in the course of well completions.

Ms. Teitz will cite various national and international sources on routine flaring of associated gas from oil wells due to the absence of take-away capacity (referred to in brief as "routine flaring"). These sources include the World Bank's *Zero Routine Flaring by 2030 Initiative,* which has been endorsed by more than three dozen oil companies, Climate Advocates' Exhibit 7; the European Commission, Climate Advocates' Exhibit 11; and GaffneyCline's June

2020 report, *Tackling Flaring: Learnings for Leading Permian Operators*, Climate Advocates' Exhibit 8. She will also reference the position of major investors who are calling on regulators to prohibit routine flaring, including investors with more than $102 billion in assets under management, and New Mexico State Treasurer Tim Eichenberg, who recently called on Governor Lujan Grisham, the New Mexico Energy, Minerals and Natural Resources Department and the New Mexico Environment Department to pass strong methane rules, including prohibiting routine flaring. Climate Advocates' Exhibit 10.

Ms. Teitz will testify in strong support of OCD's proposed requirements that would prohibit routine flaring, as well as other elements of the rule that reduce methane emissions and waste. These include the requirement for flaring over venting except when flaring is technically infeasible or would pose a risk to safety and venting would be safer than flaring; the inclusion of a 98 percent gas capture requirement; limiting venting and flaring from natural gas gathering systems; requiring operators to submit gas capture management plans showing that gas will be captured and sent to a gathering system, otherwise beneficially used, or reinjected for future use; and strong measurement requirements.

She will also testify, however, that the rule needs key improvements to lead the nation on regulating methane emissions and waste from oil and gas production. These necessary improvements include closing the loophole that allows operators to evade requirements for green completions/recompletions and unnecessarily vent and flare; strengthening the provisions for gas capture planning in several key respects; setting additional specifications for flarestacks to reduce venting of uncombusted gas; requiring faster and comprehensive replacement or retrofitting of flarestacks without automatic ignitors; requiring gas to be rerouted into the pipeline, or if necessary, flared, rather than be vented during scheduled maintenance; requiring

volumes of flared gas from controlled storage tanks to be included under reporting provisions; and clarifying the deadline for acquired wells to meet the 98% capture requirement.

With respect to the proposed provisions on completions and recompletions, Ms. Teitz will explain that uncontrolled completions and recompletions are a major source of venting and flaring from oil and gas production, how the existing EPA requirements relied on by the OCD's proposed rule have failed to adequately control these emissions in practice, and how other jurisdictions have addressed this issue. She will also propose language to close the loopholes in the current proposal. *See* Climate Advocates' Exhibit 1, 19.15.27.8.C NAMC.

With respect to the gas capture planning requirements, Ms. Teitz will testify regarding additional plan elements not included in the proposed rules that other jurisdictions have found beneficial, such as notification to midstream operators. She will also explain the importance of requiring that all operators demonstrate in their capture plans how they will avoid routine flaring of gas from new oil wells. *See id.* 19.15.27.9.D NMAC.

In addition, based on her regulatory experience, she will discuss the benefits of setting clear preconditions for issuance of APDs that ensure that operators do not exacerbate any ongoing noncompliance through developing new wells that will increase their emissions and waste. *See id.* 19.15.27.9.D(7) NMAC. Finally, Ms. Teitz will also note several suggested clarifications to the proposed rule text to ensure it achieves the apparent intent, including, for example, language to ensure that the requirement to flare rather than vent, wherever technically feasible, applies in all of the intended circumstances. *See id.* 19.15.27.8.D(5), -27.8.G.(1)(b)(iv), -27.8.G(2), -27.9.A, -28.8.B(3), -28.8.F.(1)(b)(iv), -28.8.F(2) NMAC.

3. **David McCabe, Ph.D.**, is a Senior Scientist with the Clean Air Task Force. His resume, attached as Climate Advocates' Exhibit 12, sets forth his qualifications. He will present

direct testimony for approximately 1½ hour.

Dr. McCabe will testify regarding six topics: (1) OCD's proposal to ban routine flaring; (2) OCD's proposed performance standards for flare equipment; (3) OCD's proposal to require operators to capture 98% of the natural gas they produce, subject to certain exemptions and credits, including the ALARM credit; (4) reducing waste by requiring operators to capture rather than combust vapors from tanks; (5) reduced emission completions; and (6) steps that operators in the natural gas gathering sector are able to take to reduce waste during blowdowns.

On the topic of routine flaring, Dr. McCabe will explain that routine flaring occurs when oil operators flare associated gas in non-emergency situations for extended periods of time, rather than utilizing the gas on-site, dispatching it to market, or re-injecting it. He will explain that routine flaring is extremely common in New Mexico's Permian Basin, and that it constitutes a major source of waste. He will explain that the proposed rule, 19.15.27.8(D) NMAC, would prohibit routine flaring, because it generally prohibits venting and flaring during production operations, subject to enumerated exceptions, none of which would authorize flaring due to lack of adequate takeaway capacity. He will explain that such a prohibition is appropriate and consistent with the approach taken in other jurisdictions and by leading producers. He will also note that states such as North Dakota and Texas, which have sought to limit rather than generally prohibit routine flaring, have apparently not consistently implemented their policies, resulting in the continuation (or growth) of routine flaring in those states. He will explain that companies can do a variety of things with associated gas other than venting or flaring it, including using it on-site, capturing and selling it, reinjecting it, or temporarily curtailing production.

On the subject of performance standards for flare equipment, Dr. McCabe will testify to the importance of quantitative standards for the destruction effectiveness of flares, to ensure that

a high percentage of the hydrocarbons directed to the flares is destroyed. He will explain that flares routinely malfunction in the field, leading to uncontrolled venting, but that certain technologies can reduce the likelihood and duration of a malfunction. He will explain that automatic ignitor technology is the most reliable method for reducing the likelihood and duration of venting from an unlit flare, which is why Colorado regulators have decided to require the use of auto-ignitors in its Regulation 7. He will explain that auto-ignitors should ultimately be required at any wellsite that is flaring, including stripper wells, although the Commission could reasonably choose to prioritize the installation of auto-ignitors at larger sites and sites that currently lack any form of control. This testimony supports the changes that Climate Advocates have proposed to 19.15.27.8(E) NMAC, among other provisions.

Turning to the gas capture requirement, Dr. McCabe will explain why he agrees with OCD's proposal, in 19.15.27.9(A) NMAC, to require operators to demonstrate compliance with this requirement in two reporting areas. In support of Climate Advocates' proposed changes to 19.15.27.9(A)(3) NMAC, he will explain why the rule should require operators to demonstrate compliance separately for acquired wells, to prevent operators from achieving compliance simply by selling poor-performing facilities to operators that are over-complying with their gas capture target. He will discuss the amount of waste that occurs due to malfunctions and operator negligence (including improperly closed or maintained thief hatches), explain why it is important that this waste be considered in determining an operator's gas capture percentage, and discuss how OCD can ensure that operators are properly measuring and reporting waste from these and other sources. This testimony will support Climate Advocates' proposed changes to 19.15.27.8(F) NMCA, among other changes. He will discuss the structure of the ALARM credit program, and changes that are needed to ensure it achieves its purpose. This testimony will

support Climate Advocates' proposed changes to the ALARM provision. He will testify regarding the amount of flaring that occurs in the gathering sector, the stringency of the target for this sector, and the appropriateness of the exemption that OCD has proposed, in support of Climate Advocates' proposed changes to Part 28.

Regarding the issue of reducing waste by requiring capture of hydrocarbon tank vapors, rather than destroying these vapors in combustors, Dr. McCabe will explain that vapors that emanate from tanks contain valuable hydrocarbons, which can be captured and injected into gas sales pipelines using standard, well-established technologies that are widely deployed in the United States. In contrast, flaring these vapors to control these emission sources leads to significant, harmful pollution, including carbon dioxide, nitrogen oxides, and other pollutants. Dr. McCabe will explain that large amounts of hydrocarbon tank vapors are wastefully burned off in New Mexico, and that the Commission should limit this waste by including flaring of tank vapors as a category of flaring that must be reported on a monthly basis and requiring operators to include flaring of tank vapors when calculating compliance with the Statewide Natural Gas Capture Requirements. This testimony supports changes that Climate Advocates have proposed to 19.15.27.8.G(2) NMAC, among other provisions.

Dr. McCabe will testify regarding opportunities to reduce emissions from completions and recompletions, the need for state-level regulations to require reduced emission completions notwithstanding federal green completion requirements, and steps other states have taken to improve upon the federal standard. This will support Climate Advocates' proposed changes to 19.15.27.8(C). Finally, Dr. McCabe will testify regarding steps that operators in the natural gas gathering sector are able to take to reduce waste during blowdowns, which will support changes that Climate Advocates have proposed to Part 28.

4. **Don Schreiber** owns a ranch and leases land from the Bureau of Land Management in the San Juan Basin where oil and gas wells are drilled. Mr. Schreiber's qualifications are set forth in his resume, Climate Advocates' Exhibit 13, and he will testify based on his person experience and investigation for approximately 1½ hours. Mr. Schreiber's PowerPoint presentation is Climate Advocates' Exhibit 14.

Mr. Schreiber will testify regarding his personal experience with oil and gas operations on his ranch in northwest Rio Arriba County, and will specifically focus his testimony on the need for and efficacy of reduced emissions completions/recompletions or green completions.

He will discuss the pollution he and his wife witnessed during completion/recompletion of wells on their land, how he negotiated with ConocoPhillips to do RECs on his ranch, and how ConocoPhillips successfully completed 22 RECs on his ranch between 2008 and 2012.

He will discuss that, when Hilcorp Energy Company purchased ConocoPhillips assets in the San Juan Basin in 2017, the company refused to honor his agreement with ConocoPhillips to do RECs, and he will recount his efforts at the state and federal level to require Hilcorp to undertake RECs.

He will describe how, through personal investigation, he has learned that RECs have been in wide use since the early 2000s and that major oil companies like Exxon, Noble, British Petroleum, Devon, ConocoPhillips and others, including service contractors such as Weatherford, have been successful in capturing methane (and other chemicals like volatile organic compounds and nitrogen oxides), during initial flowback, or pre-production, in a variety of different completion/recompletion situations in a variety of different locations including on and around his ranch.

He will describe how EPA's rules were intended to require green completions, but that

oil and gas companies have exploited the language in the rule to avoid doing RECs. He will discuss how Colorado recently enacted rules to require RECs.

He will describe how he sampled 11 months of OCD gas capture plans forms for Rio Arriba and San Juan counties, Climate Advocates' Exhibit 14, slide 19, and found that more than 2/3 of the completed/recompleted wells were vented directly to the atmosphere.

Mr. Schreiber will discuss the example of Weatherford Durango as a participating producer in the EPA Natural Gas STAR study sponsored by ExxonMobil and the American Petroleum Institute in September of 2005; how Weatherford Durango successfully completed three wells in the Fruitland Coal formation of the San Juan Basin not far from his ranch, Climate Advocates' Exhibit 14, Slide 21; and the energy savings obtained as a result of those completions.

5. **Lesley Fleishman, M.M.P.**, is a Senior Analyst with the Clean Air Task Force. Her resume, attached as Climate Advocates' Exhibit 15, sets forth her qualifications. She will present direct testimony for approximately 1 hour. Her summary of testimony, along with tables she will present, is set forth in Climate Advocates' Exhibit 16.

6. **Thomas O. Singer, Ph.D.**, is a Senior Policy Advisor with Western Environmental Law Center. His resume, attached as Climate Advocates' Exhibit 17, sets forth his qualifications. He will present direct testimony for approximately 1½ hour. Dr. Singer's PowerPoint presentation is Climate Advocates' Exhibit 18.

Dr. Singer will discuss "Flaring in the Oilfield," a May 19, 2020 report prepared by the New Mexico Oil and Gas Association that examined why New Mexico operators flare natural gas but did not identify or address the practice of long-term, routine flaring of associated gas as a cause of flaring in New Mexico, and instead only identified flaring practices that it described as

"temporary." 18.

Dr. Singer will testify regarding the presence of long term, routing flaring in New Mexico based on analysis of Form C-129 applications filed by operators with OCD. *See* Climate Advocates' Exhibit 18. The Commission's current rules allow companies to flare up to 60 days following well completion. 19.15.18.12.B NMAC. After that, companies are required to obtain an exception from the no-flare rule from the appropriate OCD District Office. The application for the exception is the Form C-129. In his analysis of a sample of C-129s, many wells were found to have approved applications over continuous periods of time spanning years, providing evidence of the practice of long-term routine flaring by New Mexico operators. The consequences of routine flaring following completion are especially important for shale wells because most of the gas from a well can end up being wasted since production declines dramatically over the months and years of a life of a well.

Dr. Singer's testimony on routine flaring and venting supports OCD's proposed 19.15.27.8.D NMAC, in particular the absence of any exceptions for routine flaring beyond those for exploratory wells and wells with long term high concentrations of N_2 or H_2S (Climate Advocates' Exhibit 1).

Dr. Singer will provide testimony on a June 2020 report by industry consultant GaffneyCline, "Tackling Flaring: Learnings from the Leading Permian Operators," that describes measures taken by five major Permian operators to prevent routine flaring. *See* Climate Advocates' Exhibit 18. The GaffneyCline report concluded that burning natural gas to allow oil extraction has reached such a scale in the Permian Basin as to constitute the wasting of one resource to produce another. The report profiles companies that have adopted practices to prevent routine flaring, making routine flaring unnecessary and preventable. Feasible

alternatives to routine flaring adopted by these operators include acquiring existing available takeaway capacity, aggregating production to draw investment in new pipelines and processing facilities, reinjecting gas, using gas on-site for power generation, transporting compressed or liquified natural gas to market, along with curtailing production and shutting in wells.

Dr. Singer will testify that industry's response to the historic 2020 fall in oil prices demonstrates that shutting in wells or curtailing production is a feasible response by operators to prevent routine venting and flaring. As the oil and gas industry faced a price crash resulting from too much oil supply and too little demand due to the pandemic, the Lujan Grisham administration loosened rules on temporary shut-ins, allowing companies to have flexibility in the number of wells that producers could temporarily shut-in due to economic hardship, including authorization to shut in wells for up to four years. According to OCD, as of late July 2020, there were nearly 6,000 wells for which shut-in requests had been submitted by 25 operators and approved by OCD.

Dr. Singer will testify about a recent survey of oil and gas operators that was conducted by the Federal Reserve Bank of Dallas on the cost of shutting in wells. *See id.* In its Second Quarter 2020 Energy Survey, 82% of the exploration and production companies responding said that their firms had shut in or curtailed production in the second quarter, with 94% giving low wellhead prices as the reason. The Federal Reserve asked these companies if they expected "extra costs" when putting wells back online. Twenty-seven percent said no and 61% said that costs would be minor. Eleven percent expected significant costs.

Dr. Singer will testify that OCD's proposed reporting provisions for upstream operators and operators of gathering systems are reasonable and necessary, but require modest improvements to provide valuable information to OCD and transparency for the public.

He will propose, in 19.15.27.8.G(1) NMAC, striking "or of long duration" since venting or flaring of long duration is prohibited by 19.15.27.8.D NMAC with two minor exceptions.

Dr. Singer will recommend clarifying the requirements of the revised Form C-129. The new requirements proposed by OCD specify several items of required information in an open-ended manner that will make review and analysis of C-129 information by OCD and the public difficult or impossible given the large number of producing wells in the state and the large number of C-129 forms that may be submitted. Specifying response categories in the rule would reduce reporting effort for operators as well as improve information quality and usability. Specifically, he will recommend the following:

- For 19.15.27.8.G(1)(b)(vii) NMAC "cause and nature of venting or flaring," the rule should require the operator to identify the reporting category in 19.15.27.8.G(2) NMAC that caused or was the source of the event.

- For 19.15.27.8.G(1)(b)(viii) NMAC "steps taken to limit the duration and magnitude of venting or flaring," the rule should incorporate subcategories for the most common steps rather than remain a textual description, including (1) well shut in, (2) production curtailed, (3) work expedited, and (4) upset condition resolved.

- For 19.15.27.8.G(1)(b)(ix) NMAC "corrective actions taken to eliminate the cause and recurrence of venting and flaring" the rule should similarly incorporate subcategories for the most common corrective actions, including (1) well connected to sales line, (2) compression installed, (3) equipment replaced, and (4) maintenance procedures or schedule revised.

In 19.15.27.8.G(2) NMAC, Dr. Singer will recommend that the rule clarify that vented and flared volumes for each category must be reported separately. It would defeat the purpose of more detailed reporting to have vented and flared volumes combined together for each category.

In 19.15.27.8.G(2) NMAC, the rule should include flared and vented gas from "*controlled* storage tanks" in the list of volumes of vented and flared gas to be reported given the large volume of both from controlled tanks, not just venting and flaring from *uncontrolled* tanks as proposed.

Finally, Dr. Singer will recommend that operators more precisely specify the reasons for venting and flaring associated gas and the volumes vented or flared. Section 19.15.27.8.G(2)(g) NMAC, as proposed, establishes a single category for "insufficient availability or capacity in a natural gas gathering system during separation phase of completion operations or production operations." Dr. Singer recommends including (1) lack of connection to a gathering system, (2) lack of adequate wellbore pressure or additional compression, (3) third-party or midstream upset condition or curtailment, (4) or other, which are distinct and separate reasons for venting and flaring that were examined during the Methane Advisory Panel process.

Dr. Singer will testify in support of OCD's proposal giving OCD discretion to require third-party verification in 19.15.27.9.C NMAC of venting and flaring data and information collected or reported. The integrity of measurement and reporting by operators is central to the ability of the final rule to reduce venting and flaring, and third-party verification is a reasonable means to ensure that reporting is timely, complete, and accurate. He will testify that that there are verification providers active in this field that are well-positioned to provide high-quality services to New Mexico oil and gas operators. *See id.*

7. **Charles de Saillan, J.D.**, is a Staff Attorney with the New Mexico Environmental Law Center. Mr. de Saillan's qualifications are set forth in his resume, attached as Climate Advocates' Exhibit 19. He will present direct testimony for approximately 45 minutes.

Mr. de Saillan will describe Climate Advocate's proposed modification to OCD's proposed methane waste regulation at section 19.15.27.9.D(7) NMAC. He will offer his opinion that this is a reasonable and appropriate revision to the methane waste regulations. He will discuss the importance of the 98% reduction requirement, and why any operator that is in violation of this requirement should not be entitled to drill a new well.

In support of this opinion, he will describe similar provisions in other environmental laws and regulations, both federal and state.

First, under the nonattainment provisions of the federal Clean Air Act, EPA or a state must deny an air permit for a new or modified source in a nonattainment area unless the operator (and all affiliated companies) that own or operate major air pollution sources in the state are in compliance with the emission limitation requirements of those permits. Climate Advocates' Exhibit 20.

Second, the New Mexico Water Quality Act, provides that the New Mexico Environment Department, or other constituent agency, "shall deny" a groundwater discharge permit if, among other things, "the discharge would cause or contribute to water contaminant levels in excess of any state or federal standard." Climate Advocates' Exhibit 21.

Third, the federal Resource Conservation and Recovery Act, the federal law governing the regulation of hazardous wastes, provides that EPA or an authorized state determines that a facility permitted under RCRCA is out of compliance with the core statutory requirements of RCRA, EPA or the state "shall revoke such permit." Climate Advocates' Exhibit 22.

Next, Mr. de Saillan will discuss the issue of enforcement discretion. He will explain the importance of agency discretion in enforcement and permitting matters. But he will explain that an agency decision to grant or deny a permit is not an enforcement decision. It is a permitting decision.

As a general legal principle, the State has broad discretion in determining how and when to enforce the law. The United States Supreme Court has often recognized that an agency's decision whether to enforce the laws it is entrusted to administer, and by which process, is a decision "generally committed to an agency's "absolute discretion."

There are many reasons for allowing such broad discretion. An agency decision not to enforce often involves a complicated balancing of a number of factors which are peculiarly within its expertise. Thus, the agency must not only assess whether a violation has occurred, but whether agency resources are best spent on this violation or another, whether the agency is likely to succeed if it acts, whether the particular enforcement action requested best fits the agency's overall policies, and, indeed, whether the agency has enough resources to undertake the action at all. An agency generally cannot act against each technical violation of the statute it is charged with enforcing.

As an attorney who represented federal and state agencies in countless actions to enforce environmental laws over more than three decades, Mr. de Saillan believes strongly in the importance of enforcement discretion. He has made legal arguments based on enforcement discretion in state and federal court.

Mr. de Saillan will offer his opinion that the proposed change to the regulations will not in any way limit or infringe the OCD's enforcement discretion. Under the Oil and Gas Act, OCD may grant, grant with conditions, or deny a permit. This decision is indubitably a permitting decision; it is not an enforcement decision. It is not a matter of enforcement discretion.

8. **Nathalie Eddy, J.D.**, is a Field Advocate for New Mexico and Colorado with Earthworks. Ms. Eddy's qualifications are set forth in her resume, attached as Climate Advocates' Exhibit 23. She will present direct testimony for approximately 15 minutes, and her PowerPoint presentation is Climate Advocates' Exhibit 24.

Ms. Eddy will testify that, in her experience, it is common to encounter unlit or malfunctioning flares in the Permian Basin. It appears that operator error, lack of attention, or

even something as simple as a windy day can cause flares to fail. Almost anywhere in the Permian, one can see multiple, active flares, and many appear to be venting or "smoky," indicating that combustion is incomplete or that the flare is otherwise malfunctioning. Any type of flare can fail. Ms. Eddy has observed unlit or malfunctioning flares of different types and at facilities of all ages and sizes. Even "supermajor" companies using the best flare technology appear to experience problems. Given that no flare is perfectly reliable or perfectly efficient in destroying methane and volatile organic compound pollution, eliminating flaring is the only sure way to prevent this pollution. Nonetheless, to the extent flaring is necessary in emergency situations, it is critical that operators be required to use the most reliable flares available and to conduct frequent oversight of their operations to ensure that flares are fixed and re-lit within hours, rather than the days or weeks that Ms. Eddy's field investigations indicate is sometimes the case.

Ms. Eddy will also testify regarding OCD's proposal to exempt stripper wells from the requirement to install the latest flare technology. In Ms. Eddy's experience, some of the stripper wells in New Mexico do not appear to have any flare stacks at all, but instead vent directly to the atmosphere. OCD's proposed 19.15.28.8.E(3)(c) NMAC would allow stripper wells to defer installing a flare with an automatic ignitor or continuous pilot until a "flare stack is replaced." Although this provision does not specify what will happen at a stripper well that does not have any flare stack, Climate Advocates believe that proposed 19.15.27.8(A)'s general prohibition on venting would require operators to install a new flare stack at such a well. Nonetheless, this is something the Commission should consider clarifying.

9. **Mario Atencio** is a Director on the Dine C.A.R.E Board of Directors. He will present non-technical testimony for approximately 15 minutes.

Mario Atencio is from Torreon, New Mexico. He is an enrolled member of the Navajo Nation, and serves as a Director on the Dine' C.A.R.E Board of Directors, having worked with the organization since 2009. Mr. Atencio grew up around oil and gas operations. His parents have ownership interests in at least 10 parcels of allotted lands in the Nageezi, Counselor, Ojo Encino and Torreon communities. As one of the only one of his siblings with a college education, his parents have entrusted him to review oil and gas leases and other related documents, and act as their spokesperson regarding the leases, including on matters of environmental justice. Mr. Atencio is familiar with oil and gas operations in the San Juan Basin from his personal experience and his work with Dine' C.A.R.E.

Mr. Atencio will testify regarding his personal experiences with oil and gas operations, including times when emissions from oil and gas wells degrade air quality and a toxic spill on his parents' land that led to review by federal and state officials, and inspection through an OGI camera showing significant venting and leaks to the atmosphere. He will also tell the Commission how his parents and he got immediate headaches from a stripper well venting to the atmosphere. Mr. Atencio will testify in support of stronger provisions to notify residents when they or their property is put at risk due to release from oil and gas operations.

10. **Kendra Pinto** works with Dine C.A.R.E. She will present testimony for approximately 15 minutes.

Ms. Pinto grew up in Twin Pines and resides near Lybrook, New Mexico, in the Eastern Agency of the Navajo Nation, approximately 800 feet away from the tribal and federal public lands boundary. She is an enrolled member of the Navajo Nation. Ms. Pinto has lived and worked near oil and gas facilities in the San Juan Basin all her life. She lives within one mile of three oil and gas sites.

Ms. Pinto will provide testimony on her personal experiences with the flaring, disruption, noise pollution, air pollution, and smells that are associated with oil and gas facilities, and the risks that she and her community face. She will discuss her concerns for the health of her community, their lands, and their air as a result of oil and gas operations. Ms. Pinto will testify in support of strong methane waste rules and for stronger public notice provisions if releases from oil and gas facilities present a risk to the public, their property, and the environment.

Ms. Pinto has worked with Earthworks in the Counselor, New Mexico area to document venting, flaring, and leaking of emissions from well sites on Bureau of Land Management lands, using a forward-looking infrared or "FLIR" camera, and will testify about those experiences, as well as her experience filing complaints about oil and gas operations with the State.

11. **Adella Begaye, R.N.**, is President of Dine C.A.R.E. and was a public health nurse. Her qualifications are set forth in her resume, attached as Climate Exhibit 25. She will present direct testimony for approximately 30 minutes.

Ms. Begaye will testify as a member of the Navajo Nation, who grew up and lives near the Four Corners area, and who has been an active advocate for public health and environmental and social justice for more than 40 years. She is a founding member of Diné C.A.R.E. and has served as Board President for the last 10 years. Ms. Begaye will explain that Diné C.A.R.E. members continue to practice traditional Diné cultural and spiritual teachings and practices that reference significant sacred sites in Dinétah, a region their mythology describes as the place our people first emerged into the Fourth World.

She will testify regarding the historic and current oil and gas operations that have polluted sacred and spiritually significant sites of the Navajo people, and her personal experience witnessing the pollution from such operations and feeling sick when visiting communities close

to these operations.

She will testify in support of strengthening the OCD's proposed methane waste rules by improving capturing methane during completions and recompletions, prohibiting new drilling permits to operators that are out of compliance with gas capture requirements, and requiring more robust public notice when health or safety is at risk.

Ms. Begaye will draw upon her decades of experience as a public health nurse in the Four Corners area and the findings in Climate Advocates' Exhibits 26 to 32, the public health impacts of oil and gas operations.[1] These findings include the public health impacts of chemicals released during oil and gas production including benzene, that is implicated in causing several diseases in the brain and nervous system, such as leukemia; formaldehyde which is a known cancer causing agent; toluene which linked to mental disabilities and abnormal growth in children, organ system damage in the kidney and liver, as well as immune and reproductive systems; and volatile organic compounds and particulate matter, which contribute to respiratory and circulatory system damage, which results in asthma, COPD, heart attack, stroke, and can lead to early death; and these chemicals impacts during pregnancy and to preterm children.

Ms. Begaye will discuss the hazards of ozone pollution, and that it disproportionately impacts children, Native Americans and those living in poor, rural communities.

She will discuss the 2020 Health Impact Assessment of the Counselor Chapter (Climates

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[1] Ms. Begaye also relied upon Environmental Defense Fund (n.d.). New Mexico Oil and Gas Data. Retrieved December 16, 2020, from https://www.edf.org/nm-oil-gas/map/ (mapping) and the following source, which is 475 pages, and therefore is not attached as an exhibit. Bushkin-Bedient, S., Dyrszka, L., Gorby, Y., Menapace, M., Nolan, K., Orenstein, C., Schoenfeld, B., Steingraber, S. (2020) Concerned Health Professionals of New York, & Physicians for Social Responsibility. *Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction).* 7th ed. Report. http://concernedhealthny.org/compendium/

Advocates' Exhibit 32), and its findings, which include potential childhood and birth impacts due to exposure of oil well emissions and participants' reported symptoms from VOCs that include eye and respiratory tract irritation, headaches, dizziness, visual disorders, fatigue, loss of coordination, allergic skin reaction, nausea, and memory impairment or inability to concentrate.

She will discuss the health disparities that exist among the Native American population compared to general U.S. population, and that children and elderly populations, as well as those with immune deficiencies, are most susceptible to complications from degraded air quality resulting from air pollutants present.

Ms. Begaye will cite from warnings from the Centers for Disease Control that people with underlying health conditions are most at risk for serious complication and adverse outcomes from COVID-19. The Navajo Nation has suffered one of the highest exposure and death rates from COVID-19 to date.

III. EXHIBITS

Climates Advocates' exhibits for their direct case are identified below and are attached hereto.

Ex.1	Climate Advocates' Proposed Modifications to OCD's Proposed 19.15.27 and 19.15.28 NMAC
Ex.2	Resume of Brenda Ekwuzel, Ph.D.
Ex.3	PowerPoint Presentation of Dr. Ekwuzel
Ex.4	Resume of Alexandra Teitz, J.D.
Ex.5	Governor Michelle Lujan Grisham's Executive Order 2019-03, Executive Order on Addressing Climate Change and Energy Waste Prevention
Ex.6	"Our environment is endangered," Governor Michelle Lujan Grisham, *The Santa Fe New Mexican* (Nov. 9, 2019)
Ex.7	World Bank, Zero Routine Flaring by 2030 [accessed 12/11/20]
Ex.8	Tackling Flaring: Learnings from Leading Permian Operators, GaffneyCline (June 2020)
Ex.9	"Investment Giants Urge Texas to End Most Natural Gas Flaring," *Bloomberg* (Sept. 4, 2020)
Ex.10	Investor Statement Urging Gov. Michelle Lujan Grisham's State Agencies to Strengthen Draft Rules to Reduce Methane Waste and Pollution from the Oil and Gas

	Sector (Nov. 10, 2020)
Ex.11	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on an EU strategy to reduce methane emissions; European Commission (Oct. 14, 2020)
Ex.12	Resume of David McCabe, Ph.D.
Ex.13	Resume of Don Schreiber
Ex.14	PowerPoint Presentation of Mr. Schreiber that includes: **Slides 1 – 25** 1. ConocoPhillips / Devil's Spring Ranch drilling program, 2008 2. Don and Jane Schreiber's Ranch, Navajo Dam area, Northwest New Mexico 3. Well density typical of San Juan Basin 4. Blewie line completions were typical in San Juan Basin for about 75 years 5. Blewie line completions near ranch ~ 2005-2006 6. Hilcorp #127 recompletion notice, February 2018 7. Schreiber field notes #127 onsite 2/20/18 8. Hilcorp #143 recompletion notice, February 2018 9. Hilcorp Recompletion of #143 venting to atmosphere 3/8/18 10. Hilcorp #143 recompletion frack equipment start up 3/8/18 11. Hilcorp #143 recompletion frack panorama 3/8/18 12. Setup for initial flowback with no REC in place as frac finishes. Well will vent to atmosphere through open flowback container 13. OCD Gas Capture Plans are the same 14. Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20 15. Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20 16. Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20 17. Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20 18. Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20 19. 2018 venting/flaring study of 54 Hilcorp recompletion in Rio Arriba and San Juan Counties—37 vented / 17 flared 20. Hilcorp recompletion flare US Hwy 64 near Blanco, NM 2/23/18 21. Weatherford green completion (REC) equipment in use in early 2000s 22. Hilcorp notifed us they intended to recomplete 22 wells in our area alone. Based on Weatherford numbers: 3 wells = 27 households, 22 wells = 205 households. 23. Hilcorp monitor well depth vs. pressure chart 24. View from New Mexico into Colorado near the Devil's Springs Ranch 25. Title slide **Exhibits 1 – 11, Individual pdfs:** 1. IPAA - Natural Gas and Green Completion in a Nut Shell.pdf 2. OSPP - Open Space Pilot Project brochure 5-1.pdf 3. ConocoPhillips-NMOGA REC Farmington.pdf 4. Williams-Natural-Gas-Facts.pdf 5. New Mexico home to fastest-shrinking city in the nation

	_ The NM Political Report.pdf 6. Pressure well 30039303000000_07_13_2020_11_14_34.pdf 7. Colorado Methane Emission Rules Excerpts.pdf 8. WELC-OCD Comments 9. Green Completions.pdf 10. Lessons Learned.pdf 11. IPIECA Green Completions.pdf **Videos [attached separately with this pleading]** 1. slide20.mov 2. slide21.mov 3. slide26.mov 4. slide27.mov
Ex.15	Resume of Lesley Fleischman, M.P.P.
Ex.16	Ms. Fleischman's Summary of Testimony
Ex.17	Resume of Thomas O. Singer, Ph.D.
Ex.18	Dr. Singer's PowerPoint Presentation
Ex.19	Resume of Charles de Saillan, J.D.
Ex.20	42 USCS § 7503
Ex.21	NMSA 1978, § 74-6-5
Ex.22	42 USCS § 6925
Ex.23	Resume of Nathalie Eddy, J.D.
Ex.24	Ms. Eddy's PowerPoint Presentation **[attached separately to access videos in PowerPoint]**
Ex.25	Resume of Adella Begaye, R.N
Ex.26	B. Gottlieb, L. Dyrszka, M.D., Too Dirty, Too Dangerous: Why health professionals reject natural gas, report from Physicians for Social Responsibility (Feb. 2017)
Ex.27	L. J. Cushing, K. Vavra, et al., Flaring from unconventional oil and gas development and birth outcomes in the Eagle Ford Shale I South Texas, *Environmental Health Perspectives*, 128 (7) July 2020
Ex.28	J.A. Casey, D.A. Savitz, S.G. Rasmussen, E.L. Ogburn, J. Pollak, U.D.G. Mercer, et al. 2016, Unconventional natural gas development and birth outcomes in Pennsylvania, *USA Epidemiology* 27(2): 163-172, PMID
Ex.29	K.V. Tran, J.A. Casey, et al., Residential proximity to oil and gas development and birth outcomes in California: a retrospective cohort study of 2006-2015 births, *Environmental Health Perspectives*, 128(6) June 2020
Ex.30	D.A. Garcia-Gonzales, S.B.C. Shonkoff, J. Hays, M. Jerrett, Hazardous air pollutants associated with upstream oil and natural gas development: a critical synthesis of current peer-reviewed literature, *Annu Rev Public Health* 40:283-304 (2019), PMID: 30935307
Ex.31	A. Lowe, B. Bender, A. Liu, T. Solomon, A. Kobernick, W. Morgan, L. Gerald, Environmental concerns for children with asthma on the Navajo Nation, *Annals of the American Thorac Society* 15(6), 745-753 (2018)
Ex.32	A Cultural, Spiritual and Health Impact Assessment of Oil Drilling Operations in the Navajo Nation Area of Counselor, Torreon and Ojo Encino Chapters, prepared by Counselor Health Impact Assessment - Hozhóógó na'ada Committee (2020)

Climate Advocates reserve the right to call rebuttal witnesses and introduce rebuttal exhibits.

IV. CLIMATE ADVOCATES' PROPOSED MODIFICATIONS TO OCD'S PROPOSED RULES

Climate Advocates' proposed modifications to the proposed rules filed by OCD are attached as Climate Advocates' Exhibit 1. The reasons for adopting Climate Advocates' proposed modifications are set forth in the witnesses' summaries of testimony, set forth above.

Respectfully submitted,

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Certificate of Service

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TITLE 19 NATURAL RESOURCES AND WILDLIFE
CHAPTER 15 OIL AND GAS
PART 27 VENTING AND FLARING OF NATURAL GAS

19.15.27.1 ISSUING AGENCY: Oil Conservation Commission.
[19.15.27.1 NMAC – N, xx/xx/xxxx]

19.15.27.2 SCOPE: 19.15.27 NMAC applies to persons engaged in oil and gas development and production within New Mexico.
[19.15.27.2 NMAC – N, xx/xx/xxxx]

19.15.27.3 STATUTORY AUTHORITY: 19.15.27 NMAC is adopted pursuant to the Oil and Gas Act, Section 70-2-6, Section 70-2-11 and Section 70-2-12 NMSA 1978.
[19.15.27.3 NMAC – N, xx/xx/xxxx]

19.15.27.4 DURATION: Permanent.
[19.15.27.4 NMAC – N, xx/xx/xxxx]

19.15.27.5 EFFECTIVE DATE: {DATE}, unless a later date is cited at the end of a section.
[19.15.27.5 NMAC – N, xx/xx/xxxx]

19.15.27.6 OBJECTIVE: To regulate the venting and flaring of natural gas from wells and production equipment and facilities to prevent waste and protect correlative rights, public health, and the environment.
[19.15.27.6 NMAC – N, xx/xx/xxxx]

19.15.27.7 DEFINITIONS: Terms shall have the meaning specified in 19.15.2 NMAC except as specified below.

A. **"Air Pollution Control Equipment"** means a combustion device or vapor recovery unit.

~~A.~~B. **"ALARM"** means advanced leak and repair monitoring technology for detecting natural gas or crude oil leaks or releases that is not required by applicable state or federal law, rule, or regulation, and which the division has approved as eligible to earn a credit against the reported volume of lost natural gas pursuant to Paragraph (3) of Subsection B of 19.15.28.10 NMAC.

~~B.~~C. **"Average daily production"** has the same meaning as in Subsection A of 19.15.6.7 NMAC.

~~C.~~D. **"AVO"** means audio, visual and olfactory.

~~D.~~E. **"Completion operations"** means the period that begins with the initial perforation of the well in the completed interval and concludes on the earlier of 30 days after commencement of initial flowback or when permanent production equipment is first placed into service.

F. **"Drilling operations"** means the period that begins when a well is spud and concludes when casing and cementing has been completed and casing slips have been set to install the tubing head.

~~E.~~G. **"Drill out"** means the process of removing the plugs placed during hydraulic fracturing or refracturing. Drill-out ends after the removal of all stage plugs and the initial wellbore clean-up.

~~F.~~H. **"~~Delineation~~ Exploratory well"** means a well located in a spacing unit the closest boundary of which is two miles or more from:

(1) the outer boundary of a defined pool that has produced oil or gas from the formation to which the well is or will be drilled; and

(2) an existing gathering pipeline as defined in 19.15.28 NMAC.

~~G.~~I. **"Emergency"** means a temporary, infrequent, and unavoidable event in which the loss of natural gas is uncontrollable or necessary to avoid a risk of an immediate and substantial adverse impact on safety, public health, or the environment, but does not include an event arising from or related to:

(1) the operator's failure to install appropriate equipment of sufficient capacity to accommodate the anticipated or actual rate and pressure of production;

(2) the operator's failure to limit production when the production rate exceeds the capacity of the related equipment or natural gas gathering system as defined in 19.15.28 NMAC, or exceeds the sales contract volume of natural gas;

(3) scheduled maintenance;

(4) venting or flaring of natural gas for more than four hours that is caused by unscheduled maintenance, or malfunction of a natural gas gathering system as defined in 19.15.28 NM

(5) the operator's negligence, including a recurring equipment failure;

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EX. 1

or

(6) three or more emergencies experienced by the operator within the preceding 60 days, unless the division determines the operator could not have reasonably anticipated the current event and it was beyond the operator's control.

~~H.~~J. **"Flare" or "Flaring"** means the controlled combustion of natural gas in a device designed for that purpose.

~~I.~~K. **"Flare stack"** means an appropriately designed stack equipped with a burner used for the combustion and disposal of natural gas.

L. **"Flowback"** means the process of allowing fluids and entrained solids to flow from a well following stimulation, either in preparation for a subsequent phase of treatment or in preparation for cleanup and placing the well into production. Flowback ends when all temporary flowback equipment is removed from service. Flowback does not include drill-out.

M. **"Flowback fluid"** means the gases, liquids, and entrained solids flowing from a well after drilling or hydraulic fracturing or refracturing.

~~"Gas-to-oil ratio (GOR)" for purposes of 19.15.27 NMAC means the ratio of natural gas to oil in the production stream expressed in standard cubic feet of natural gas per barrel of oil.~~

~~J.~~N. **"Initial flowback"** means the period during completion operations that begins with the onset of flowback and concludes when it is technically feasible for a separator to function.

~~K.~~O. **"Malfunction"** means a sudden, unavoidable failure or breakdown of equipment beyond the reasonable control of the operator that substantially disrupts operations and requires correction, but does not include a failure or breakdown that is caused entirely or in part by poor maintenance, careless operation, or other preventable equipment failure or breakdown.

~~L.~~P. **"N2"** means nitrogen gas.

~~M.~~Q. **"Natural gas"** means a gaseous mixture of hydrocarbon compounds, primarily composed of methane, and includes both casinghead gas and gas as those terms are defined in 19.15.2 NMAC.

~~N.~~ **"Production operations"** means the period that begins on the earlier of 31 days following the commencement of initial flowback or when permanent production equipment is placed into service and concludes when the well is plugged and abandoned.

~~O.~~R. **"Producing in paying quantities"** mean the production of a quantity of oil and gas that yields revenue in excess of operating expense

~~P.~~S. **"Separation flowback"** means the period during completion operations that begins when it is technically feasible for a separator to function and concludes on the earlier of 30 days after the commencement of initial flowback or when permanent production equipment is placed into service.

~~Q.~~T. **"Vent" or "Venting"** means the release of uncombusted natural gas to the atmosphere.

[19.15.27.7 NMAC – N, xx/xx/xxxx]

19.15.27.8 VENTING AND FLARING OF NATURAL GAS:

A. Venting and flaring of natural gas during drilling, completion or production operations constitutes waste and is prohibited except as authorized in Subsections B, C and D of 19.15.27.8 NMAC. The operator has a general duty to maximize the recovery of natural gas and to minimize the release of natural gas to the atmosphere. During drilling, completion and production operations, the operator shall flare natural gas rather than vent natural gas except when flaring is technically infeasible or would pose a risk to safe operations or personnel safety, and venting is a safer alternative than flaring.

B. Venting and flaring during drilling operations.

(1) The operator shall capture or combust natural gas if technically feasible using best industry practices and control technologies.

(2) A flare stack shall be located at a minimum of 100 feet from the nearest surface hole location ~~and,~~ shall be properly sized, enclosed and equipped with an automatic ignition system, ~~or continuous pilot,~~ and have a destruction removal efficiency of at least 98%.

(3) In an emergency or malfunction, the operator may vent natural gas to avoid a risk of an immediate and substantial adverse impact on safety, public health, or the environment. The operator shall report natural gas vented or flared during an emergency or malfunction to the division pursuant to Paragraph (1) of Subsection G of 19.15.27.8 NMAC.

C. Venting and flaring during completion and recompletion operations.

(1) During initial flowback, the operator must direct all fluids to flowback vessels and collect and control emissions from each flowback vessel on and after the date of initial flowback ~~fluids are routed~~

~~to the flowback vessel~~ by routing emissions to an operating air pollution control equipment that achieves a hydrocarbon control efficiency of at least 95%. If a combustion device is used, it must have a design destruction efficiency of at least 98% for hydrocarbons.

(a) Operators must use enclosed, vapor-tight flowback vessels with an appropriate pressure relief system to be used only as necessary to ensure safety.

(b) Flowback vessels must be inspected, tested, and refurbished where necessary to ensure the flowback vessel is vapor-tight prior to receiving flowback.

~~(a)~~(c) Flares used to control emissions from flowback vessels and pressure relief systems must be equipped with an automatic ignitor. ~~shall route flowback fluids into a completion or storage tank and commence operation of a separator as soon as it is technically feasible for a separator to function.~~

(2) During separation flowback, the operator shall capture and route natural gas:

(a) to a gas flowline or collection system, reinject into the well, or use on-site as a fuel source or other purpose that a purchased fuel or raw material would serve; or

(b) to a flare if routing the natural gas to a gas flowline or collection system, reinjecting it into the well, or using it on-site as a fuel source or other purpose that a purchased fuel or raw material would serve would pose a risk to safe operation or personnel safety, provided that the flare is properly sized and equipped with an automatic igniter ~~or continuous pilot.~~

(3) If N_2 or H_2S concentrations in natural gas exceeds the gathering pipeline specifications, the operator may flare the natural gas for 60 days or until the N_2 or H_2S concentrations meet the pipeline specifications, whichever is sooner, provided that:

(a) the flare stack is properly sized and equipped with an automatic igniter ~~or continuous pilot~~;

(b) the operator analyzes natural gas samples twice per week;

(c) the operator routes the natural gas into a gathering pipeline as soon as the pipeline specifications are met; and

(d) the operator provides the pipeline specifications and natural gas analyses to the division upon request.

D. Venting and flaring during production operations. The operator shall not vent or flare natural gas except:

(1) to the extent authorized by a valid federally enforceable air quality permit issued by the New Mexico environment department;

(2) during an emergency or malfunction, but only to avoid a risk of an immediate and substantial adverse impact on safety, public health, or the environment. The operator shall notify the division of venting or flaring resulting from an emergency or malfunction pursuant to Paragraph (1) of Subsection G of 19.15.27.8 NMAC;

(3) to unload or clean-up liquid holdup in a well to atmospheric pressure, provided

(a) the operator uses an automated control system such as a plunger lift where technically feasible, and optimizes the system to minimize the venting of natural gas;

~~(a)~~(b) the operator does not vent after the well achieves a stabilized rate and pressure;

~~(b)~~(c) for liquids unloading by manual purging, the operator remains present on-site until the end of unloading, takes all reasonable actions to achieve a stabilized rate and pressure at the earliest practical time and takes all reasonable actions to minimize venting to the maximum extent practicable;

~~(c) for a well equipped with a plunger lift system or an automated control system, the operator optimizes the system to minimize the venting of natural gas; or~~

(d) during downhole well maintenance, only when the operator uses a workover rig, swabbing rig, coiled tubing unit or similar specialty equipment and minimizes the venting of natural gas to the extent that it does not pose a risk to safe operations and personnel safety and is consistent with best management practices; and

(e) The operator must notify the division at least 48 hours prior to conducting unloading or well clean-up activities, except where the operator must act more quickly in order to minimize waste of natural gas. In these cases, the operator must notify the division as soon as possible prior to conducting unloading or well clean-up activities.

(4) during the first 12 months of production from an exploratory ~~delineation~~ well, or as

extended by the division for good cause shown, provided:

(a) the operator proposes and the division approves the well as an exploratory ~~delineation~~ well;

(b) the operator is in compliance with its statewide gas capture requirements; and

(c) if an exploratory ~~delineation~~ well is capable of producing in paying quantities within 12 months of the division's approval, the operator submits an updated form C-129 to the division, including a natural gas management plan and timeline for connecting the well to a natural gas gathering system; or

(5) during the following activities unless prohibited by applicable state or federal law, rule, or regulation for the emission of hydrocarbons and volatile organic compounds:

(a) gauging or sampling a storage tank or other low-pressure production vessel;

(b) loading out liquids from a storage tank or other low-pressure production vessel to a transport vehicle;

(c) scheduled repair and maintenance, including blowing down and depressurizing production equipment to perform repair and maintenance, but only where it is not technically feasible to transfer the gas to equipment not being depressurized;

(d) normal operation of a gas-activated pneumatic controller or pump;

(e) normal operation of a storage tank or other low-pressure production vessel, but not including venting from a thief hatch that is not fully and timely closed or from a seal that is not maintained on an established schedule;

(f) a bradenhead test;

(g) a packer leakage test;

(h) a production test lasting less than 24 hours unless the division requires or approves a longer test period; or

(i) when N_2 or H_2S concentrations in natural gas exceeds the gathering pipeline specifications, provided the operator analyzes natural gas samples twice per week to determine whether the specifications have been achieved, routes the natural gas into a gathering pipeline as soon as the pipeline specifications are met and provides the pipeline specifications and natural gas analyses to the division upon request;

provided, all venting occurs in compliance with the requirement to flare rather than vent in section 19.15.27.8.A. and all flaring is conducted using a flare stack that is properly sized, equipped with an automatic igniter, and has a destruction removal efficiency of at least 98%.

E. Performance standards for separation, storage tank and flare equipment.

(1) The operator shall design completion and production separation equipment and storage tanks for maximum throughput and pressure to maximize hydrocarbon recovery and minimize excess natural gas flashing and vapor accumulation.

(2) The operator shall equip a permanent storage tank associated with production operations that is installed after {effective date of rule} with an automatic gauging system that reduces the venting of natural gas.

(3) The operator shall combust natural gas in a flare stack that is properly sized and designed for and operated at maximum efficiency.

(a) A flare stack installed or replaced after May 31, 2021 shall be equipped with an automatic ignitor ~~or continuous pilot~~and meet a destruction removal efficiency of 98%.

(b) A flare stack installed before June 1, 2021 which does not have a continuous pilot, automatic igniter, or a technology that alerts the operator that the flare has malfunctioned shall be retrofitted with an automatic ignitor ~~or continuous pilot or a technology that alerts the operator that the flare has malfunctioned~~ no later than ~~18 months~~ 120 days after {effective date of rule}.

(c) Notwithstanding subsection E(3)(b), a ~~A~~ flare stack located at a wellsite with an average daily production of equal to or less than 10 barrels of oil or 60,000 cubic feet of natural gas shall be equipped with a continuous pilot or ann automatic ignitor ~~or continuous pilot if the flare stack is replaced~~no later than 12 months after {effective date of the rule}.

(4) A flare stack located at a well spud after {effective date of rule} shall be securely anchored and located at least 100 feet from the well and storage tanks.

(5) The operator shall conduct an AVO inspection on the frequency specified below to confirm that all production equipment is operating properly and there are no leaks or releases except as allowed in Subsection D of 19.15.27.8 NMAC.

(a) During an AVO inspection the operator shall inspect all components, including flare stacks, thief hatches, closed vent systems, pumps, compressors, pressure relief devices, valves, lines, flanges,

connectors, and associated piping to identify defects, leaks, and releases by:

(i) visually inspecting for cracks and holes; loose connections; leaks; broken and missing caps; broken, damaged seals and gaskets; broken, missing and open hatches; broken, missing and open access covers and closure devices; and to ensure a flare stack is operating in conformance with its design;

(ii) listening for pressure and liquid leaks; and

(iii) smelling for unusual and strong odors.

(b) The operator shall conduct an AVO inspection weekly:

(i) during the first year of production; and

(ii) on a well with an average daily production greater than 10 barrels of oil or 60,000 cubic feet of natural gas.

(c) The operator shall conduct an AVO inspection weekly if it is on site, and in no case less than once per calendar month with at least 20 calendar days between inspections:

(i) on a well with an average daily production equal to or less than 10 barrels of oil or 60,000 cubic feet of natural gas; and

(ii) on shut-in, temporarily abandoned, or inactive wells.

(d) The operator shall make and keep a record of an AVO inspection for not less than five years and make such record available for inspection by the division upon request.

(7) Subject to the division's prior written approval, the operator may use a remote or automated monitoring technology to detect leaks and releases in lieu of an AVO inspection.

F. Measurement of vented and flared natural gas.

(1) The operator shall measure the volume of natural gas that it vents, flares, or beneficially uses during drilling, completion, and production operations regardless of the reason ~~or authorization~~ for such venting or flaring.

(2) The operator shall install equipment on flowlines that are piped from equipment such as high pressure separators, heater treaters and vapor recovery units to measure the volume of natural gas vented or flared from a well authorized by an APD issued after May 31, 2021 that has an average daily production greater than 10 barrels of oil or 60,000 cubic feet of natural gas.

(3) Measuring equipment shall be an orifice meter or other measurement device or technology such as a thermal mass or ultrasonic flow meter approved by the division that, at the time of installation, complies with the accuracy ratings and design standards for the measurement of natural gas, such as the American petroleum institute, international organization for standards, or American gas association.

(4) Measuring equipment shall not be designed or equipped with a manifold that allows the diversion of natural gas around the metering element except for the sole purpose of inspecting and servicing the measurement equipment.

(5) For an event for which metering is not practicable, such as low pressure venting and flaring, or for a well that does not require measuring equipment, the operator ~~may estimate~~shall calculate the volume of vented or flared natural gas using the methodologies specified by the U.S. EPA Greenhouse Gas Reporting Rule (40 CFR Part 98 Subpart W, § 98.233) or other established methodologies specified by the division. If the division determines that no established methodology is available for a particular source of venting or flaring, it may authorize the operator to estimate the volume of vented or flared gas using the best information available to the operator.

~~**(6)** For a well that does not require measuring equipment, the operator shall estimate the volume of vented and flared natural gas based on the result of an annual GOR test for that well reported on form C-116.~~

~~(7)~~(6) The operator shall install additional measuring equipment whenever the division determines that the existing measuring equipment ~~or GOR test~~ is not sufficient to measure the volume of vented and flared natural gas.

G. Reporting of vented or flared gas.

(1) Venting or flaring caused by emergency or malfunction~~, or of long duration~~.

(a) The operator shall notify the division of venting or flaring that exceeds 50 MCF in volume and either results from an emergency or malfunction~~,~~ or lasts eight hours or more cumulatively within any 24-hour period by filing a form C-129 with the division as follows:

(i) for venting or flaring that equals or exceeds 50 MCF but less than 500 MCF, notify the appropriate division district office in writing by filing a form C-129 no later than 15 days following discovery or commencement of venting or flaring;

(ii) for venting or flaring that equals or exceeds 500 MCF or otherwise qualifies as a major release as defined in 19.15.29.7 NMAC, notify the appropriate division district office verbally or by e-mail as soon as possible and no later than 24 hours following discovery or commencement of venting or flaring

and provide the information required in form C-129. No later than 15 days following the discovery or commencement of venting or flaring, the operator shall file a form C-129 that verifies, updates, or corrects the verbal or e-mail notification;

~~(ii)~~**(iii)** for venting or flaring that qualifies as a major release as defined in 19.15.29.7.A(2)(a), (c) and (d), the operator shall use best efforts to notify all members of the public whose health, safety or property are endangered; and

~~(iii)~~**(iv)** no later than 15 days following the termination of venting or flaring, notify the appropriate division district office by filing a form C-129.

(b) The operator shall provide and certify the accuracy of the following information in the form C-129:

- **(i)** operator's name;
- **(ii)** name and type of facility;
- **(iii)** equipment involved;
- **(iv)** compositional analysis of vented or flared natural gas;
- **(v)** date(s) and time(s) that venting or flaring was discovered or commenced and terminated;
- **(vi)** measured or estimated volume of vented or flared natural gas;
- **(vii)** cause and nature of venting or flaring, as identified in the venting and flaring categories set forth in Subsection G, Paragraph (2) of 19.15.27.9 NMAC;
- **(viii)** steps taken to limit the duration and magnitude of venting or flaring, including (1) well shut in, (2) production curtailed, (3) work expedited, (4) upset condition resolved, or (5) other;
- **(ix)** corrective actions taken to eliminate the cause and recurrence of venting and flaring, including (1) well connected to sales line, (2) compression installed, (3) equipment replaced, (4) maintenance procedure or schedule revised, or (5) other.

(c) At the division's request, the operator shall provide and certify additional information by the specified date.

(d) The operator shall file a form C-141 instead of a form C-129 for the release of a liquid during venting or flaring that is or may be a major or minor release under 19.15.29.7 NMAC.

(2) Monthly reporting of vented and flared natural gas. The operator shall separately report the volume of vented natural gas and volume of flared natural gas for each month in each category listed below. Beginning June 2021, the operator shall submit quarterly reports in a format specified by the division. Beginning January 2022, the operator shall submit a form C-115B monthly on or before the 15th day of the second month following the month in which it vented or flared natural gas. The operator shall specify whether it estimated or measured each reported volume. In filing the initial report, the operator shall provide the methodology, formulas, and parameters (measured or estimated using calculations and industry standard factors) used to report the volumes and shall report changes in the methodology on future forms. The operator shall make and keep records of the measurements and estimates, including records showing how it calculated the estimates, for no less than five years and make such records available for inspection by the division upon request. The categories are:

(a) emergency;

(b) non-scheduled maintenance or malfunction;

(c) routine repair and maintenance, including blowdown and depressurization;

(d) routine downhole maintenance, including operation of workover rigs, swabbing rigs, coiled tubing units and similar specialty equipment;

(e) manual liquid unloading;

(f) uncontrolled storage tanks;

~~(f)~~(g) controlled storage tanks;

~~(g)~~(h) insufficient availability or capacity in a natural gas gathering system or downstream processing plant during ~~separation phase of~~ completion operations or production operations, including lack of connection to a gathering system; lack of adequate wellbore pressure or additional compression-; third-party or midstream upset condition or curtailment; or other-;

~~(h)~~(i) natural gas that is not suitable for transportation or processing because of N_2 or H_2S concentration;

~~(i)~~(j) venting as a result of normal operation of pneumatic controllers and pumps, unless the operator vents or flares less than 500,000 cubic feet per year of natural gas;

~~(j)~~(k) improperly closed or maintained thief hatches on tanks that are routed to a flare or control device;

~~(k)~~(l) venting or flaring in excess of four hours that is caused by an emergency,

~~(l)~~(m) unscheduled maintenance or malfunction of a natural gas gathering system as defined in 19.15.28 NMAC;

~~(m)~~(n) other not described above.

(3) The operator shall report the lost natural gas for each month on a volumetric and percentage basis on form C-115B.

(a) To calculate the lost natural gas on a volumetric basis, the operator shall deduct the volume of natural gas sold, used for beneficial use, vented or flared during an emergency, and vented or flared because it was not suitable for transportation or processing, from the natural gas produced.

(b) To calculate the lost natural gas on a percentage basis, the operator shall add the volume of natural gas sold, used for beneficial use, vented or flared during an emergency and vented or flared because it was not suitable for transportation or processing, and divide by the total volume of natural gas produced.

(4) The operator shall report the vented and flared natural gas on a volumetric and percentage basis to all royalty owners in the mineral estate being produced by the well on a monthly basis, keep such reports for not less than five years and make such records available for inspection by the division upon request.

(5) Upon request by the division, the operator, at its own expense, shall retain a third-party approved by the division to verify any data or information collected or reported pursuant to Subsections F and G of 19.15.27.8 NMAC and make recommendations to correct or improve the collection and reporting of data and information, submit a report of the verification and recommendations to the division by the specified date, and implement the recommendations in the manner approved by the division.

(6) Upon the New Mexico environment department's request, the operator shall promptly provide a copy of any form filed pursuant to 19.15.27 NMAC.

[19.15.27.8 NMAC – N, xx/xx/xxxx]

19.15.27.9 STATEWIDE NATURAL GAS CAPTURE REQUIREMENTS:

A. Statewide natural gas capture requirements. Commencing January 1, 2022, the operator shall, in addition to meeting the requirements of 19.15.27.8 NMAC reduce the annual volume of vented and flared natural gas in order to capture no less than ninety-eight percent of the natural gas produced from its wells in each of two reporting areas, one north and one south of the Township 10 North line, by December 31, 2026. The division shall calculate and publish each operator's baseline natural gas capture rate based on the operator's 2021 monthly data reported on form C-115B for each reporting area in which the operator operates a well. In each calendar year between January 1, 2022 and December 31, 2026, the operator shall increase the percentage of natural gas captured in each reporting area in which it operates by at least the amount identified using ~~based on~~ the following formula: (2021 baseline loss rate minus two percent) divided by five.

(1) The following table provides examples of the formula based on a range of baseline natural gas capture rates.

Baseline Natural Gas Capture Rate	Minimum Required Annual Natural Gas Capture Percentage Increase
90-98%	0-1.6%
80-89%	>1.6-3.6%
70-79%	>3.6-5.6%
0-69%	>5.6-19.6%

(2) If the operator's baseline capture rate is less than sixty percent, the operator shall submit by the specified date to the division for approval a plan to meet the minimum required annual capture percentage increase.

(3) An operator that acquires one or more wells from another operator shall comply with its statewide natural gas capture requirements for the acquired well(s) on the capture schedule under Subsection A, Paragraph (1) of 19.15.27.9 NMAC that applied to the acquired wells prior to acquisition. ~~and no later than December 31, 2026, unless the division approves a later date.~~

B. Accounting. No later than February 15 each year beginning in 2022, the operator shall submit a report certifying compliance with its statewide gas capture requirements. The operator's volume of vented and flared natural gas shall be counted as produced natural gas and excluded from the volume of natural gas sold or used for beneficial use in the calculation of its statewide natural gas capture requirements, except that:

(1) the operator may exclude from the volume of produced natural gas the volume of natural gas vented or flared pursuant to Subparagraphs (a) and (~~h~~i) of Paragraph (2) of Subsection G of 19.15.27.8 NMAC for which the operator timely filed, and the division approved, a form C-129; and

(2) the operator may exclude from the volume of produced natural gas the volume of natural gas reported as a beneficial use or vented or flared from an exploratory ~~delineation~~ well and reported on the operator's form C-115.

(3) An operator that used a division-approved ALARM technology to monitor for leaks and releases may obtain a credit against the volume of lost natural gas if it discovered the leak or release using the ALARM technology and the operator:

(a) isolated the leak or release within 48 hours following field verification;

(b) repaired the leak or release within 15 days following field verification or another date approved by the division;

(c) timely notified the division by filing a form C-129 or form C-141;

(d) timely reported the volume of natural gas leaked or released on form C-115 as an ALARM event pursuant to Subparagraph (n) of Paragraph (2) of Subsection F of 19.15.28.8 NMAC; and

(d) used ALARM monitoring technology as a routine and on-going aspect of its waste-reduction practices.

(i) For discrete waste-reduction practices such as aerial methane monitoring, the operator must use the technology at least twice per year; and

(ii) for waste-reduction practices such as automated emissions monitoring systems that operate routinely or continuously, the division will determine the required frequency of use.

(4) An operator may file an application with the division for a credit against its volume of lost natural gas that identifies:

(a) the ALARM technology used to discover the leak or release;

(b) the dates on which the leak or release was discovered, field-verified, isolated and repaired;

(c) the method used to measure, calculate, or estimate the volume of natural gas leaked or released, which method shall be consistent with the quantification requirements specified under 19.15.27.8(F);

(d) a description and the date of each action taken to isolate and repair the leak or release;

(e) visual documentation or other verification of discovery, isolation and repair of the leak or release;

(f) a certification that the operator did not know or have reason to know of the leak

or release before discovery using ALARM technology; and

(g) a description of how the operator used ALARM technology as a routine and on-going aspect of its waste-reduction practices.

(5) For each leak or release reported by an operator that meets the requirements of Paragraphs (3) and (4) of Subsection B of 29.15.28.10 NMAC, the division, in its sole discretion, may approve a credit that the operator can apply against its reported volume of lost natural gas as follows:

(a) a credit of forty percent of the volume of natural gas discovered and isolated within 48 hours of discovery and timely repaired;

(b) an additional credit of twenty percent if the operator used ALARM technology no less than once per calendar quarter as a routine and on-going aspect of its waste-reduction practices.

(6) A division-approved ALARM credit shall:

(a) be used only by the operator who submitted the application pursuant to Paragraph (4) of Subsection B of 29.15.27.10 NMAC;

(b) not be transferred to or used by another operator, including a parent, subsidiary, related entity, or person acquiring the well;

(c) be used only once; and

(d) expire 24 months after division approval.

C. Third-party verification. Upon request by the division, the operator, at its own expense, shall retain a third-party approved by the division to verify any data or information collected or reported pursuant to Subsections F and G of 19.15.27.8 NMAC or Subsection B(4) of 19.15.27.9 and make recommendations to correct or improve the collection and reporting of data and information, submit a report of the verification and recommendations to the division by the specified date, and implement the recommendations in the manner approved by the division.

D. Natural gas management plan.

(1) After May 31, 2021, the operator shall file a natural gas management plan with each APD for a new or recompleted well. The operator may file a single natural gas management plan for multiple wells drilled or recompleted from a single well pad or that will be connected to a central delivery point. The natural gas management plan shall describe the actions that the operator will take at each proposed well to meet its statewide natural gas capture requirements and to comply with the requirements of Subsections A through F of 19.15.27.8 NMAC, including for each well:

(a) the operator's name and OGRID number;

(b) the name, API number, location and footage; and

(c) the anticipated dates of drilling, completion and first production;

(d) certification that the operator communicated with one or more operators of natural gas gathering systems in the general area about transporting natural gas from the well or wells;

(e) certification that the operator has provided the following information to each operator of a natural gas gathering systems in the general area:

(i) well location;

(ii) date of anticipated first production;

(~~i~~)(iii) anticipated volume of natural gas production in units of MCFD for the first three years of production of the well.

(2) An operator that, at the time it submits an APD for a new or recompletion well, is not in compliance with its statewide natural gas capture requirements shall also include the following information in the natural gas management plan:

(a) the anticipated volume of produced natural gas in units of MCFD for the first year of production;

(b) the existing natural gas gathering system the operator has contracted or anticipates contracting with to gather the natural gas, including:

(i) the name of the natural gas gathering system operator;

(ii) the name and location of the natural gas gathering system;

(iii) a map of the natural gas gathering system as built or as planned if it has not yet been built; and

(iv) the maximum daily capacity of the natural gas gathering system to which the well will be connected; and

(c) the operator's plans for connecting the well to the natural gas gathering system, including:

(i) the anticipated date on which the natural gas gathering system will be available to gather the natural gas produced from the well;

(ii) whether, at the time of application, the natural gas gathering system has existing capacity and at the anticipated time of connection is expected to have capacity to gather the anticipated natural gas production volume from the well; and

(iii) whether the operator anticipates the operator's existing well(s) connected to the same natural gas gathering system will continue to be able to meet anticipated increases in line pressure caused by~~e~~ the well and the operator's plan to manage increased line pressure~~.~~; and

(d) the name and location of the natural gas processing plant receiving or anticipated to receive natural gas from the natural gas gathering system.

(3) The operator may submit a request asserting confidentiality for information specified in

Paragraph (2) of Subsection D of 19.15.27.9 NMAC, which the division will review in accordance with Section 71-2-8 NMSA 1978.

(4) The operator shall certify that it has determined based on the available information at the time of submitting the natural gas management plan either:

(a) it will be able to connect the well to a natural gas gathering system in the general area with sufficient capacity to transport one hundred percent of the volume of natural gas the operator anticipates the well will produce commencing on the date of first production, taking into account the current and anticipated volumes of produced natural gas from other wells connected to the pipeline gathering system; or

(b) it will not be able to connect to a natural gas gathering system in the general area with sufficient capacity to transport one hundred percent of the volume of natural gas the operator anticipates the well will produce commencing on the date of first production, taking into account the current and anticipated volumes of produced natural gas from other wells connected to the pipeline gathering system.

(5) If the operator determines it will not be able to connect a natural gas gathering system in the general area with sufficient capacity to transport one hundred percent of the anticipated volume of natural gas produced on the date of first production from the well, the operator shall submit a venting and flaring plan to the division that evaluates and selects from among the potential alternative uses for the natural gas to ensure that the natural gas is put to an alternative use until a natural gas gathering system is available, including:

(a) power generation on lease;
(b) power generation for grid;
(c) compression on lease;
(d) liquids removal on lease;
(e) reinjection for underground storage;
(f) reinjection for temporary storage;
(g) reinjection for storage;
(h) reinjection for enhanced oil recovery;
(i) fuel cell production; and
(j) other alternative uses approved by the division.

(6) If, at any time after the operator submits the natural gas management plan and before the well is spud:

(a) the operator becomes aware that the natural gas gathering system it planned to connect the well to has become unavailable or will not have capacity to transport one hundred percent of the production from the well, no later than 20 days after becoming aware of such information, the operator shall submit for the division's approval a new or revised venting and flaring plan containing the information specified in Paragraph (4) of Subsection D of 19.15.27.9 NMAC; and

(b) the operator becomes aware that it has become out of compliance with the statewide natural gas capture requirements, no later than 20 days after becoming aware of such information, the operator shall submit for the division's approval a new or revised natural gas management plan containing the information specified in Paragraph (2) of Subsection D of 19.15.27.9 NMAC.

(7) If the operator does not make a certification of compliance with its statewide gas capture requirements, the division shall deny the APD.

~~(7)~~(8) ~~or~~ If the operator fails to submit an adequate venting and flaring plan that provides for alternative uses for one hundred percent of the anticipated volume of natural gas produced on the date of first production from the well, or if the division determines that the operator will not have adequate natural gas takeaway capacity at the time a well will be spud, the division ~~may~~shall:

(a) deny the APD; or

(b) ~~conditionally~~ approve the APD with conditions sufficient to ensure that one hundred percent of the anticipated volume of natural gas produced on the date of first production from the well will be transported through a natural gas gathering system or will be used for one or more of the alternative uses identified in 19.15.27.9.D.5. [19.15.27.9 NMAC – N, xx/xx/xxxx]

TITLE 19 NATURAL RESOURCES AND WILDLIFE
CHAPTER 15 OIL AND GAS
PART 28 NATURAL GAS GATHERING SYSTEMS

19.15.28.1 ISSUING AGENCY: Oil Conservation Commission.
[19.15.28.1 NMAC – N, xx/xx/xxxx]

19.15.28.2 SCOPE: 19.15.28 NMAC applies to persons engaged in oil and natural gas gathering and processing within New Mexico.
[19.15.28.2 NMAC – N, xx/xx/xxxx]

19.15.28.3 STATUTORY AUTHORITY: 19.15.28 NMAC is adopted pursuant to the Oil and Gas Act, Section 70-2-6, Section 70-2-11 and Section 70-2-12 NMSA 1978.
[19.15.27.3 NMAC – N, xx/xx/xxxx]

19.15.28.4 DURATION: Permanent.
[19.15.27.4 NMAC – N, xx/xx/xxxx]

19.15.28.5 EFFECTIVE DATE: {Date}, unless a later date is cited at the end of a section.
[19.15.28.5 NMAC – N, xx/xx/xxxx]

19.15.28.6 OBJECTIVE: To regulate the venting and flaring of natural gas from natural gas gathering systems to prevent waste and, public health and the environment.
[19.15.28.6 NMAC – N, xx/xx/xxxx]

19.15.28.7 DEFINITIONS: Terms shall have the meaning specified in 19.15.2 NMAC except as specified below.

A. "ALARM" means advanced leak and repair monitoring technology for detecting natural gas or oil leaks or releases that is not required by applicable state or federal law, rule, or regulation, and which the division has approved as eligible to earn a credit against the reported volume of lost natural gas pursuant to Paragraph (3) of Subsection B of 19.15.28.10 NMAC.

B. "AVO" means audio, visual and olfactory.

C. "Custody transfer point" means the transfer of natural gas from upstream separation, processing or treatment to a pipeline or any other form of transportation.

D. "Emergency" means a temporary, infrequent, and unavoidable event in which the loss of natural gas is uncontrollable or necessary to avoid a risk of an immediate and substantial adverse impact on safety, public health or the environment, but does not include an event arising from or related to:

(1) the operator's failure to install appropriate equipment of sufficient capacity to accommodate the anticipated or actual rate and pressure of the natural gas gathering system;

(2) the operator's failure to limit the gathering of natural gas when the volume of natural gas exceeds the capacity of the natural gas gathering system;

(3) scheduled maintenance;

(4) unscheduled maintenance or a malfunction that results in venting or flaring of natural gas by an upstream operator;

(5) the operator's negligence, including a recurring equipment failure; or

(6) three or more emergencies experienced by the operator within the preceding 60 days, unless the division determines the operator could not have reasonably anticipated the current event and it was beyond the operator's control.

E. "Flare" or "Flaring" means the controlled combustion of natural gas in a device designed for that purpose.

F. "Flare stack" means an appropriately designed stack equipped with a burner used for the combustion and disposal of natural gas.

G. "Gathering pipeline" means a pipeline that gathers natural gas from the custody transfer point to the connection point with a natural gas processing plant or a transmission or distribution system.

H. "GIS" means geographic information system.

I. "GPS" means global positioning system.

J. **"Malfunction"** means a sudden, unavoidable failure or breakdown of equipment beyond the reasonable control of the operator that substantially disrupts operations and requires correction, but does not include a failure or breakdown that is caused entirely or in part by poor maintenance, careless operation, or other preventable equipment failure or breakdown.

K. **"Natural gas"** means a gaseous mixture of hydrocarbon compounds, primarily composed of methane, and includes both casinghead gas and gas as those terms are defined in 19.15.2 NMAC.

L. **"Natural gas gathering system"** means the gathering pipelines and associated facilities that compress, dehydrate or treat natural gas from the custody transfer point to the connection point with a natural gas processing plant or transmission or distribution system.

M. **"New gathering pipeline"** means a gathering pipeline placed into service after {effective date of rule}.

N. **"Vent" or "Venting"** means the release of uncombusted natural gas to the atmosphere. [19.15.28.7 NMAC – N, xx/xx/xxxx]

19.15.28.8 VENTING AND FLARING OF NATURAL GAS:

A. Venting and flaring of natural gas from a natural gas gathering system constitutes waste and is prohibited except as authorized in Subsection B of 19.15.28.8 NMAC. The operator has a general duty to maximize the gathering of natural gas and to minimize the release of natural gas to the atmosphere. The operator shall flare rather than vent natural gas except when flaring is not technically feasible or would pose a risk to safe operations or personnel safety and venting is a safer alternative than flaring.

B. The operator shall not flare or vent natural gas except:

(1) to the extent authorized by a valid federally enforceable air quality permit issued by the New Mexico environment department;

(2) during an emergency or malfunction, but only to avoid a risk of an immediate and substantial adverse impact on safety, public health, or the environment. The operator shall report natural gas vented or flared during an emergency or malfunction to the division pursuant to Paragraph (1) of Subsection F of 19.15.28.8 NMAC; or

(3) during the following activities unless prohibited by applicable state and federal law, rule, or regulation for the emission of hydrocarbons and volatile organic compounds:

(a) scheduled repair and maintenance, including blowing down and depressurizing equipment to perform repair or maintenance, but only where the gas cannot be rerouted back into the pipeline outside of the depressurized zone or otherwise beneficially used;

(b) normal operation of a gas-activated pneumatic controller or pump;

(c) normal operation of a dehydration unit;

(d) normal operation of a compressor or compressor engine;

(e) normal operation of a storage tank or other low-pressure production vessel, but not including venting from a thief hatch that is not fully and timely closed or from a seal that is not maintained on an established schedule;

(f) gauging or sampling a storage tank or other low-pressure vessel;

(g) loading out liquids from a storage tank or other low-pressure vessel to a transport vehicle;

(h) blowdown to repair a gathering pipeline, but only where the gas cannot be rerouted back into the pipeline outside of the depressurized zone or otherwise beneficially used;~~;~~

(i) pigging a gathering pipeline; or

(j) purging a gathering pipeline

provided, all venting occurs in compliance with the requirement to flare rather than vent in section 19.15.28.8.A. and all flaring is conducted using a flare stack that is properly sized, equipped with an automatic igniter, and has a destruction removal efficiency of at least 98%.

C. Performance standards.

(1) The operator shall take all reasonable actions to prevent and minimize leaks and releases of natural gas from a natural gas gathering system and shall implement an operations plan to minimize the waste of natural gas for each non-contiguous natural gas gathering system. The plan should include procedures to reduce leaks and releases, such as a routine maintenance program, cathodic protection, corrosion control, liquids management and integrity management. The operator shall file its operations plan with the division:

(a) for a natural gas gathering system placed into service after [effective date of rule], within 60 days following the date the natural gas gathering system is placed into service;

(b) for a natural gas gathering system in place on or before {effective date of rules}, within 90 days following {the effective date of these rules}; and

(c) for a natural gas gathering system to which the operator added a new gathering pipeline during the calendar year or changed the operations plan, an updated operations plan no later than March 31 of the following year.

(2) During scheduled maintenance, replacement, or repair of a new or existing natural gas gathering system, the operator shall not vent natural gas during blowdown and shall reroute the gas back into the pipeline outside of the depressurized zone or otherwise beneficially use the gas, or where neither such action is practicable, route natural gas to a portable flare stack ~~which~~ that complies with the flare stack standards, inspection, and recordkeeping requirements in Subsection E of 19.15.27.8 NMAC.

(3) During unscheduled maintenance, replacement or repair of a new or existing natural gas gathering system, to the extent that it is technically feasible and would not pose a risk to safe operations or personnel safety, the operator shall not vent route natural gas during blowdown and shall reroute the gas back into the pipeline outside of the depressurized zone, otherwise beneficially use the gas, or route natural gas to a portable flare stack ~~which~~ that complies with the flare stack standards, inspection and recordkeeping in Subsection E of 19.15.27.8 NMAC.

(4) The operator shall conduct a weekly AVO inspection of the compressors, dehydrators and treatment facilities associated with a natural gas gathering system to confirm those components are operating properly and there are no leaks or releases except as allowed in Subsection B of 19.15.28.8 NMAC.

(a) During an AVO inspection the operator shall inspect all components, including flare stacks, thief hatches, closed vent systems, pumps, compressors, pressure relief devices, valves, lines, flanges, connectors, and associated piping to identify defects, leaks, and releases by:

(i) visually inspecting for cracks and hole; loose connections; leaks; broken and missing caps; broken, damaged seals and gaskets; broken, missing and open hatches; and broken, missing and open access covers and closure devices; and to ensure a flare stack is operating in conformance with its design;

(ii) listening for pressure and liquid leaks; and

(iii) smelling for unusual and strong odors.

(b) The operator shall make and keep a record of an AVO inspection for no less than five years and make such records available for inspection by the division upon request.

(c) Subject to the division's prior written approval, the operator may use a remote or automated monitoring technology to detect leaks and releases in lieu of an AVO inspection.

(5) The operator shall perform an annual instrument monitoring of the entire length of a gathering pipeline using an AVO technique, ALARM technology or other valid method to detect leaks and releases. The operator shall record and report to the division the date and time of the monitoring, the method and technology used and the name of the employee(s) who conducted the monitoring. If the operator uses ALARM technology to detect and isolate a leak or release within 48 hours of discovery and repair the leak or release within 15 days of discovery, the operator may obtain a credit against its reported volume of lost natural gas pursuant to Paragraph (4) of Subsection B of 19.15.28.10 NMAC.

D. Reporting to affected upstream operators.

(1) No less than 14 days prior to the date of scheduled maintenance, replacement or repair of a natural gas gathering system, the operator shall provide written notification to each upstream operator whose natural gas is gathered by the system of the date and expected duration that the system will not gather natural gas.

(2) As soon as possible but no more than 24 hours after discovery of the need for unscheduled maintenance, replacement or repair of a natural gas gathering system, the operator shall provide written notification to each upstream operator whose natural gas is gathered by the system of the date and expected duration that the system will not gather natural gas.

(3) The operator shall make and keep a record of each notification for no less than five years and make such records available for inspection by the division upon request.

E. Measurement of vented and flared natural gas.

(1) The operator shall measure the volume of natural gas that it vents, flares or beneficially uses regardless of the reason or authorization for such venting or flaring.

(2) The operator shall install equipment to measure the volume of natural gas vented or flared from a natural gas gathering system.

(3) Measuring equipment shall be an orifice meter or other measurement device or technology such as a thermal mass or ultrasonic flow meter approved by the division that, at the time of installation, complies with the accuracy ratings and design standards for the measurement of natural gas, such as the American petroleum institute, international organization for standards, or American gas association.

(4) Measuring equipment shall not be designed or equipped with a manifold that allows the diversion of natural gas around the metering element except for the sole purpose of inspecting and servicing the measuring equipment.

(5) For an event for which metering is not practicable, such as low pressure venting and flaring, the operator shall estimate the volume of vented or flared natural gas.

F. Reporting of vented and flared natural gas.

(1) Venting or flaring caused by emergency or malfunction ~~or of long duration~~.

(a) The operator shall notify the division of venting or flaring that exceeds 50 MCF in volume and either results from an emergency or malfunction or lasts eight hours or more cumulatively within any 24-hour period by filing a form C-129 with the division as follows:

(i) for venting or flaring that equals or exceeds 50 MCF but is less than 500 MCF, notify the appropriate division district office in writing by filing a form C-129 no later than 15 days following discovery or commencement of venting or flaring; or

(ii) for venting or flaring that equals or exceeds 500 MCF or otherwise qualifies as a major release as defined in 19.15.29.7 NMAC, notify the appropriate division district office verbally or by e-mail as soon as possible and no later than 24 hours following discovery or commencement of venting or flaring and provide the information required in form C-129. No later than 15 days following the discovery or commencement of venting or flaring, the operator shall file a form C-129 that verifies, updates, or corrects the verbal or e-mail notification;

(iii) for venting or flaring that qualifies as a major release as defined in 19.15.29.7.A(2)(a), (c) and (d), the operator shall use best efforts to notify all members of the public whose health, safety or property are endangered; and

~~(ii)~~(iv) no later than 15 days following the termination of venting or flaring, notify the appropriate division district office by filing a form C-129.

(b) The operator shall provide and certify the accuracy of the following information in the form C-129:

(i) operator's name;
(ii) name and type of facility;
(iii) equipment involved;
(iv) compositional analysis of vented or flared natural gas;
(v) date(s) and time(s) that venting or flaring was discovered or commenced and terminated.
(vi) measured or estimated volume of vented or flared natural gas;
(vii) cause and nature of venting or flaring, as identified in the venting and flaring categories set forth in Subsection B, Paragraph (3) of 19.15.28.8 NMAC;
(viii) steps taken to limit the duration and magnitude of venting or flaring; and
(ix) corrective actions taken to eliminate the cause and recurrence of venting and flaring.

(c) At the division's request, the operator shall provide and certify additional information by the specified date.

(d) The operator shall file a form C-141 instead of a form C-129 for the release of a liquid during venting or flaring that is or may be a major or minor release under 19.15.29.7 NMAC.

(2) Monthly reporting of vented and flared natural gas. The operator shall separately report the volume of vented natural gas and the volume of flared natural gas for each month in each category listed below. Beginning June 2021, the operator shall submit quarterly reports in a format specified by the division. Beginning January 2022, the operator shall submit a form C-115B monthly on or before the 15th day of the second month following the month in which it vented or flared natural gas. The operator shall specify whether it estimated or measured each reported volume. In filing the initial report, the operator shall provide the methodology, formulas, and parameters (measured or estimated using calculations and industry standard factors) used to report the volumes on the form, and shall report changes in the methodology on future forms. The operator shall make and keep records of the measurements and estimates, including records showing how it calculated the estimates, for no less than five years and make such records available for inspection by the division upon request. The categories are:

(a) emergency;
(b) non-scheduled maintenance and malfunction;
(c) routine repair and maintenance, including blowdown and depressurization;
(d) beneficial use, including pilot and purge gas, fired equipment and engines;
(e) gathering pipeline blowdown and purging;
(f) gathering pipeline pigging;
~~(g)~~ uncontrolled storage tanks;
~~(g)~~(h) controlled storage tanks;
~~(h)~~(i) venting as a result of normal operation of pneumatic controllers and pumps;

~~(i)~~(j) ___improperly closed or maintained thief hatches from storage tanks that are routed to a flare or control device; and

~~(j)~~(k) ___other not described above.

(3) The operator shall report the lost natural gas for each month on a volumetric and percentage basis on form C-115B.

(a) To calculate the lost natural gas on a volumetric basis, the operator shall deduct the volume of natural gas used for beneficial use, vented or flared during an emergency and ALARM credits authorized by Paragraphs (5) and (6) of Subpart B of 19.15.28.10 NMAC, from the volume of natural gas reported on its form C-115B for the calendar year.

(b) To calculate the lost natural gas on a percentage basis, the operator shall deduct the volume of natural gas reported on its form C-115B for the calendar year, but not including the volume of natural gas used for beneficial use, vented or flared during an emergency and ALARM credits authorized by Paragraphs (5) and (6) of Subpart B of 19.15.28.10 NMAC, from the total volume of natural gas gathered, and divide by the total volume of natural gas gathered.

(4) Upon request by the division, the operator, at its own expense, shall retain a third-party approved by the division to verify any data or information collected or reported pursuant to Subsections E and F of 19.15.28.8 NMAC and make recommendations to correct or improve the collection and reporting of data and information, submit a report of the verification and recommendations to the division by the specified date, and implement the recommendations in the manner approved by the division.

(5) Upon the New Mexico environment department's request, the operator shall promptly provide a copy of any form filed pursuant to 19.15.28 NMAC.

[19.15.28.8 NMAC – N, xx/xx/xxxx]

19.15.28.9 LOCATION REQUIREMENTS:

A. The operator shall file with the division a GIS digitally formatted as-built map:

(1) for a new gathering pipeline or natural gas gathering system, no later than 90 days after placing the gathering pipeline or system into service;

(2) for an existing gathering pipeline or natural gas gathering system, no later than May 31, 2021; and

(3) for an addition to an existing gathering pipeline or natural gas gathering system, no later than 90 days after placing the addition into service.

B. To ensure proper field identification of a gathering pipeline in an emergency, the as-built map shall include a layer which identifies the pipeline size and construction material type.

C. No later than May 31 of each year, the operator shall file with the division an updated GIS digitally formatted as-built map of its gathering pipeline or natural gas gathering system, which shall include a GIS layer that identifies the date, location and volume of vented or flared natural gas of each emergency, malfunction and release reported to the division since 19.15.28 NMAC became applicable to the pipeline or system.

C. An operator may assert confidentiality for the GIS digitally formatted as-built map and GIS layer, which the division will review pursuant to Section 71-2-8 NMSA 1978.

[19.15.28.9 NMAC – N, xx/xx/xxxx]

19.15.28.10 STATEWIDE NATURAL GAS CAPTURE REQUIREMENTS:

A. Statewide natural gas capture requirements. Commencing January 1, 2022, the operator of a natural gas gathering system shall reduce the annual volume of vented and flared natural gas in order to capture ninety-eight percent of the natural gas gathered in each of two reporting areas, one north and one south of the Township 10 North line, by December 31, 2026. The division shall calculate and publish each operator's baseline gas capture rate based on the operator's 2021 monthly data reported on form C-115B for each reporting area in which the operator has a natural gas gathering system. In each calendar year between January 1, 2022 and December 31, 2026, the operator shall increase the percentage of natural gas captured in each reporting area in which it operates based on the following formula: (2021 baseline loss rate minus two percent) divided by five.

(1) The following table provides examples of the formula based on a range of baseline natural gas capture rates.

Baseline Natural Gas Capture Rate	Minimum Required Annual Natural Gas Capture Percentage Increase
90-98%	0-1.6%
80-89%	>1.6-3.6%

70-79%	>3.6-5.6%
0-69%	>5.6-19.6%

(2) If the operator's baseline capture rate is less than sixty percent, the operator shall submit by the specified date to the division for approval, a plan to meet the minimum required annual capture percentage increase.

(3) An operator that acquires a natural gas gathering system from another operator shall comply with ~~its~~ the statewide natural gas capture requirements ~~for~~ that applied to the acquired system ~~no later than December 1, 2026, unless the division approves a later date~~ under Paragraph (1) of Subsection A. of 19.15.28.8 NMAC prior to its acquisition.

B. Accounting. No later than February 15 each year beginning in 2022, the operator shall submit a report certifying compliance with its statewide gas capture requirements. The operator's volume of vented and flared natural gas shall be counted as lost natural gas and excluded from the volume of natural gas gathered or used for beneficial use in the calculation of its statewide natural gas capture requirements, except that:

(1) the operator may exclude from the volume of gathered natural gas the volume of vented and flared natural gas pursuant to Subparagraph (a) of Paragraph (2) of Subsection F of 19.15.28.8 NMAC for which the operator timely filed, and the division approved, a form C-129; and

(2) the operator may exclude from the volume of gathered natural gas the volume of natural gas reported as a beneficial use pursuant to Subparagraphs (d) or (h) of Paragraph (2) of Subsection F of 19.15.28.8 NMAC, provided that the operator identifies the volume of vented natural gas, the reason that the operator vented the natural gas rather than capturing it and any other relevant information requested by the division; and

(3) an operator that used a division-approved ALARM technology to monitor for leaks and releases may obtain a credit against the volume of lost natural gas if it discovered the leak or release using the ALARM technology, and the operator:

(a) isolated the leak or release within 48 hours following field verification;

(b) repaired the leak or release within 15 days or another date approved by the division;

(c) timely notified the division by filing a form C-129 or form C-141;

(d) timely reported the volume of natural gas leaked or released on form C-115 as an ALARM event pursuant to Subparagraph (n) of Paragraph (2) of Subsection F of 19.15.28.8 NMAC; and

(e) used ALARM monitoring technology as a routine and on-going aspect of its waste-reduction practices.

(i) For discrete waste-reduction practices such as aerial methane monitoring, the operator must use the technology at least twice per year; and

(ii) for waste-reduction practices such as automated emissions monitoring systems that operate routinely or continuously, the division will determine the required frequency of use.

(4) An operator may file an application with the division for a credit against its volume of lost natural gas that identifies:

(a) the ALARM technology used to discover the leak or release;

(b) the dates on which the leak or release was discovered, field-verified, isolated, and repaired;

(c) the method used to measure or estimate the volume of natural gas leaked or released;

(d) a description and the date of each action taken to isolate and repair the leak or release;

(e) visual documentation or other verification of discovery, isolation, and repair of the leak or release;

(f) a certification that the operator did not know or have reason to know of the leak or release before discovery using ALARM technology; and

(g) a description of how the operator used ALARM technology as a routine and on-going aspect of its waste-reduction practices.

(5) For each leak or release reported by an operator that meets the requirements of Paragraphs (3) and (4) of Subsection B of 29.15.28.10 NMAC, the division, in its sole discretion, may approve a credit that the operator can apply against its reported volume of lost natural gas as follows:

(a) a credit of forty percent of the volume of natural gas discovered and isolated within 48 hours of discovery and timely repaired; and

(b) an additional credit of twenty percent if the operator used ALARM technology no less than once per calendar quarter as a routine and on-going aspect of its waste-reduction practices.

(6) A division-approved ALARM credit shall:

(a) be used only by the operator who submitted the application pursuant to Paragraph (4) of Subsection B of 29.15.28.10 NMAC;

(b) not be transferred to or used by another operator, including a parent, subsidiary, related entity or person acquiring the natural gas gathering system;

(c) be used only once; and

(d) expire 24 months after division approval.

C. Third-party verification. Upon request by the division, the operator, at its own expense, shall retain a third-party approved by the division to verify any data or information collected or reported pursuant to Subsections E and F of 19.15.28.8 NMAC and make recommendations to correct or improve the collection and reporting of data and information, submit a report of the verification and recommendations to the division by the specified date, and implement the recommendations in the manner approved by the division.

[19.15.28.10 NMAC – N, xx/xx/xxxx]

Brenda Ekwurzel, Ph.D.

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OVERVIEW

Director of climate science for the Climate & Energy Program at the Union of Concerned Scientists (UCS). In her role, she ensures that program analyses reflect robust and relevant climate science. The program currently has over fifty staff with three major campaigns. Two of which she is most involved with and periodically supports the third campaign and has co-lead special projects across campaigns. She served as co-author of the fourth National Climate Assessment (NCA4), *29: Reducing Risks Through Emissions Mitigation.* She presents frequently to a range of audiences on climate science, educating the public on practical, achievable solutions for climate change. Publication topics include climate attribution, climate variability and wildfire, isotopic dating of groundwater, Arctic Ocean tracer oceanography, paleohydrology, coastal sediment erosion and climate science communication. Expert testimony before state legislatures and the US Congress. Media spokesperson in print, online, radio and TV including CNN, Fox News Channel, The Colbert Report, New York Times, MSNBC, Washington Post, and USA Today.

HONORS, AWARDS, ELECTED ROLES, AND SELECT APPOINTMENTS

2018	Recognized for top downloaded climate article in Springer Climate Journals
2016	Named an American Association for the Advancement of Science (AAAS) fellow cited for her "distinguished contributions to analysis and outreach aimed at strengthening support for sound U.S. climate policies, and making the science of climate change accessible to diverse audiences."
2015-2016	U.S. National Research Council's "Arctic Matters" Symposium, Committee appointment
2012-2015	Elected as a member of the Electorate Nominating Committee (ENC) for the American Association for the Advancement of Science (AAAS) Section on Geology & Geography
2007	Hitchon Award of the International Association of GeoChemistry (IAGC) recognizes the most significant paper published in 2006 in the IAGC journal *Applied Geochemistry*.
2003	Excellence at the Student Interface – College of Engineering and Mines, University of Arizona – chosen by the graduate students of the department of Hydrology and Water Resources in recognition of excellence in teaching and student guidance.
2000	Achievement Award for Leadership, Lawrence Livermore National Laboratory Chemistry and Materials Science Directorate
1998	Award for Arctic Research Excellence, Arctic Research Consortium of the United States (ARCUS) (4 awarded that year)
1997	DISCO XIV, Dissertations Symposium on Chemical Oceanography, sponsored by NSF, ONR, and NOAA, (25 honored that year)
1995	Sigma Xi, inducted into the national scientific research society, Columbia University
1992	S. F. Langer Prize, Department of Earth and Environmental Sciences, Columbia University
1985	Phi Beta Kappa, inducted into the national honor society, Smith College
1985	*Cum Laude*, Smith College

EDUCATION

1998	Ph.D. Geochemistry, Lamont-Doherty Earth Observatory of Columbia University, NY
1988	M.S. Geology, Rutgers University, New Jersey
1985	B.A. Geology, Smith College, Massachusetts

EMPLOYMENT

2016-Present	Director of Climate Science, UCS DC
2013-2016	Climate Analytics Lead, Senior Scientist, UCS, DC
2010-2012	Assistant Director of Climate Research & Analysis, UCS, DC
2004-2010	Climate Scientist, Union of Concerned Scientists, Washington, DC
2001-2004	Assistant Professor, Joint Faculty Appt., Geosciences, University of Arizona
2000-2004	Assistant Professor, Hydrology and Water Resources, University of Arizona
1998-2000	Post Doctoral Researcher, Lawrence Livermore National Laboratory, California
1990-1997	Research/Teaching Assistant, Columbia University, New York
1988-1990	Hydrologist, Connecticut Department of Environmental Protection, Connecticut
1985-1987	Research/Teaching Assistant, Rutgers University, New Jersey

PUBLICATIONS

Book

Cooler Smarter: Practical Steps for Low-Carbon Living, Seth Shulman, Jeff Deyette, Brenda Ekwurzel, David [illegible] Mellon, John Rogers and Suzanne Shaw, published by Island Press, Washington DC, 1st edition (Ap
ISBN 13 9781610911924

CA

EX. 2

Peer-reviewed Publications (* *Denotes graduate students under direct supervision.)*

Licker, R., B. Ekwurzel, S.C. Doney, S.R. Cooley, I.D. Lima, R. Heede and P.C. Frumhoff, 2019: Attributing ocean acidification to major carbon producers. *Environmental Research Letters*, **14** (12) doi.org/10.1088/1748-9326/ab5abc

Martinich, J., B.J. DeAngelo, D. Diaz, B. Ekwurzel, G. Franco, C. Frisch, J. McFarland, and B. O'Neill, 2018. Reducing Risks Through Emissions Mitigation. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA. doi: 10.7930/NCA4.2018.CH29. **Recognized for 2018 highest number of downloads of Springer Climate Journals**

White-Newsome J.L, B. Ekwurzel, M. Baer-Schultz, K.L. Ebi, M.S. O'Neill, and G.B. Anderson (2014) Survey of county-level heat preparedness and response to the 2011 summer heat in 30 U.S. States, *Environmental Health Perspectives* **122**:573–579; http://dx.doi.org/10.1289/ehp.1306693

Ekwurzel B., P.C. Frumhoff, and J.J. McCarthy (2011) Climate uncertainties and their discontents: increasing the impact of assessments on public understanding of climate risks and choices, *Climatic Change*, **108**:791-802, DOI 10.1007/s10584-011-0194-6.

Desilets*, S.L.E., T.P.A. Ferré, and B. Ekwurzel (2008) Flash flood dynamics and composition in a semiarid mountain watershed, *Water Resources Research*: **44**, W12436, doi:10.1029/2007WR006159.

Wahi*, A.K., J.F. Hogan, B. Ekwurzel, M.N. Baillie, C.J. Eastoe (2008) Geochemical quantification of semiarid mountain recharge, *Ground Water*, doi: 10.1111/j.1745-6584.2007.00413.x

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Baillie*, M. N., J. F. Hogan, B. Ekwurzel, A. K. Wahi, and C. J. Eastoe (2007), Quantifying water sources to a semiarid riparian ecosystem, San Pedro River, Arizona, *J. Geophys. Res.*, **112**, G03S02, doi:10.1029/2006JG000263.

Moore*, K. B., B. Ekwurzel, B. K. Esser, G. B. Hudson, J. E. Moran (2006) Sources of Groundwater Nitrate Revealed Using Residence Time and Isotope Methods, Applied Geochemistry, 21:1016-1029. **Winner of the Hitcheon Award**

Ekwurzel, B. (2005) Role and Importance of Paleohydrology in Study of Climate Change and Variability *in* Encyclopedia of Hydrological Sciences, M. G. Anderson (Editor-in-Chief), J. J. McDonnell (Advisory Editor), S. Sorooshian (Climate Change Section Editor)., John Wiley & Sons, Ltd., pp. 3051-3072.

Van der Loeff, M. R., S. Kühne, M. Wahsner, H. Höltzen, M. Frank, B. Ekwurzel, M. Mensch, and V. Rachold (2003) ^{288}Ra and ^{226}Ra in the Kara and Laptev seas, *Continental Shelf Research*, **23**:113-124.

Schlosser, P., R. Newton, B. Ekwurzel, S. Khatiwala, R. Mortlock, and R. Fairbanks (2002) Decrease of river runoff in the upper waters of the Eurasian Basin, Arctic Ocean, between 1991 and 1996: Evidence from δ^{18}O data, *Geophysal Research Letters*, **29**(9), 10.1029/2001GL013135

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Plummer, L. N., E. Busenberg, S. Drenkard, P. Schlosser, J. B. McConnell, R. L. Michel, B. Ekwurzel, R. Weppernig (1998) Flow of river water into a karstic limestone aquifer --2. Age-dating the young fraction in groundwater mixtures in the Upper Floridan aquifer near Valdosta, Georgia., *Applied Geochemistry*, **13**(8):1017-1043.

Schlosser, P., B. Kromer, B. Ekwurzel, G. Bönisch, A. McNichol, R. Schneider, K. von Reden, H. G. Östlund, J. H. Swift (1997) The first trans-Arctic ^{14}C section: comparison of the mean ages of the deep waters in the Eurasian and Canadian basins of the Arctic Ocean. *Nuclear Instruments and Methods in Physics Research*, **B 123**:431-437.

Schlosser, P., B. Kromer, G. Östlund, B. Ekwurzel, G. Bönisch, H. H. Loosli, and R. Purtschert (1994) On the ^{14}C and ^{39}Ar distribution in the central Arctic Ocean: implications for deep water formation. *Radiocarbon*, **36**(3):327-343.

Ekwurzel, B., P. Schlosser, W. M. Smethie Jr., L. N. Plummer, E. Busenberg, R. L. Michel, R. Weppernig, and M. Stute (1994) Dating of shallow groundwater: Comparison of the transient tracers ^{3}H/^{3}He, chlorofluorocarbons, and ^{85}Kr. *Water Resources Research*, **30**(6):1693-1708.

Ekwurzel, B. (1990) A complex bayside beach: Herring Cove Beach, Cape Cod, Massachusetts, USA. *Journal of Coastal Research*, **6**(4):879-891.

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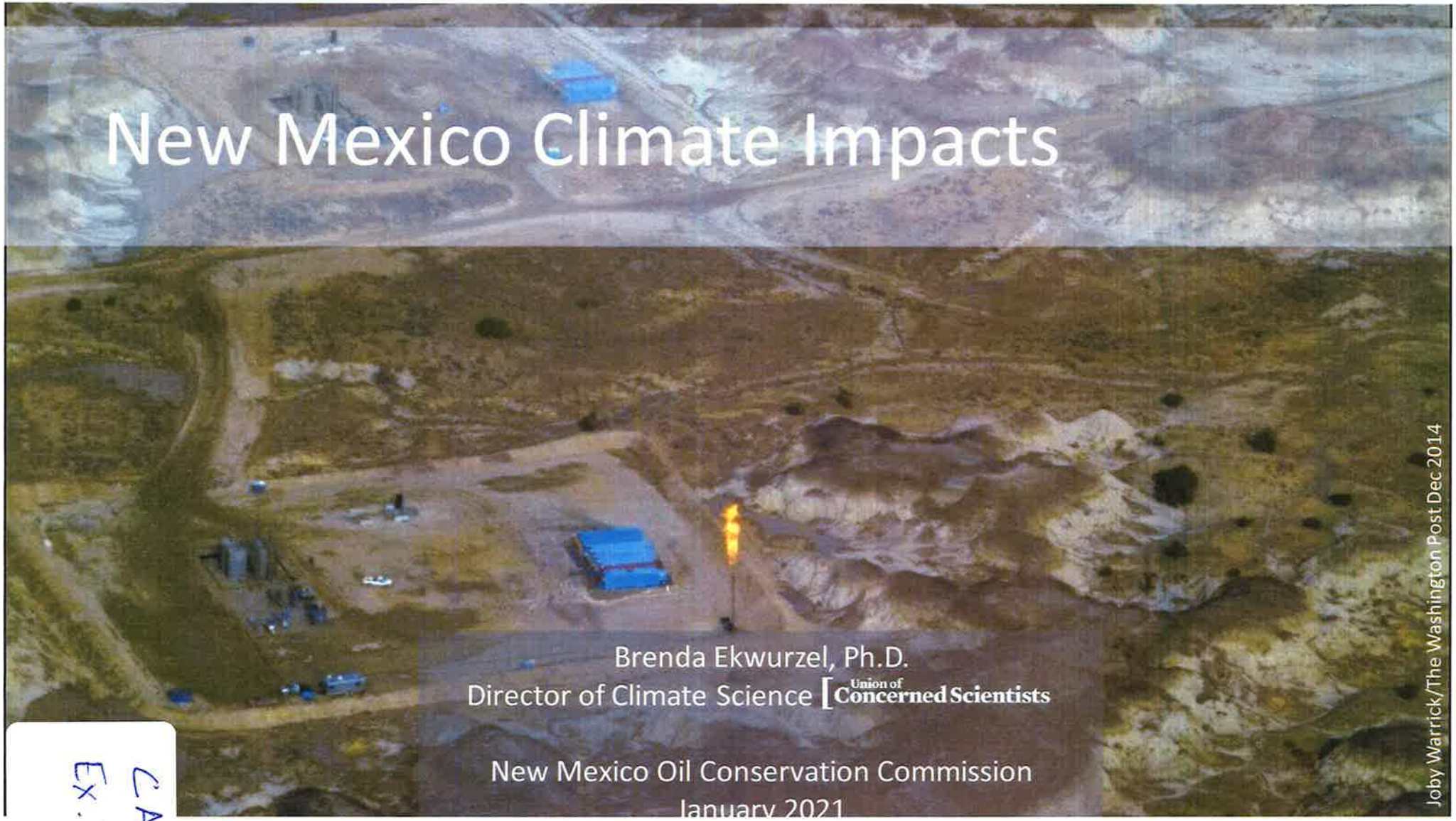
New Mexico Climate Impacts



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Director of Climate Science [Union of Concerned Scientists

New Mexico Oil Conservation Commission
January 2021

Joby Warrick/The Washington Post Dec 2014

CA Ex. 3

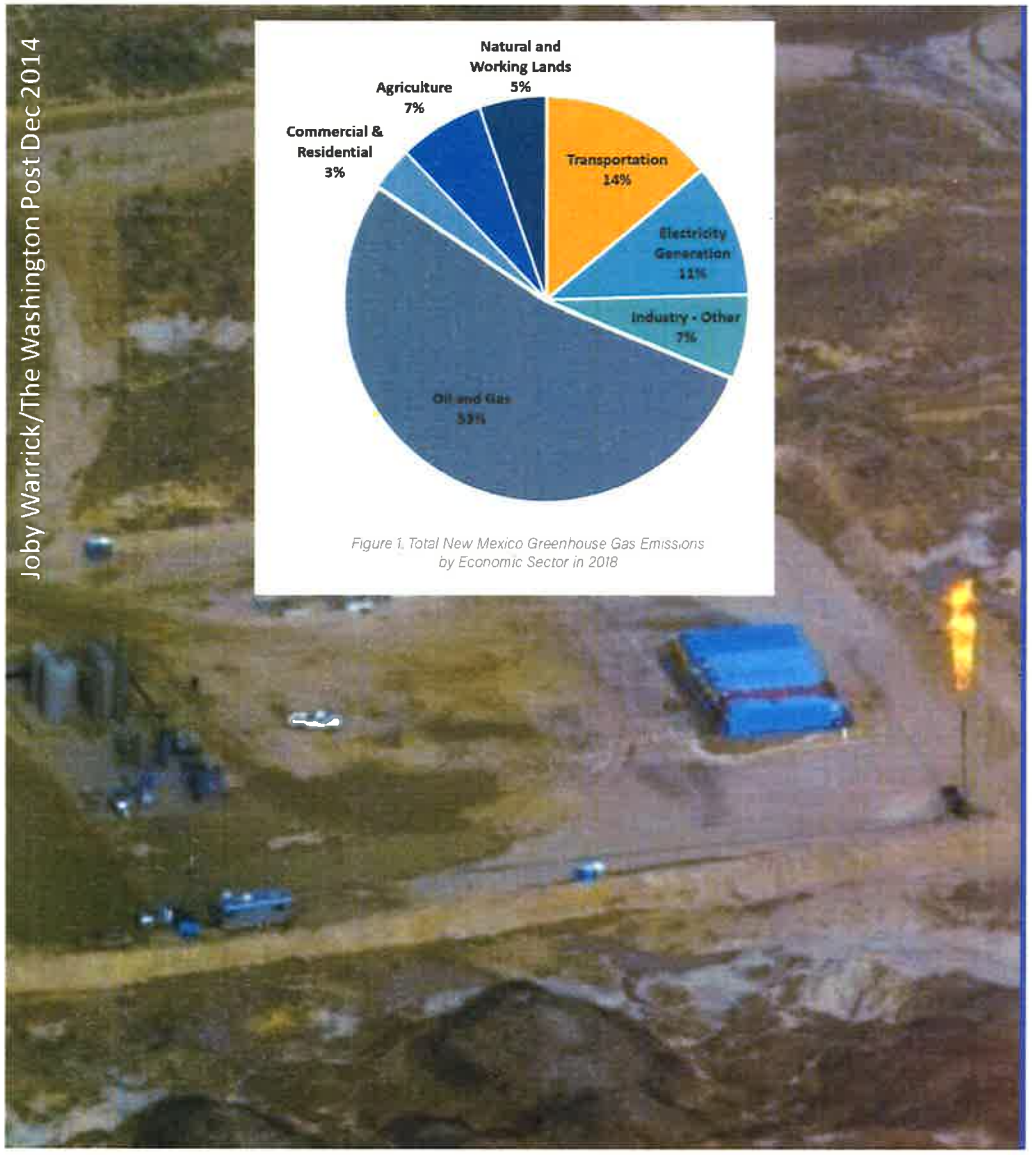


Figure 1. Total New Mexico Greenhouse Gas Emissions by Economic Sector in 2018

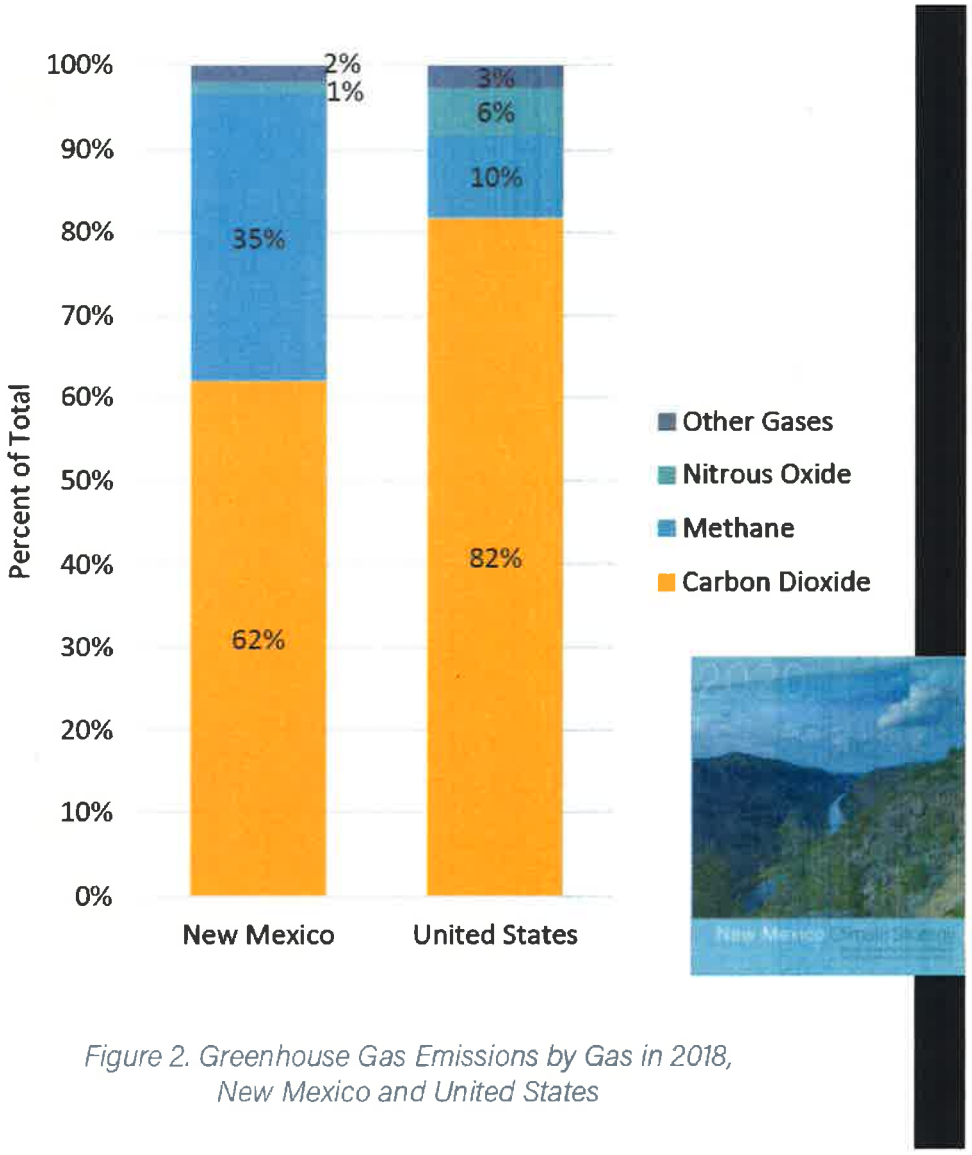
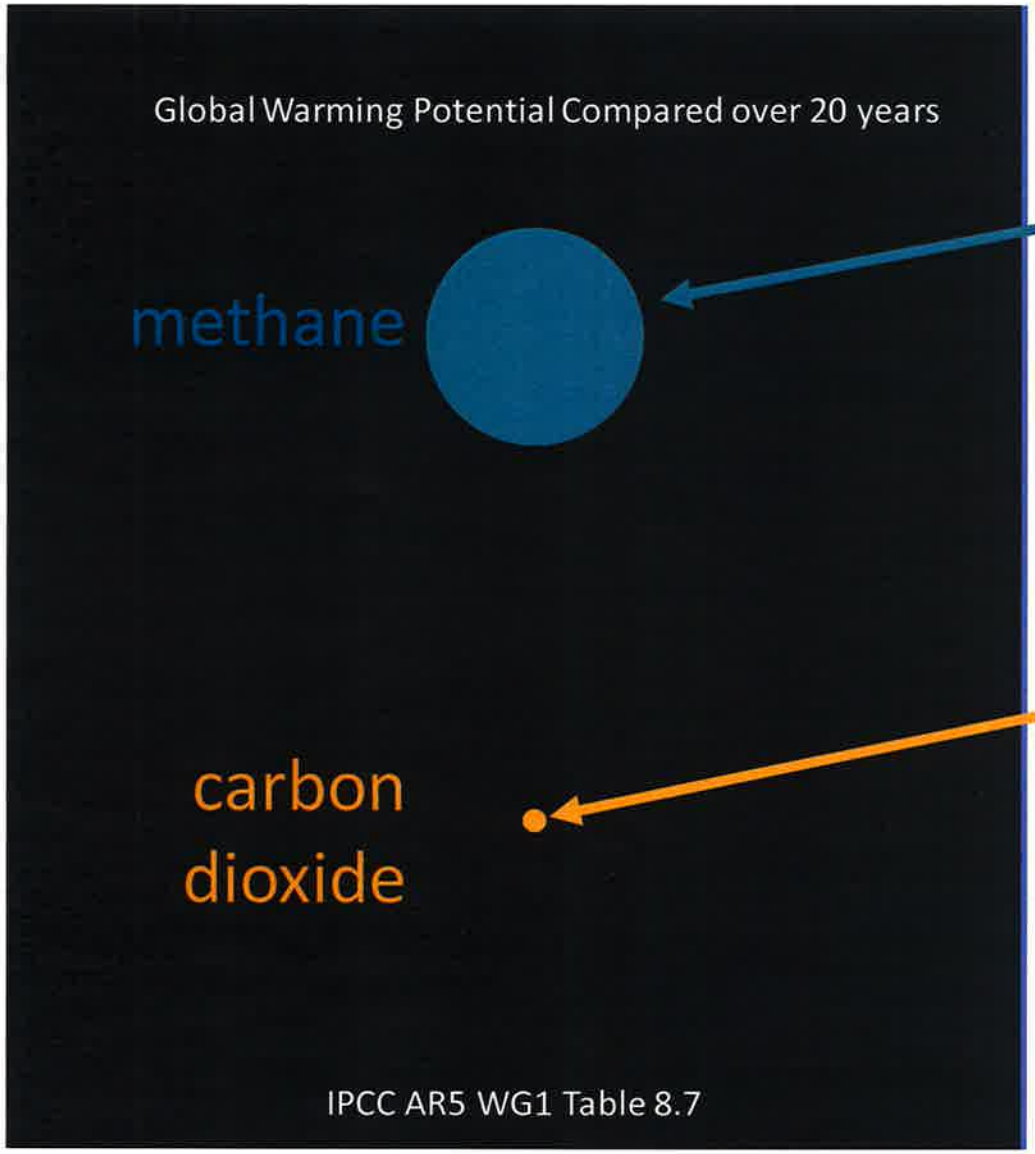


Figure 2. Greenhouse Gas Emissions by Gas in 2018, New Mexico and United States



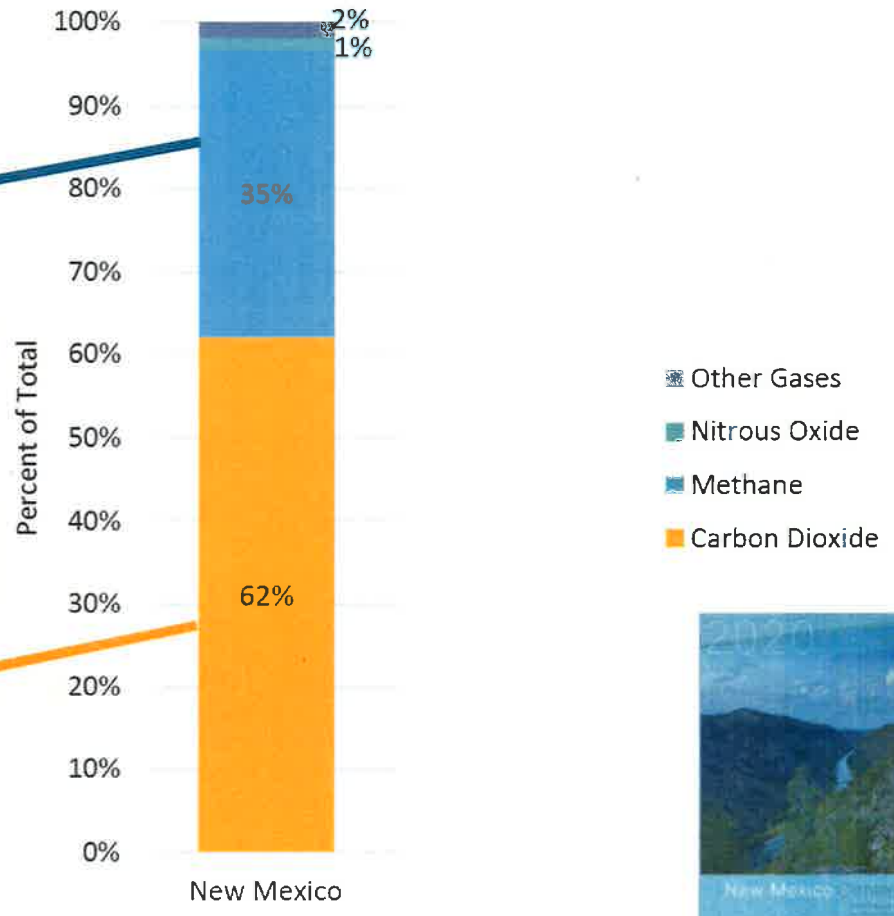


Figure 2. Greenhouse Gas Emissions by Gas in 2018, New Mexico and United States

Difference between 1986–2016 and 1901–1960 average temperature

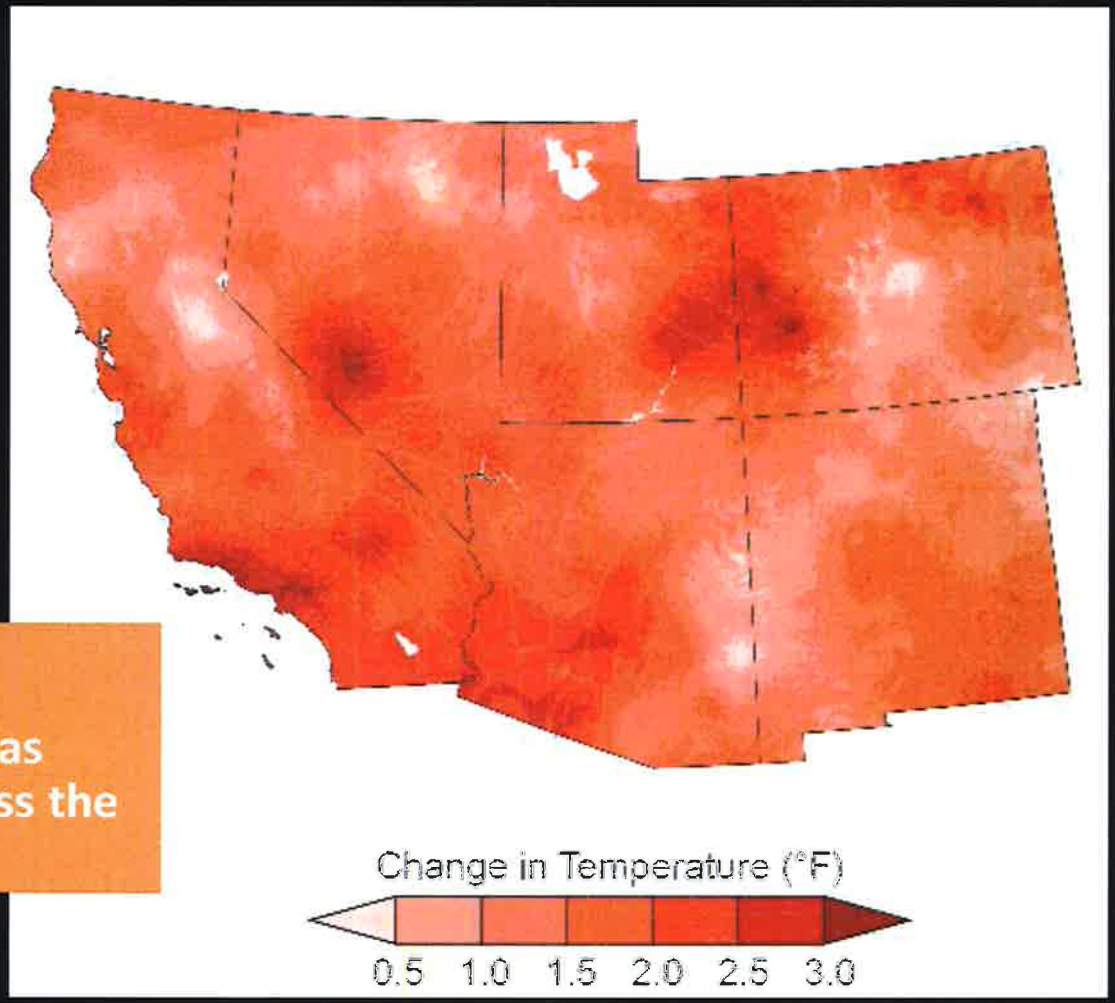


Fig. 25.1: Temperature Has Increased Across the Southwest

https://nca2018.globalchange.gov

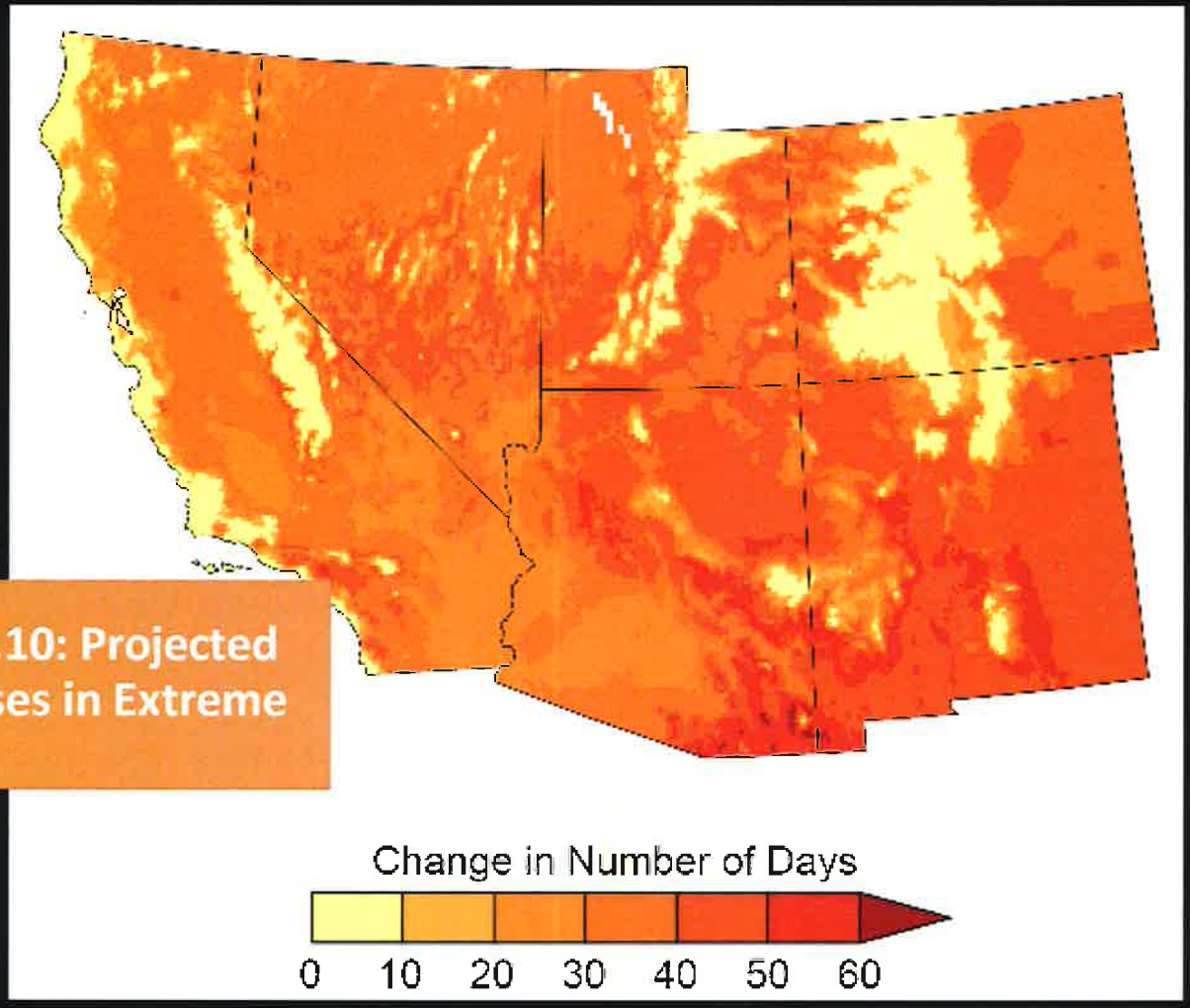
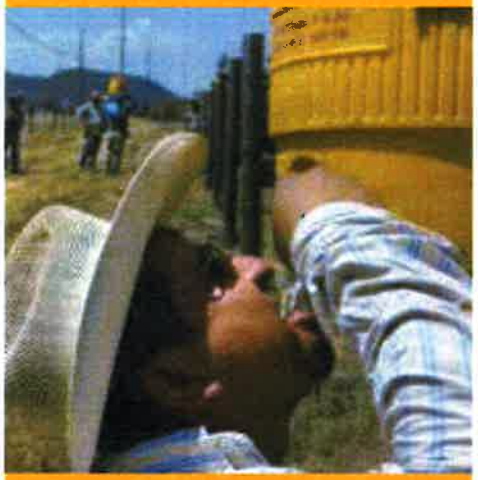


Fig. 25.10: Projected Increases in Extreme Heat

https://nca2018.globalchange.gov

Days per year where the temperature exceeds 90°F by the period 2036–2065, compared to the period 1976–2005 under high emissions scenario RCP8.5

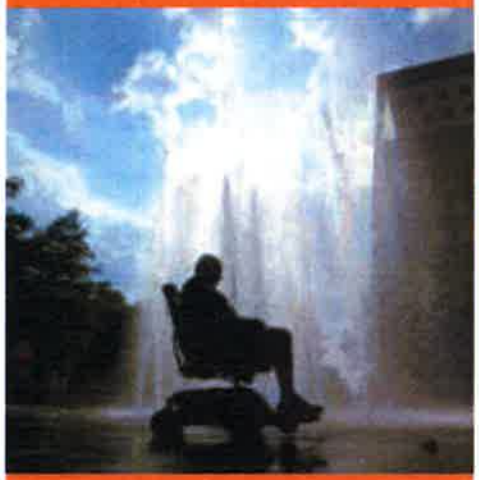
Heat Index Above 90°F



Outdoor workers become more susceptible to heat-related illness.

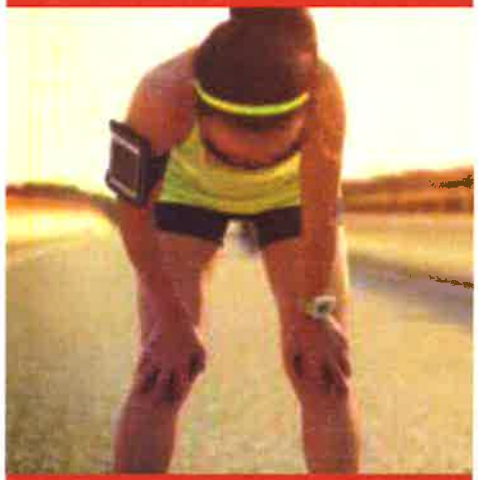
Union of Concerned Scientists

Heat Index Above 100°F



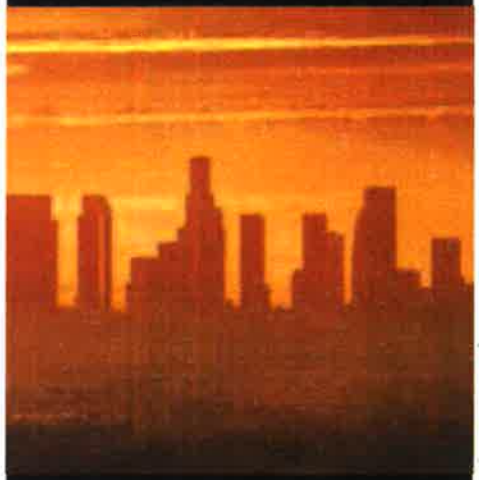
Children, elderly adults, pregnant women, and people with underlying conditions are at heightened risk of heat-related illness.

Heat Index Above 105°F



Anyone could be at risk of heat-related illness or even death as a result of prolonged exposure.

Heat Index Off the Charts



Undetermined: any level of exposure is presumed extremely dangerous for all people and likely to result in heat-related illness or even death.

Left to right: AP Photo/Napa Valley Register, Lianne Milton; AP Photo/Julio Cortez; lzf/iStock; logoboom/Shutterstock

Killer Heat report available at www.ucsusa.org/killer-heat

[redacted]

TYPE IN YOUR LOCATION (CITY OR COUNTY)

Albuquerque, NM

CHOOSE HOW HOT

Above 90°

GO

WHERE WE ARE NOW	WHERE WE ARE CURRENTLY HEADED		WITH BOLD ACTION
Historically	**Midcentury**	Late Century	**Extreme Heat Limited to**
1971-2000 average	2036-2065 average	2070-2099 average	
17	68	105	60
DAYS PER YEAR	DAYS PER YEAR	DAYS PER YEAR	DAYS PER YEAR

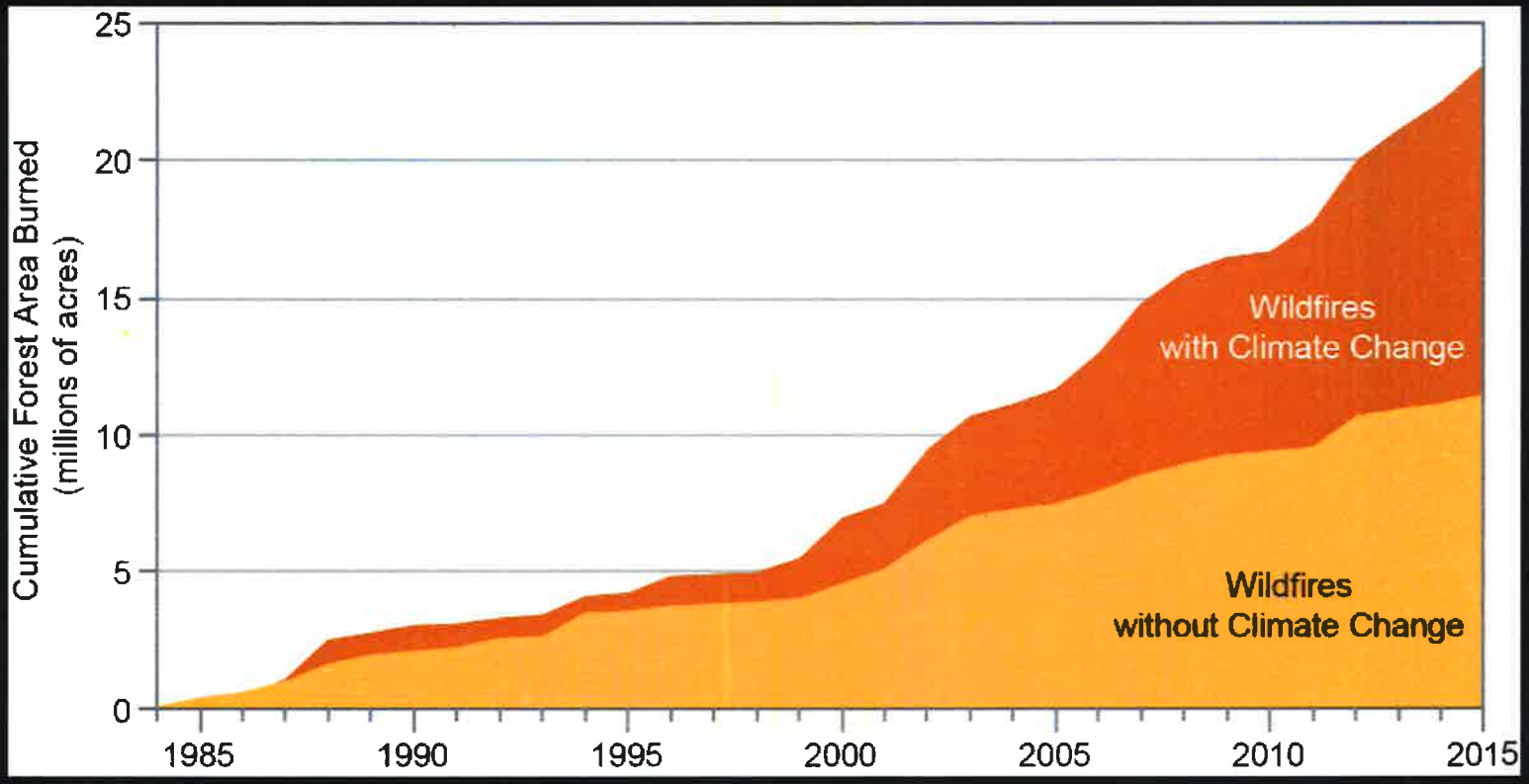
[redacted]

Data are drawn from the July 2019 report, *Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days*.

[redacted]

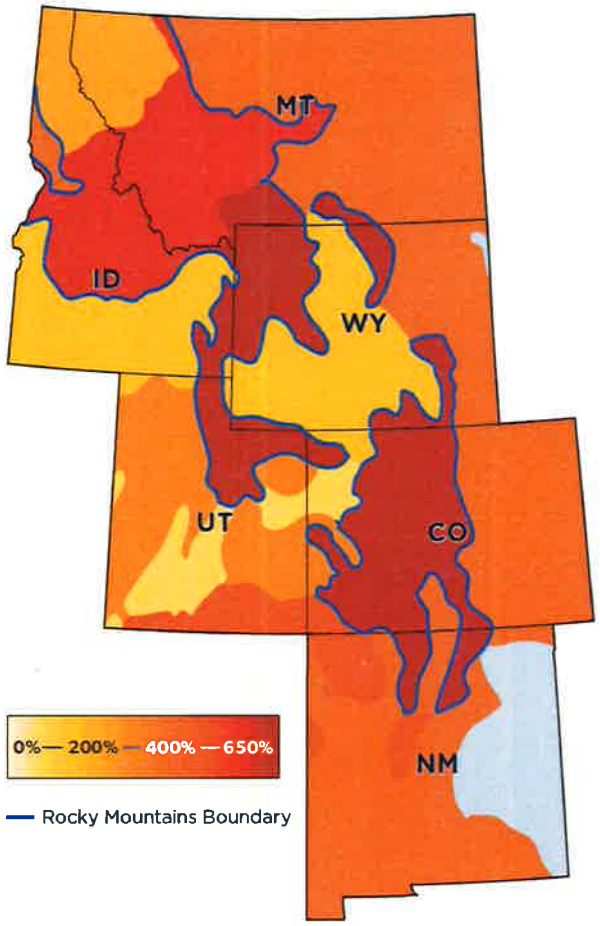

Photo: Rory Gauthier, NPS

Fig. 25.4: Climate Change Has Increased Wildfire



https://nca2018.globalchange.gov

FIGURE 4. **Projected Changes in Average Area Burned with a 1.8°F Rise in Average Temperature**



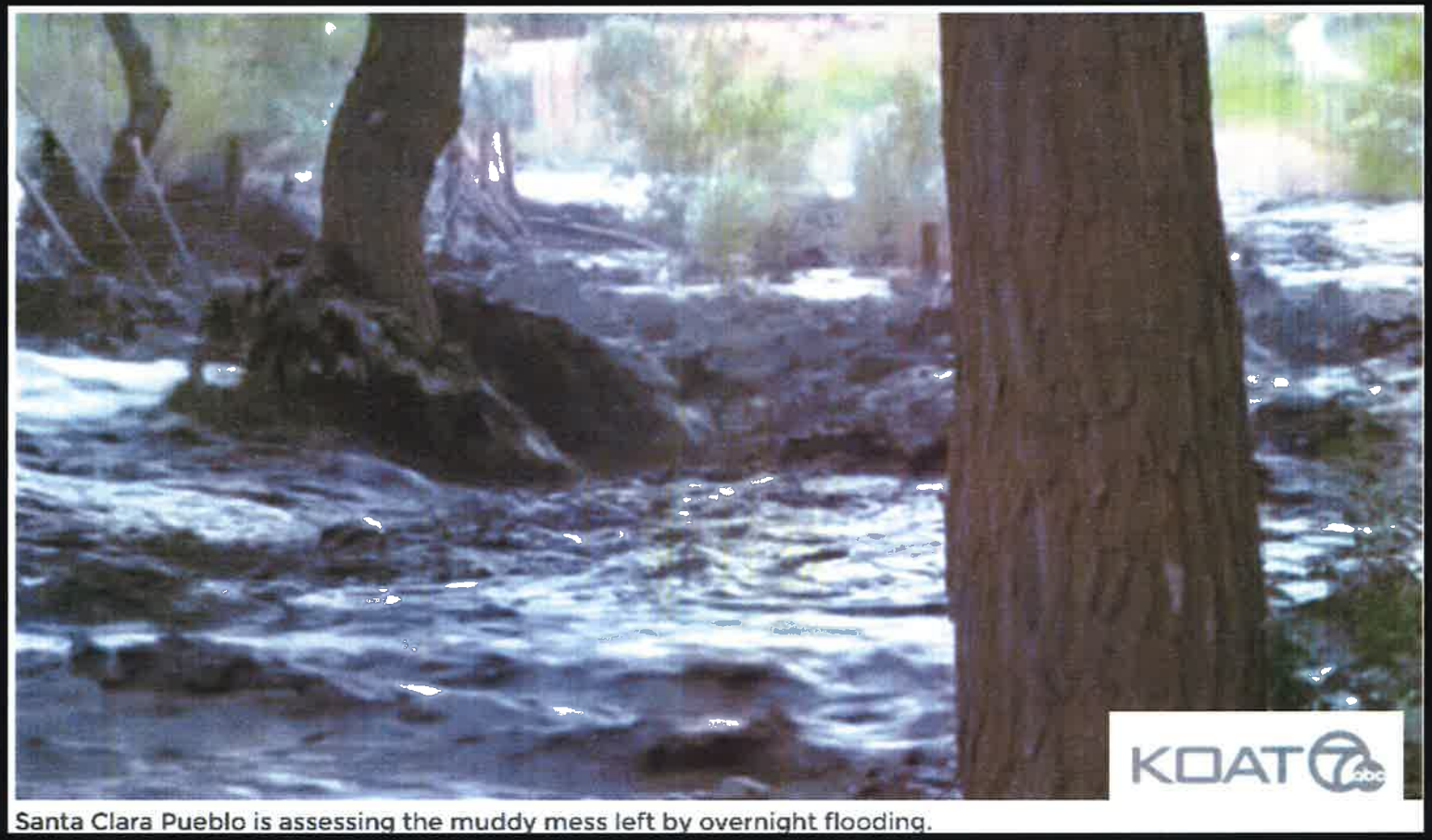
Scientists project that a temperature increase of just 1.8°F will lead to marked increases in acreage burned by wildfires in the West. The figure shows the projected percentage increase in burned area, compared with the 1950–2003 average, for different ecological regions of the West, including the Rocky Mountains. (Grey indicates areas with insufficient data for making projections.)

SOURCES: ADAPTED FROM NRC 2011 AND LITTELL ET AL. 2009.

Wildfire

U.S. Air Force photo by Master Sgt. Jeremy Lock, 28 June 2012

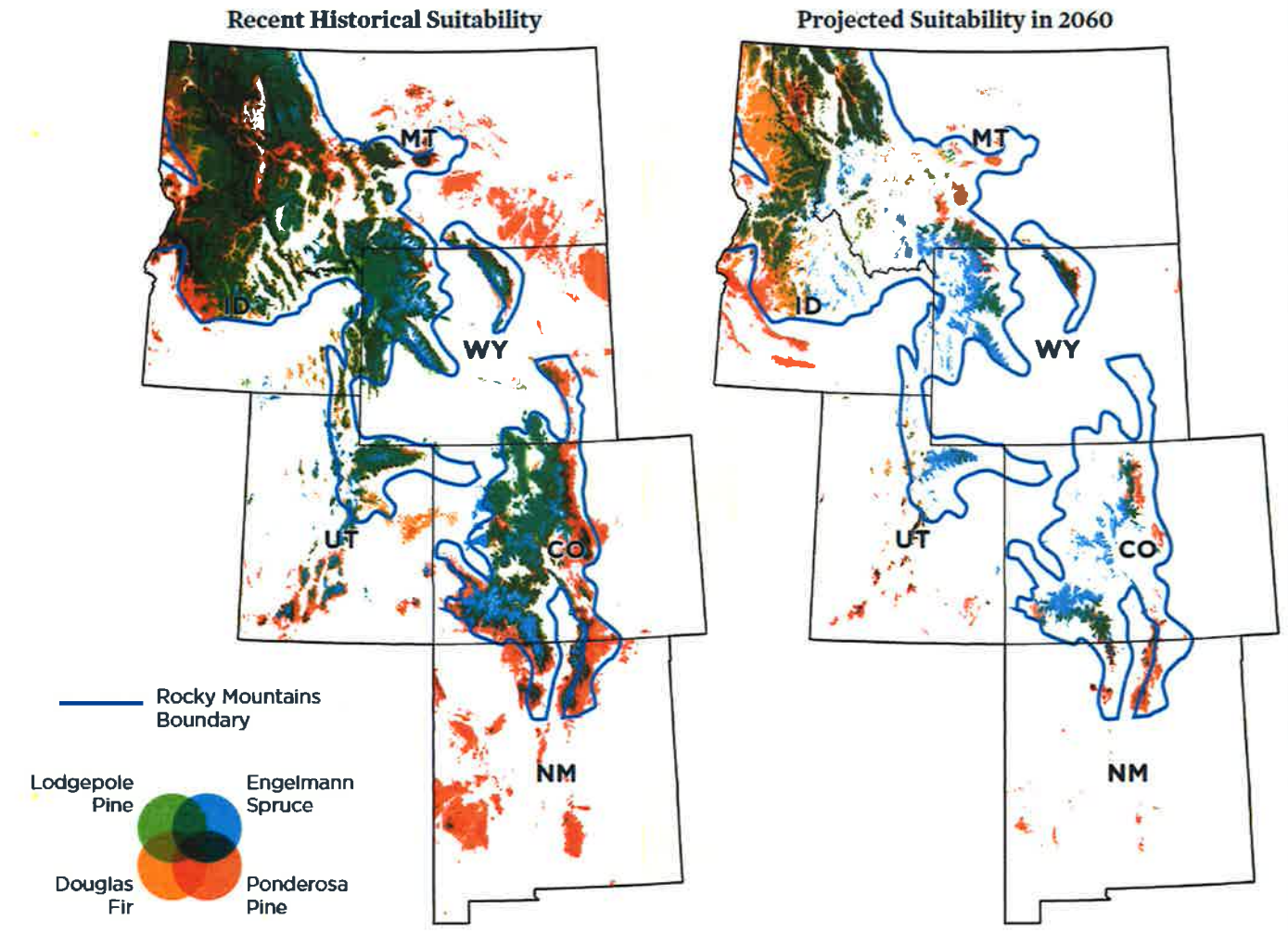
Post Wildfire Flood



Santa Clara Pueblo is assessing the muddy mess left by overnight flooding.

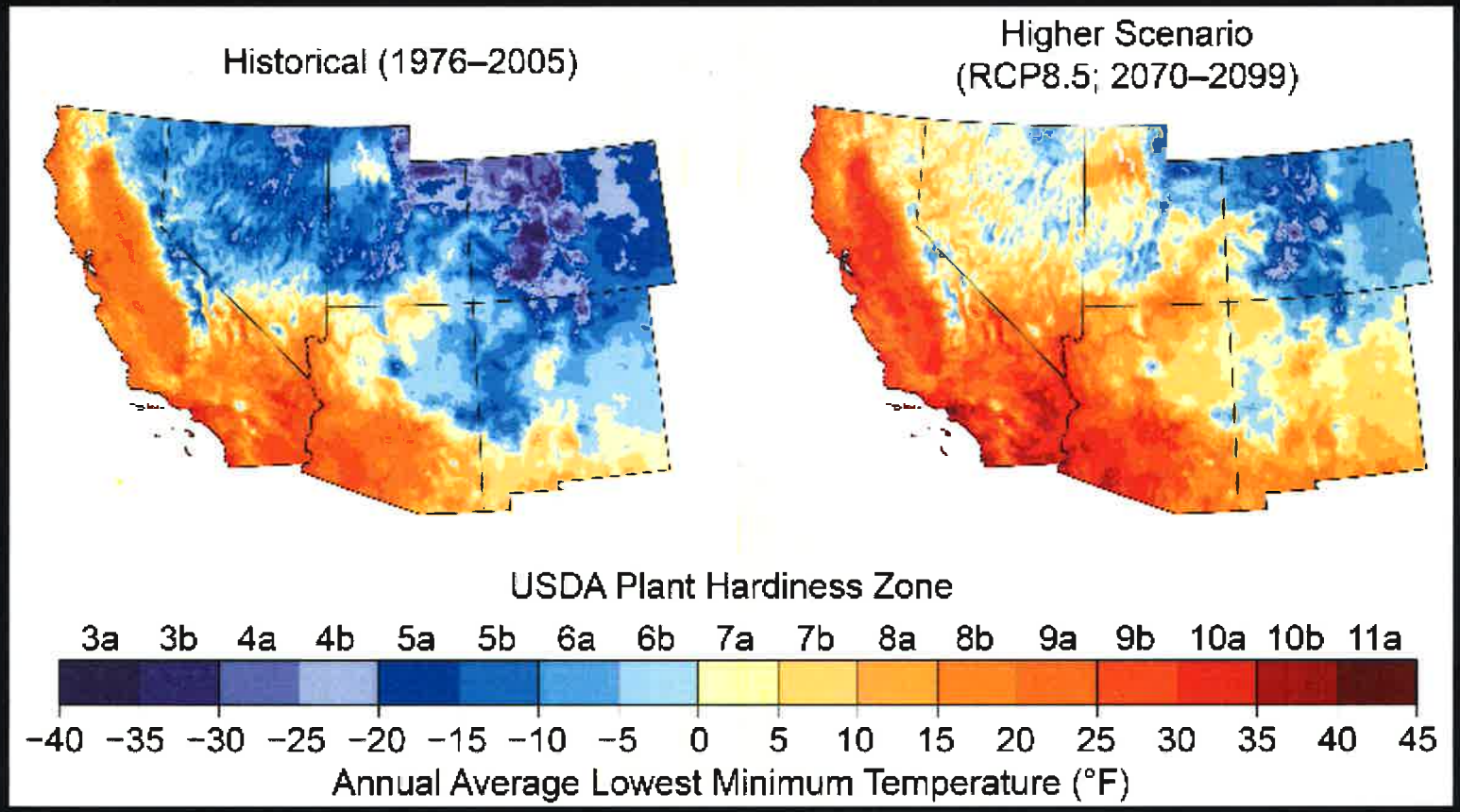
http://www.koat.com/article/pueblo-declares-state-of-emergency-following-flood/5041818

FIGURE 5 AND TABLE 1. Projected Changes in Suitable Ranges for Key Rocky Mountain Tree Species

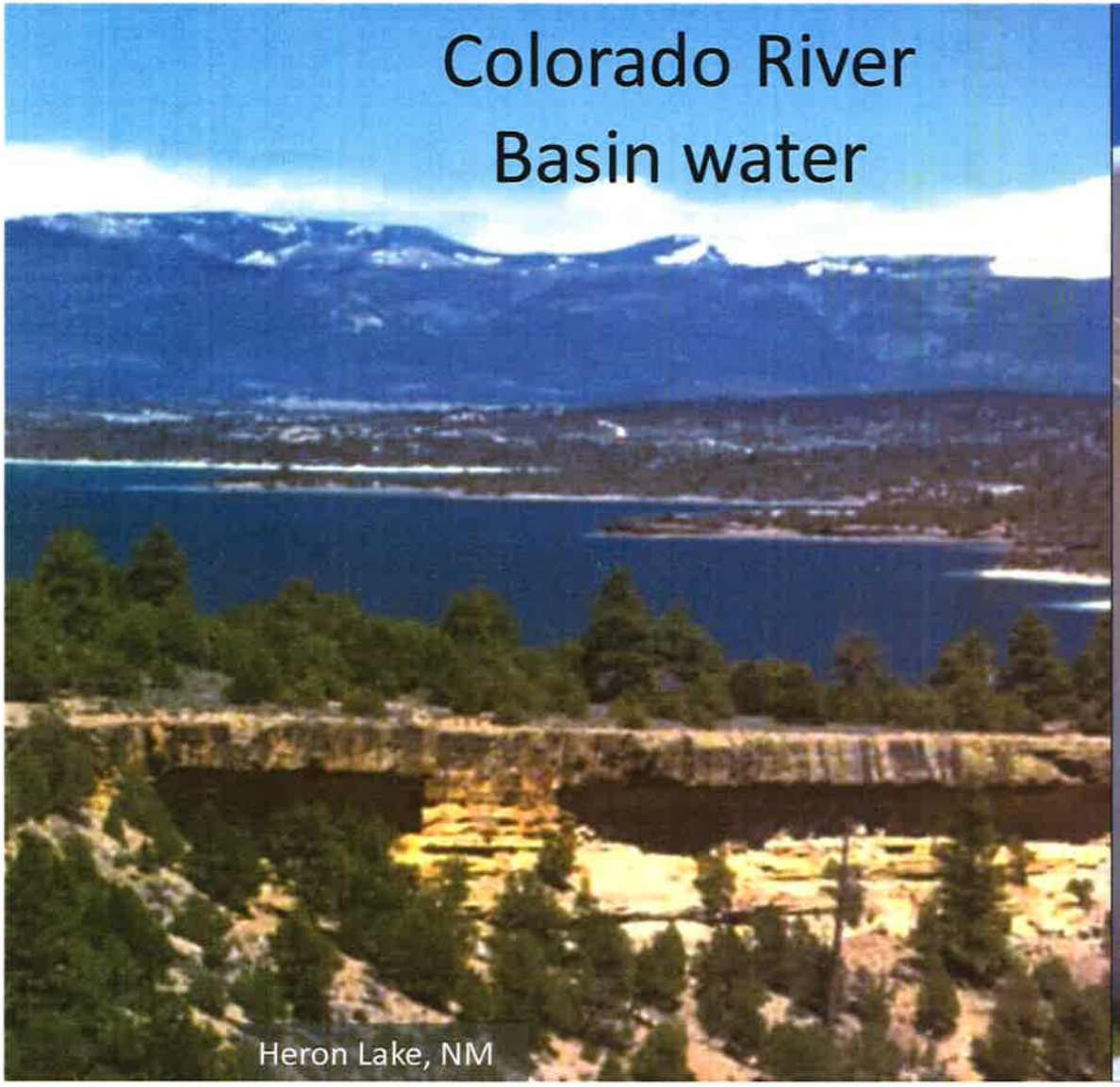


www.rockymountainclimate.org/reports_6.htm.

Fig. 25.9: Projected Shift in Agricultural Zones



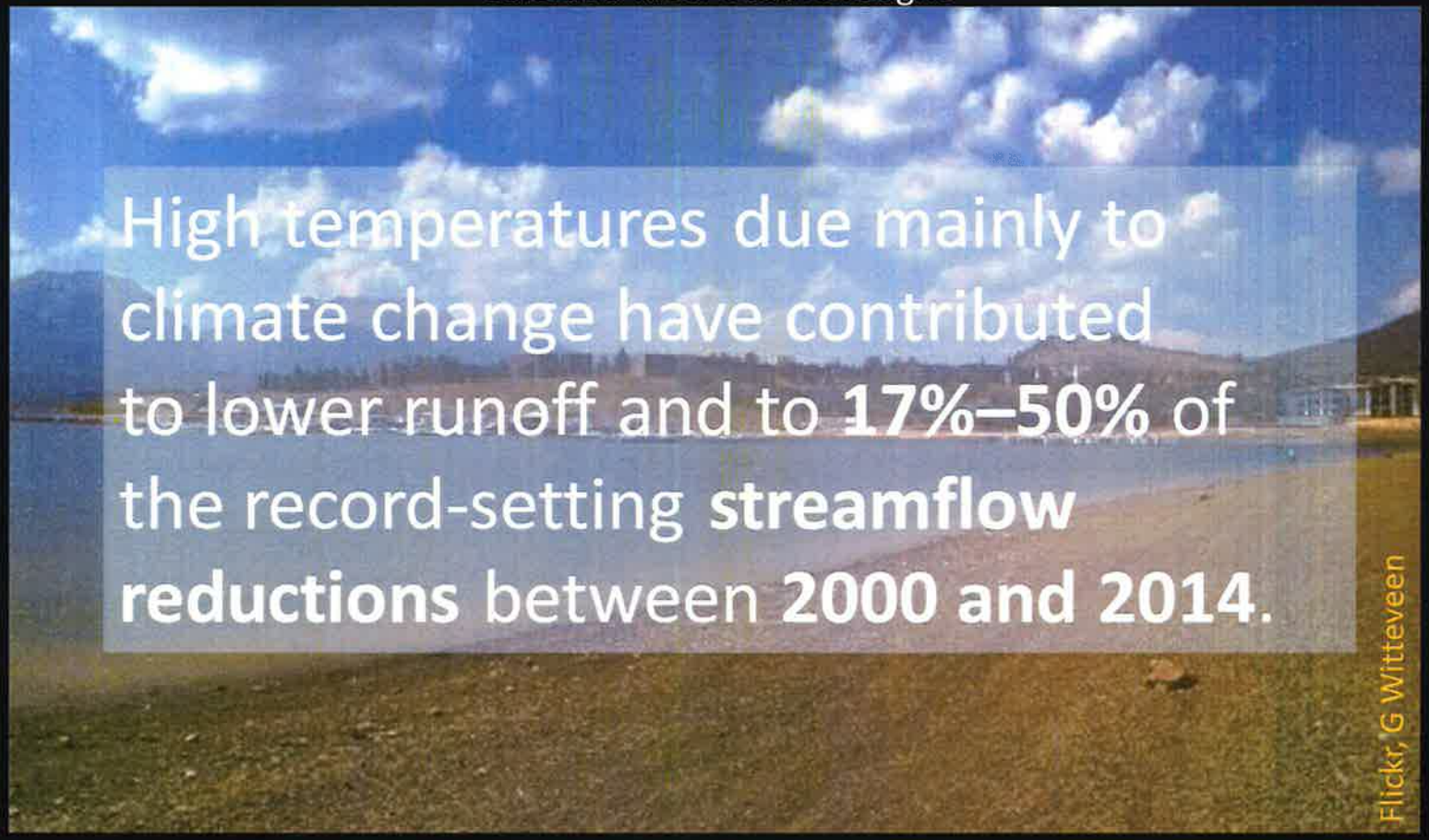
https://nca2018.globalchange.gov


Colorado River
Basin water
Heron Lake, NM


Albuquerque
Groundwater
Albuquerque Bernalillo County
Water Utility Authority

Ch. 25 | Southwest

Colorado River Basin Drought



https://nca2018.globalchange.gov

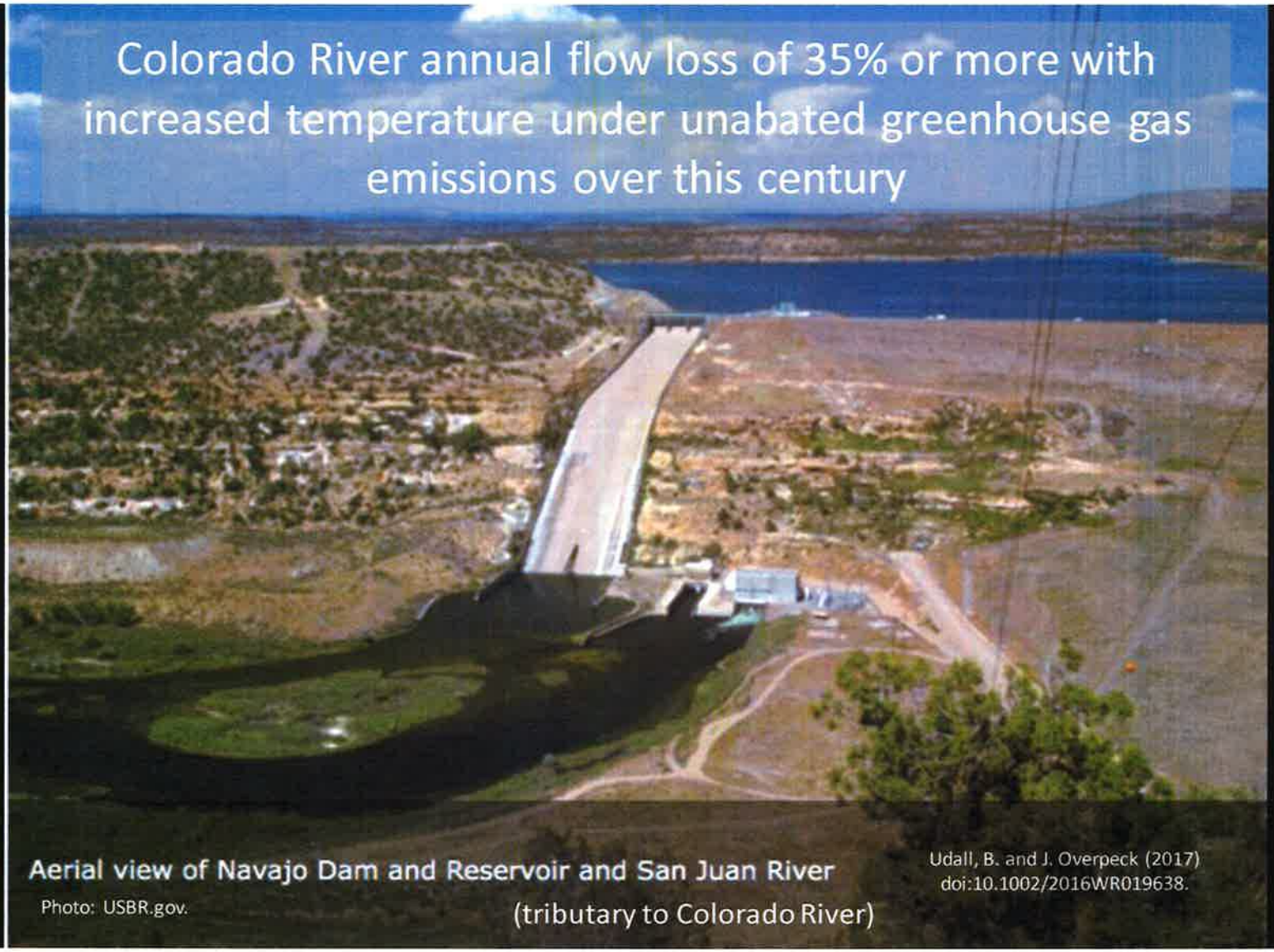
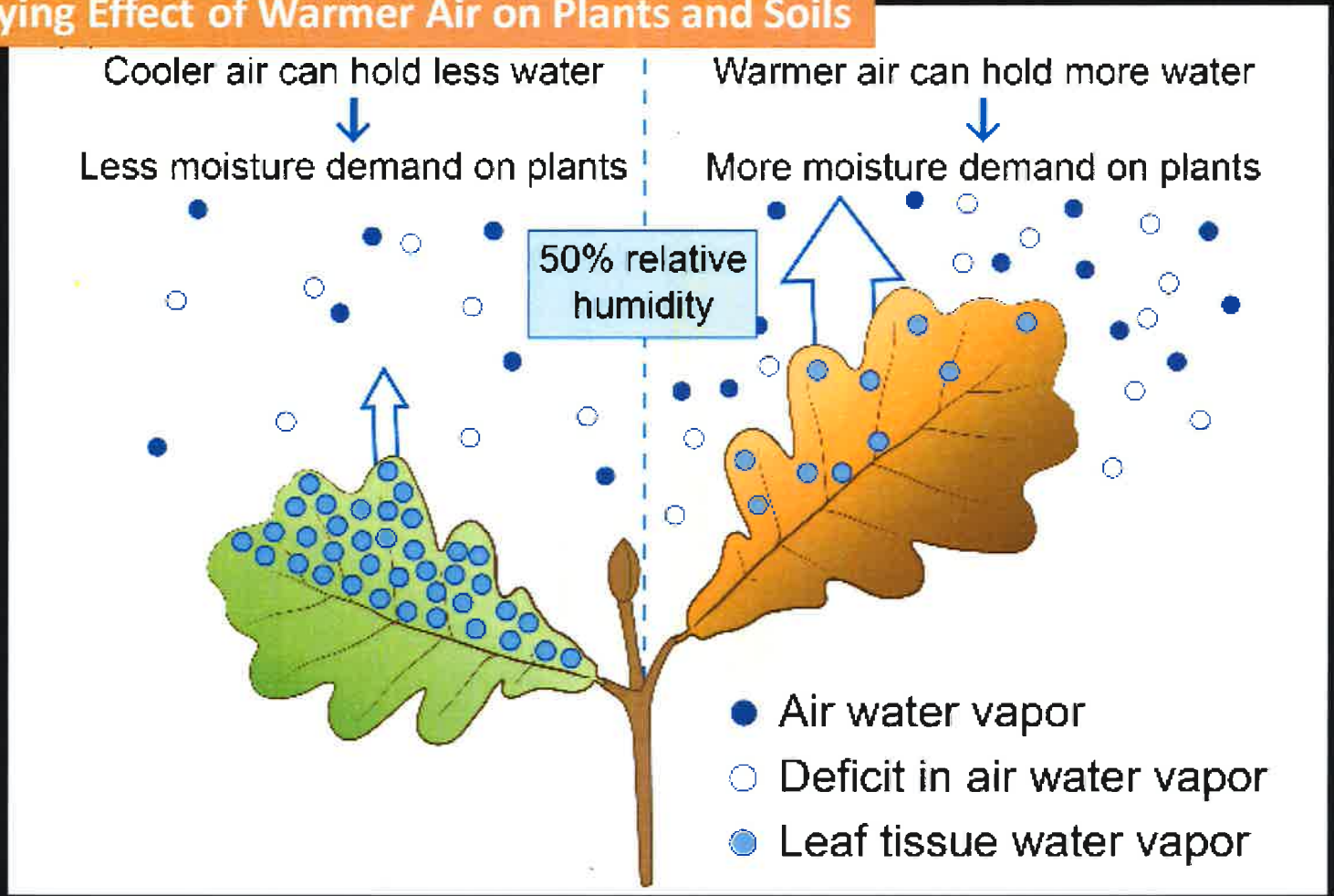
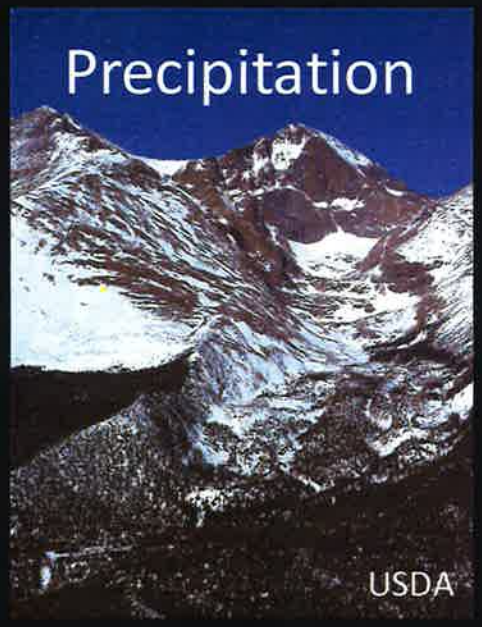
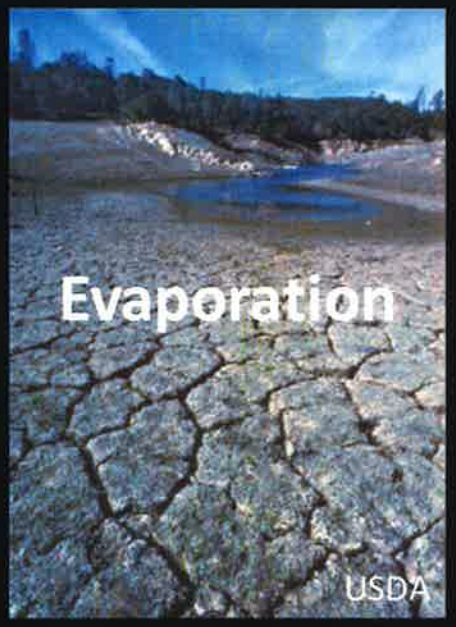

Colorado River annual flow loss of 35% or more with increased temperature under unabated greenhouse gas emissions over this century
Aerial view of Navajo Dam and Reservoir and San Juan River
(tributary to Colorado River)
Photo: USBR.gov.
Udall, B. and J. Overpeck (2017)
doi:10.1002/2016WR019638.

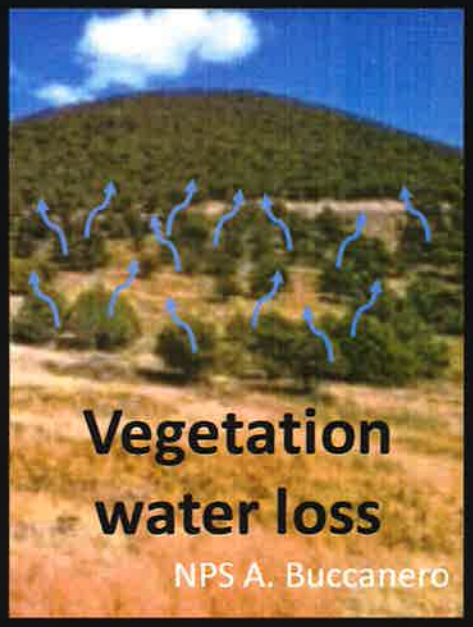
Fig. 21.3: Drying Effect of Warmer Air on Plants and Soils



https://nca2018.globalchange.gov







Historical drought

Hot drought

Risks of inaction

Under scenarios with high emissions and limited or no adaptation, annual losses in some sectors are estimated to grow to hundreds of billions of dollars by the end of the century.

Source: adapted from EPA 2017

(in 2015 dollars)

https://nca2018.globalchange.gov

Annual Economic Damages in 2090		
Sector	**Annual damages under RCP8.5**	**Damages avoided under RCP4.5**
Labor	$155B	48%
Extreme Temperature Mortality◊	$141B	58%
Coastal Property◊	$118B	22%
Air Quality	$26B	31%
Roads◊	$20B	59%
Electricity Supply and Demand	$9B	63%
Inland Flooding	$8B	47%
Urban Drainage	$6B	26%
Rail◊	$6B	36%
Water Quality	$5B	35%
Coral Reefs	$4B	12%
West Nile Virus	$3B	47%
Freshwater Fish	$3B	44%
Winter Recreation	$2B	107%
Bridges	$1B	48%
Munic. and Industrial Water Supply	$316M	33%
Harmful Algal Blooms	$199M	45%
Alaska Infrastructure◊	$174M	53%
Shellfish*	$23M	57%
Agriculture*	$12M	11%
Aeroallergens*	$1M	57%
Wildfire	–$106M	–134%

NM STATE UNIVERSITY

Climate Change and Its Implications for New Mexico's Water Resources and Economic Opportunities

Technical Report 45

Brian H. Hurd and Julie Coonrod[1]

Agricultural Experiment Station • Cooperative Extension Service • College of Agriculture and Home Economics

"While total annual economic losses are estimated in the vicinity of $300 million, under severe climate changes, where runoff is reduced by nearly 30%, both economic and non-economic losses are likely to be significantly higher."


Reducing Risks for our future

Alexandra E. Teitz

7101 Beechwood Dr. • Chevy Chase, MD 20815
202.907.3242 • ateitz@icloud.com

PROFESSIONAL EXPERIENCE

Principal, AT Strategies, LLC, Chevy Chase, MD 2017—present

- Provide strategic advice and legal analysis, draft materials, talk to press, brief legislative staff and members, and testify on climate, energy, and air law and policy issues for nonprofit NGOs.
- Present/past clients include: Environmental Defense Fund; Sierra Club; Natural Resources Defense Council; Union of Concerned Scientists; Clean Air Task Force; and Western Environmental Law Center.

Counselor to the Director
Bureau of Land Management, Department of Interior, Washington, D.C. 2014—2017

- Advised the Director and Deputy Director of BLM, focusing on regulation, oil and gas, coal, and climate.
- Led team and timely completed the Methane and Waste Prevention Rule; developed policies and text; coordinated with States and Administration; oversaw contractor, budget and schedule; supported litigation.
- Worked on Secretarial Order to pause federal coal leasing and review the program; drafted Notice of Intent.
- Worked on development of climate guidance and other climate-related issues.
- Secretary's Outstanding Service Award for Methane and Waste Prevention Rule.

Senior Counsel, Environment and Energy/Chief Counsel for Energy and Environment
Committee on Energy and Commerce, U.S. House of Representatives, Washington, D.C. 2009—2014

- Senior/Chief Counsel (2014) on climate, air and energy for Chairman/Ranking Member Henry A. Waxman.
- Co-led drafting and negotiations on Waxman-Markey climate and clean energy bill.
- Staffed hearings, markups and floor activity on bills; drafted legislation, amendments, supporting materials, and Member statements; conducted Administration oversight; informally/formally supervised junior staff.
- Developed policy; conducted strategic and legal analysis; worked with stakeholders, public and press.

Minority Counsel/Senior Environmental Counsel 2001—2008
Committee on Oversight & Government Reform, U.S. House of Representatives, Washington, D.C.

- Counsel for environment, energy, and regulatory process for Ranking Member/Chairman Henry A. Waxman.
- Drafted Carbon Neutral Government Act, enacted in Energy Independence and Security Act of 2007. Staffed bill through Committee action, floor passage, and House-Senate conference.
- Conducted oversight of Administration activities; deposed agency officials.
- Drafted Safe Climate Act, other bills and reports; staffed hearings; gave presentations; spoke to press.

Attorney Advisor
Office of General Counsel, U.S. Environmental Protection Agency, Washington, D.C. 1994—2001

- Advised clients in Office of Air and Radiation and Office of Water on Clean Air Act and Clean Water Act rulemaking, litigation and implementation; drafted rules; negotiated settlements; briefed senior officials.
- U.S. EPA Silver Medal for Superior Service for OTC LEV/National Low Emission Vehicle Program.
- U.S. EPA Bronze Medals for Commendable Service for: NOx SIP Call Litigation Response; Knollenberg Amendment on Climate Change; NJ Oxygenated Fuels SIP/NYMEX Litigation.

EDUCATION

University of California at Berkeley, Boalt Hall School of Law. J.D., Order of the Coif 1994
Thelen Marrin Prize, Best Comment at Boalt Hall • Winner, Harmon Environmental Law Writing Competition
Sadie and Alvin Landis Scholarship for Excellence in Water Law • Writing Award in Appellate Advocacy
Articles Editor, *Ecology Law Quarterly*
Comment, *Assessing Point Source Discharge Permit Trading,* 21 ECOLOGY LAW QUARTERLY 79 (1994)

Yale University, School of Forestry & Environmental Studies. Masters in Environmental Studie

CA
Ex. 4

Yale F&ES Mellon Foundation Grant for Masters' Project on Western Water Policy

Oberlin College, Oberlin, OH. B.A. in History and Government, Minor in Environmental Studies 1988
Comfort Starr Prize in Government • *Phi Beta Kappa*, 1987

University of Sussex, Brighton, England Autumn, 1986

Member of the California Bar, District of Columbia Bar

EXECUTIVE ORDER 2019-003

EXECUTIVE ORDER ON ADDRESSING CLIMATE CHANGE AND ENERGY WASTE PREVENTION

I. Background and Purpose

To further New Mexico's responsibility and opportunity to build a clean energy future for our people, limit adverse climate change impacts that harm our natural and cultural heritage, prevent the waste of New Mexico energy resources and reduce pollution that threatens human health, I hereby issue this Executive Order.

II. Climate Change

WHEREAS, climate change creates new risks and exacerbates existing vulnerabilities in communities across New Mexico and presents growing challenges for human health and safety, quality of life, and the rate of economic growth.

WHEREAS, in a special report authored by the United Nations and World Meteorological Organization Intergovernmental Panel on Climate Change ("IPCC"), it was found that the planet has as little as 12 years to take meaningful climate action in order to limit the increase in global average temperature to 1.5°C – the level necessary to forestall dramatic climatic changes that will further imperil our water supplies.

WHEREAS, carbon dioxide, methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons, and sulfur hexafluoride are recognized as the six greenhouse gases contributing to climate change.

WHEREAS, in 2009, the U.S. Environmental Protection Agency ("EPA") found that these "six greenhouse gases taken in combination endanger both the public health and the public welfare of current and future generations."

WHEREAS, in May 2010, the National Research Council, the operating arm of the National Academy of Sciences, published an assessment which concluded that "climate change is occurring, is caused largely by human activities, and poses significant risks for - and in many cases is already affecting - a broad range of human and natural systems."

WHEREAS, carbon dioxide is emitted through the combustion of fossil fuels for electricity generation and for combustion-engine vehicles.

WHEREAS, the U.S. Energy Information Administration finds that the transportation sector is the largest anthropogenic source of carbon dioxide emissions in the United States.

WHEREAS, methane is a powerful greenhouse gas, 84 times more effective at trapping heat than carbon dioxide over a 20-year timeframe.

CA
Ex. 5

WHEREAS, the oil and gas industry is the largest industrial source of methane emissions.

WHEREAS, HFCs are potent greenhouse gases used in the refrigeration, air conditioning, and foam industries, for which alternatives are readily available and approved for use by the EPA.

WHEREAS, governments and global industries have expressed widespread support for a global transition to alternatives to HFCs, as agreed to in the 2016 Kigali Amendment to the Montreal Protocol.

WHEREAS, New Energy Conservation Code templates are developed by the International Code Council every three years. New Mexico adopted and is using the 2009 International Energy Conservation Code (IECC), which puts the state three full code cycles behind. As newer, safer, and more durable building materials, technologies, and techniques become more commonplace, they are voted on and incorporated into the model energy code.

WHEREAS, energy codes create safe, resilient, and habitable structures based on building science and physics principals for heat, air, and moisture transfer—all of which have real and significant impacts on human lives and health; they also can cut utility bills in buildings.

WHEREAS, low- and zero-emission vehicles can provide long-term public health, environmental, and climate benefits.

WHEREAS, federal rollbacks of climate protections, waste prevention, and clean air rules have made it imperative for New Mexico to act to protect our citizens and our economy from the damages of climate change impacts.

WHEREAS, emissions, venting, flaring, and leaks of natural gas by New Mexico's oil and gas industry results in the waste of an important source of domestic energy to the tune of an estimated $244 million per year.

WHEREAS, oil and gas production growth in the New Mexico Permian Basin resulted in an 18% increase in venting and flaring volumes during the first seven months of 2018 compared to 2017 according to official state statistics.

WHEREAS, efforts to reduce methane emissions throughout New Mexico will have a significant climate benefit as well as prevent the waste of energy resources.

WHEREAS, science, innovation, collaboration and compliance efforts can prevent waste, methane emissions and improve air quality while creating jobs for New Mexicans.

III. Directives

NOW, THEREFORE, by the authority vested in me as Governor by the Constitution and laws of the State of New Mexico, IT IS ORDERED:

1. The State of New Mexico will support the 2015 Paris Agreement Goals by joining the U.S. Climate Alliance. New Mexico's objective is to achieve a statewide reduction in greenhouse gas emissions of at least 45% by 2030 as compared to 2005 levels.

2. The Secretary (or designee) of each state agency shall serve on an interagency Climate Change Task Force which is hereby established. The Secretary (or designee) of the Energy, Minerals and Natural Resources Department ("EMNRD") and the Environment Department ("NMED") shall serve as the Co-Chairs, convening meetings, facilitating stakeholder participation, and providing strategic direction for achieving the above goals in developing a New Mexico Climate Strategy document.

3. All State Agencies shall evaluate the impacts of climate change on their programs and operations and integrate climate change mitigation and adaptation practices into their programs and operations. The agencies shall share these actions with the Climate Change Task Force for inclusion into the New Mexico Climate Strategy document.

4. EMNRD and NMED shall work with stakeholders on legislation to increase the New Mexico renewable portfolio standard ("RPS") and increase New Mexico's energy efficiency standards for electric utilities.

5. The Climate Change Task Force shall evaluate policies and regulatory strategies to achieve reductions in greenhouse gas pollution, consistent with the targets set out above, across all categories of emission sources. Such policies and regulatory strategies shall include, but not be limited to, the following:

    a. Adoption of a comprehensive market-based program that sets emission limits to reduce carbon dioxide, and other greenhouse gas pollution across New Mexico;
    b. Adoption of approaches to reduce greenhouse gas and criteria pollutant emissions from light-duty vehicles sold in state, including Low Emission Vehicle (LEV) emission standards and Zero Emission Vehicle (ZEV) performance standards;
    c. Adoption of building codes; and
    d. Collaboration with the Renewable Energy Transmission Authority (RETA) to identify transmission corridors needed to transport the state's renewable electricity to market.

6. EMNRD and NMED shall jointly develop a statewide, enforceable regulatory framework to secure reductions in oil and gas sector methane emissions and to prevent waste from new and existing sources and enact such rules as soon as practicable.

7. EMNRD and NMED shall coordinate as much as possible with the New Mexico State Land Office and federal bureaus and agencies that manage land and natural resources in New Mexico to help advance the priorities identified in this Executive Order.

8. The Climate Change Task Force will develop a *New Mexico Climate Strategy* document with initial recommendations and a status update, where applicable, to the Governor by September 15, 2019.

IV. Disclaimer

Nothing in this Executive Order is intended to create a private right of action to enforce any provision of this Order or to mandate the undertaking of any particular action pursuant to this Order; nor is this Order intended to diminish or expand any existing legal rights or remedies.

THIS ORDER supersedes any other previous orders, proclamations, or directives in conflict. This Executive Order shall take effect immediately and shall remain in effect until such time as it is rescinded by the Governor.

ATTEST:

Maggie Toulouse Oliver

MAGGIE TOULOUSE OLIVER
SECRETARY OF STATE

DONE AT THE EXECUTIVE OFFICE
THIS 29th DAY OF JANUARY, 2019

WITNESS MY HAND AND THE GREAT
SEAL OF THE STATE OF NEW MEXICO

Michelle Lujan Grisham

MICHELLE LUJAN GRISHAM
GOVERNOR

https://www.santafenewmexican.com/opinion/my_view/our-environment-is-endangered/article_198077df-4e69-5dd4-a8c8-3a4027212f23.html

MY VIEW

Our environment is endangered

Nov 9, 2019

Last week, when the Trump administration began its formal withdrawal from the Paris climate agreement, the president sent a clear signal to the rest of the world:

The United States government once again will surrender its standing as a global leader, leaving state and local citizens and leaders to take up the mantle of climate action in this country.

Our environment is endangered. Our land, our air and water are imperiled by the effects of climate change. We do not have the luxury of inaction.

More than two dozen governors, representing more than half the U.S. states, have vowed to stand up and fight for meaningful climate action and environmental protections at the state level. I'm one of them. The states that make up the U.S. Climate Alliance have taken up this work on several fronts. In New Mexico, we're making important progress.

We have passed an aggressive renewable energy law, we're going to reduce our greenhouse gas emissions, and we have begun the essential work of moving toward a zero-carbon economy. We're going to implement responsible clean car standards. We're directing millions toward ecosystem resiliency to protect water resources and minimize the risks of catastrophic wildfire. We're going to make state government as energy efficient as it can be, investing tens of millions into solar and electric vehicles and efficiency upgrades that will save us millions on our electric bills. And, of course, a crucial component: We will continue to build out our state economy so we can have sustainable revenue streams beyond just one volatile industry.

I have been clear with that industry on their role in our balanced and yet unequi

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Ex. 6

approach: We recognize climate change as the threat it is to our planet and state, and we will be doing everything we must in order to combat it and improve the quality of life and health of New Mexicans. While that industry's business is key to the current economic well-being of our state, the well-being of our state depends on clean air, soil and water. The oil and gas industry must do its part to protect public health and has a non-negotiable responsibility to develop resources wisely and within a fair regulatory framework, minimizing negative health impacts on New Mexico communities.

The state is enforcing accountability. My Environment Department continues to accelerate investigations at well pads, storage tanks, gas plants and compressor stations, ensuring the industry catches and fixes leaks as quickly as possible. We're embracing innovation such as aerial surveillance and enacting new tools to track and mitigate ozone and methane leaks. We're also leading to develop new applications and technologies, like replacing flares with fuel cells, to convert stranded gas to electricity. We're engaging stakeholders at every step of the way and ensuring science leads the conversation. We are clear as to who we are in this moment — leaders with a vision and clear strategy.

The state of New Mexico must — and will — hold all industries, all sectors of our economy, accountable, from oil and gas to agriculture to transportation and beyond. To be sure, we must also hold ourselves to a higher standard individually and do what we can as citizens of the globe to reduce our emissions and modify our consumption.

But to reach the emission levels we know we must reach in a limited amount of time, we must start with rules to reduce oil and gas methane emissions while also moving to more and broader climate pollution reduction efforts, including economy-wide, market-based mechanisms. And the rules my administration will enact to protect New Mexicans from methane pollution will serve as an example to the rest of the country.

When the Trump administration takes us backward on climate action, as it did last week, we must take two steps forward. New Mexico will continue to advance the subject on climate action and environmental protection. I want all New Mexicans — across regions, across industries, across communities and political leanings and generations — to take part in our transformation to a clean energy leader, to help us lead in reducing harmful emissions, addressing the threat of climate change and strengthening our economy for the 21st century and beyond.

Michelle Lujan Grisham is the governor of New Mexico.

THE WORLD BANK
(http://www.worldbank.org/)

What We Do (/en/what-we-do)

Zero Routine Flaring by 2030

(mailto:?body=https%3A%2F%2Fwww.worldbank.org%2Fen%2Fprograms%2Fzero-routine-flaring-by-2030%232%3Fcid%3DEXT_WBEmailShare_EXT&subject=Zero%20Routine%20Flaring%20by%202030)

FEATURED ‹1/6›

(https://www.worldbank.org/en/programs/gasflaringreduction/brief/as-part-of-a-new-methane-reduction-strategy-the-european-union-pledges-to-support-gas-flaring-reduction)

European Union pledges to support gas flaring reduction (https://www.worldbank.org/en/programs/gasflaringreduction/brief/as-part-of-a-new-methane-reduction-strategy-the-european-union-pledges-to-support-gas-flaring-reduction)

The EC's new "strategy to reduce methane emissions" says it will consider regulation to end routine flaring and venting and pledges its support for the World Bank's Zero Routine Flaring by 2030 initiative, developed to end routine flaring globally no later than 2030.
Read More » (https://www.worldbank.org/en/programs/gasflaringreduction/brief/as-part-of-a-new-methane-reduction-strategy-the-european-union-pledges-to-support-gas-flaring-reduction)

(/en/news/press-release/2020/07/21/global-gas-flaring-jumps-to-levels

Global Gas Flaring Jumps to Levels Last Seen in 200 /21/global-gas-flaring-jumps-to-levels-last-seen-in-2

Estimates from satellite data show global gas flaring increased to levels not seen i (bcm), equivalent to the total annual gas consumption of Sub-Saharan Africa.
Read More » (/en/news/press-release/2020/07/21/global-gas-flaring-jumps-to-leve

Governments, oil companies, and development institutions around the world are encouraged to endorse the "Zero Routine Flaring by 2030" Initiative. Read the full text below:

During oil production, associated gas is produced from the reservoir together with the oil. Much of this gas is utilized or conserved because governments and oil companies have made substantial investments to capture it; nevertheless, some of it is flared because of technical, regulatory, or economic constraints. As a result, thousands of gas flares at oil production sites around the globe burn approximately 140 billion cubic meters of natural gas annually, causing more than 300 million tons of CO2 to be emitted to the atmosphere.

Flaring of gas contributes to climate change and impacts the environment through emission of CO2, black carbon and other pollutants. It also wastes a valuable energy resource that could be used to advance the sustainable development of producing countries. For example, if this amount of gas were used for power generation, it could provide about 750 billion kWh of electricity, or more than the African continent's current annual electricity consumption. While associated gas cannot always be used to produce power, it can often be utilized in a number of other productive ways or conserved (re-injected into an underground formation).

This "**Zero Routine Flaring by 2030" initiative** (the Initiative), introduced by the World Bank, brings together governments, oil companies, and development institutions who recognize the flaring situation described above is unsustainable from a resource management and environmental perspective, and who agree to cooperate to eliminate routine flaring no later than 2030.

The Initiative pertains to routine flaring and not to flaring for safety reasons or non-routine flaring, which nevertheless should be minimized. Routine flaring of gas is flaring during normal oil production operations in the absence of sufficient facilities or amenable geology to re-inject the produced gas, utilize it on-site, or dispatch it to a market. Ventir substitute for flaring.

Governments that endorse the Initiative will provide a legal, regulatory, investment, and operating environment that is conducive to upstream investments an markets for utilization of the gas and the infrastructure necessary to deliver the gas to these markets. This will provide companies the confidence and incentive elimination solutions. Governments will require, and stipulate in their new prospect offers, that field development plans for new oil fields incorporate sustainat the field's associated gas without routine flaring. Furthermore, governments will make every effort to ensure that routine flaring at existing oil fields ends as so

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Ex. 7

A letter of support from World Petroleum Council (WPC) President Dr. józsef Tóth says "One of the Council's core objectives is to support our members by raising awareness of environmental, sustainability, and social issues gaining attention and traction around the world. We encourage all WPC members, particularly from government, national and international oil companies, to endorse this initiative because it is well-crafted and a highly visible way to demonstrate our industry's commitment to strong environmental stewardship and effective resource management."

GAS FLARING IN THE NEWS

African countries must take a balanced approach to the energy transition (https://www.africanews.com/2020/12/07/african-countries-must-take-a-balanced-approach-to-the-energy-transition-by-nj-ayuk//)

12 things the EU should do about gas flaring (https://www.energyvoice.com/opinion/282814/eu-gas-flaring-capterio/)

Oxy Becomes First U.S. Driller To Announce Net-Zero Plan (https://oilprice.com/Latest-Energy-News/World-News/Oxy-Becomes-First-US-Driller-To-Announce-Net-Zero-Plan.html)

Middle East is a mixed bag as investors weigh oil's role in climate change (https://www.spglobal.com/platts/en/market-insights/latest-news/oil/110920-middle-east-is-a-mixed-bag-as-investors-weigh-oils-role-in-climate-change)

"Flaring" at oil and gas wells to be curtailed as Colorado regulators adopt some of nation's strictest rules (https://coloradosun.com/2020/11/04/colorado-tough-new-flaring-rules-oil-and-gas/)

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Ed Kashi / World Bank Group

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Zero Routine Flaring by 2030

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(https://www.worldbank.org/en/programs/gasflaringreduction/brief/as-part-of-a-new-methane-reduction-strategy-the-european-union-pledges-to-support-gas-flaring-reduction)

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(/en/news/press-release/2020/07/21/global-gas-flaring-jumps-to-levels

Global Gas Flaring Jumps to Levels Last Seen in 200
/21/global-gas-flaring-jumps-to-levels-last-seen-in-2

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(bcm), equivalent to the total annual gas consumption of Sub-Saharan Africa.
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List of endorsers *(In alphabetical order)*

Governments (32)

- Angola
- Azerbaijan
- Bahrain
- California (U.S.)
- Cameroon
- Canada
- Republic of Congo
- Denmark
- Ecuador
- Egypt

- France
- Gabon
- Germany
- Indonesia
- Iraq
- Kazakhstan
- Morocco
- Mexico
- Netherlands
- New Zealand
- Niger
- Nigeria
- Norway
- Oman
- Peru
- Russia
- Saudi Arabia
- South Sudan
- Turkmenistan
- Uzbekistan
- United States of America
- Western Australia

Oil companies (41)

- BP
- Cairn Energy (UK)
- ConocoPhillips
- Ecopetrol (Colombia)
- Eni
- Enterprise Tunisienne d'Activités Pétrolières (ETAP - Tunisia)
- Equinor (formerly Statoil)
- Frontier Oil Limited (Nigeria)
- Galp Energia
- Gazprom Neft
- KazMunayGas (Kazakhstan)
- KazPetrol Group (Kazakhstan)
- Kuwait Oil Company
- LUKOIL
- MOL Group
- Niger Delta Petroleum Resources Ltd. (Nigeria)
- Nigerian National Petroleum Corporation (NNPC)
- Nile Petroleum Corporation (South Sudan)
- Oando Energy Resources
- Occidental (United States)
- Oil India Limited
- OMV Group
- ONGC (India)

- Pan Ocean Oil Corporation (Nigeria) Ltd.
- Petroamazonas EP (Ecuador)
- Petrobras
- Petroleum Development Oman (PDO)
- Repsol
- Saudi Aramco
- Seplat Petroleum Development Company Plc (Nigeria)
- Seven Energy (Nigeria)
- Shell
- SOCAR
- Societé Nationale des Hydrocarbures (SNH – Cameroon)
- Societé Nationale des Petroles du Congo (SNPC)
- Sonangol (Angola)
- Sonatrach (Algeria)
- TOTAL
- Uzbekneftegaz (Uzbekistan)
- Wintershall Dea
- Woodside

Development institutions (15)

- African Development Bank (AfDB)
- Agence Française de Développement (AFD)
- Asian Development Bank (ADB)
- Asian Infrastructure Investment Bank (AIIB)
- CAF - Development Bank of Latin America
- East African Development Bank (EADB)
- ECOWAS Bank for Investment and Development (EBID)
- European Bank for Reconstruction and Development (EBRD)
- European Investment Bank (EIB)
- Inter-American Development Bank (IDB)
- Islamic Development Bank (IsDB)
- OPEC Fund for International Development (OFID)
- United Nations Sustainable Energy for All (SE4All)
- West African Development Bank (BOAD)
- World Bank Group

Organizations Supporting the "Zero Routine Flaring by 2030" Initiative

While the "Zero Routine Flaring by 2030" Initiative is for governments, oil companies, and development institutions to endorse, the World Bank encourages relevant industry organizations to participate as advocates and to help meet the initiative's objectives.

OPEC supports the "Zero Routine Flaring by 2030" initiative

In a letter to the World Bank, OPEC Secretary General Mohammad Sanusi Barkindo assures support for the "Zero Routine Flaring by 2030" initiative. Mr. Barkindo writes that "This initiative, along with other similar initiatives, through preventing and mitigating GHG emissions, could contribute profoundly to address climate change as one of the great challenges of our time. Several OPEC Member Countries and countries participating in the Declaration of Cooperation and their oil companies are already participating in this initiative and I am sure if the capacities of other member countries allow, they will also welcome this initiative and would strive to address this environmental challenge."

OLADE committed to supporting and advocating "Zero Routine Flaring by 2030"

In a letter to the World Bank, Latin America's intergovernmental energy organization, OLADE, and its Executive Secretary Eng. Alfonso Blanco Bonilla, write: "..., the Organization aims to support the World Bank's objectives of the "Zero Routine Flaring by 2030" initiative, which is fully aligned with our objectives and activities. OLADE is also focused on supporting and joining the global effort to end the burning and routine venting by raising awareness, providing technical assistance to the Member Countries that so request it, and encouraging them to join the initiative." OLADE works for the integration, sustainable development and energy security in the Latin America region, advising and promoting cooperation and coordination among its 27 Member Countries.

World Petroleum Council supports the ZRF Initiative and encourages its members to do the same

A letter of support from World Petroleum Council (WPC) President Dr. József Tóth says "One of the Council's core objectives is to support our members by raising awareness of environmental, sustainability, and social issues gaining attention and traction around the world. We encourage all WPC members, particularly from government, national and international oil companies, to endorse this initiative because it is well-crafted and a highly visible way to demonstrate our industry's commitment to strong environmental stewardship and effective resource management."

GAS FLARING IN THE NEWS

African countries must take a balanced approach to the energy transition (https://www.africanews.com/2020/12/07/african-countries-must-take-a-balanced-approach-to-the-energy-transition-by-nj-ayuk//)

12 things the EU should do about gas flaring (https://www.energyvoice.com/opinion/282814/eu-gas-flaring-capterio/)

Oxy Becomes First U.S. Driller To Announce Net-Zero Plan (https://oilprice.com/Latest-Energy-News/World-News/Oxy-Becomes-First-US-Driller-To-Announce-Net-Zero-Plan.html)

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Gloria Whitaker
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"Zero Routine Flaring by 2030" Initiative
Benefits and commitments for endorsing **governments**

Benefits:

- ✓ **Better resource management.** Implementing the Initiative increases and sustains effective monetization of hydrocarbon resources.

- ✓ **Environmentally-friendly oil production.** An endorsement sustains and underpins an exemplary practice already in place in your country, or sets in motion a process to ensure cleaner operations, reducing your country's carbon footprint.

- ✓ **Global recognition.** Your government's endorsement communicates to the world that despite an industry downturn, your country is a responsible oil producer with strong environmental stewardship.

- ✓ **Regional impact.** Your government's endorsement demonstrates regional leadership and sets an example for others to follow, thereby impacting flaring practices in other countries.

- ✓ **Nationally Determined Contribution (NDC) implementation.** An endorsement of the Initiative supports implementation of your government's NDC to the Paris Climate Agreement.

- ✓ **Attract experienced oil industry investors.** The many international oil companies that already have a no-flaring policy for new oil field developments consider the Initiative a positive contribution because it will level the playing field – other companies would adopt the same good practice and governments would require it. The Initiative reduces regulatory uncertainty and risk.

- ✓ **Foster innovation.** Abiding by the flaring Initiative could foster innovation in gas monetization.

- ✓ **Network advantages.** An endorsement connects your government to a network of leading oil-producing countries and companies that sets a de facto new global industry standard for gas flaring. This will provide governments valuable opportunities to exchange knowledge and experience, and to interact with the world's leading multilateral financial institutions.

- ✓ **Your legacy.** The Initiative provides your government an opportunity to establish a positive environmental legacy; one that will be carried on well into the future.

Commitments:

- ✓ **What you endorse** is laid out in the text of the Initiative, and relates to (a) an operating environment conducive to flaring reduction; (b) avoiding routine flaring in new oil field developments; and (c) making efforts to end ongoing routine flaring over time.

- ✓ **Reporting.** Based on the Initiative's text on reporting, the World Bank will request and then publish as received (1) overall annual gas flaring from oil production in your country; and (2) the share of flaring that is routine flaring. The World Bank will not request data for individual flares and only has a reporting role, not an auditing role. The Bank may re-report the government's own public reporting on progress towards flaring reduction goals.

- ✓ **Not legally binding, but...** The Initiative is not a legally binding document. An endorsement does, however, establish a public commitment.

THE WORLD BANK
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(http://www.worldbank.org/)

What We Do (/en/what-we-do)

Zero Routine Flaring by 2030

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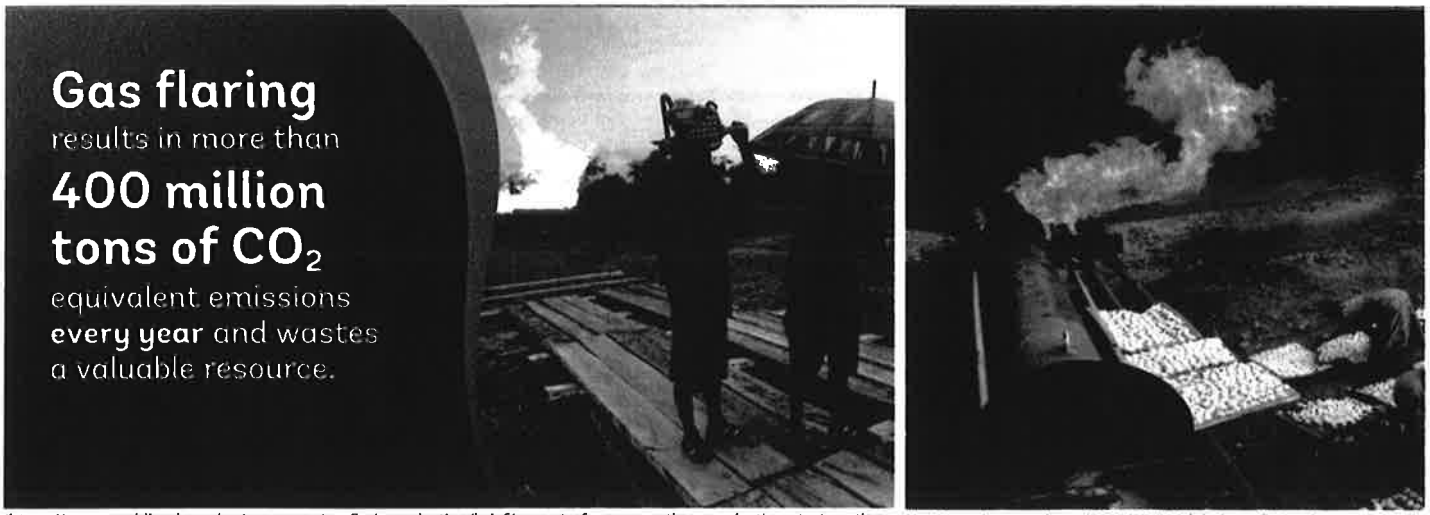

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Initiative Text

Endorsers

Benefits

Q&A

Reporting

Get Involved

Governments, oil companies, and development institutions around the world are encouraged to endorse the "Zero Routine Flaring by 2030" initiative. Read the full text below:

During oil production, associated gas is produced from the reservoir together with the oil. Much of this gas is utilized or conserved because governments and oil companies have made substantial investments to capture it; nevertheless, some of it is flared because of technical, regulatory, or economic constraints. As a result, thousands of gas flares at oil production sites around the globe burn approximately 140 billion cubic meters of natural gas annually, causing more than 300 million tons of CO2 to be emitted to the atmosphere.

Flaring of gas contributes to climate change and impacts the environment through emission of CO2, black carbon and other pollutants. It also wastes a valuable energy resource that could be used to advance the sustainable development of producing countries. For example, if this amount of gas were used for power generation, it could provide about 750 billion kWh of electricity, or more than the African continent's current annual electricity consumption. While associated gas cannot always be used to produce power, it can often be utilized in a number of other productive ways or conserved (re-injected into an underground formation).

This **"Zero Routine Flaring by 2030" initiative** (the Initiative), introduced by the World Bank, brings together governments, oil companies, and development institutions who recognize the flaring situation described above is unsustainable from a resource management and environmental perspective, and who agree to cooperate to eliminate routine flaring no later than 2030.

The Initiative pertains to routine flaring and not to flaring for safety reasons or non-routine flaring, which nevertheless should be minimized. Routine flaring of gas is flaring during normal oil production operations in the absence of sufficient facilities or amenable geology to re-inject the produced gas, utilize it on-site, or dispatch it to a market. Venting is not an acceptable substitute for flaring.

Governments that endorse the Initiative will provide a legal, regulatory, investment, and operating environment that is conducive to upstream investments and to the development of viable markets for utilization of the gas and the infrastructure necessary to deliver the gas to these markets. This will provide companies the confidence and incentive as a basis for investing in flare elimination solutions. Governments will require, and stipulate in their new prospect offers, that field development plans for new oil fields incorporate sustainable utilization or conservation of the field's associated gas without routine flaring. Furthermore, governments will make every effort to ensure that routine flaring at existing oil fields ends as soon as possible, and no later than

2030.

Oil companies that endorse the Initiative will develop new oil fields they operate according to plans that incorporate sustainable utilization or conservation of the field's associated gas without routine flaring. Oil companies with routine flaring at existing oil fields they operate will seek to implement economically viable solutions to eliminate this legacy flaring as soon as possible, and no later than 2030.

Development institutions that endorse the Initiative will facilitate cooperation and implementation, and consider the use of financial instruments and other measures, particularly in their client countries. They will endeavor to do so also in client countries that have not endorsed the Initiative.

Governments and oil companies that endorse the Initiative will publicly report their flaring and progress towards the Initiative on an annual basis. They also agree to the World Bank aggregating and reporting the same.

The parties that endorse the Initiative acknowledge that its success requires all involved – governments and oil companies, with the support of development institutions – to fully cooperate and take the action described herein to eliminate routine flaring no later than 2030.

GAS FLARING IN THE NEWS

African countries must take a balanced approach to the energy transition (https://www.africanews.com/2020/12/07/african-countries-must-take-a-balanced-approach-to-the-energy-transition-by-nj-ayuk//)

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- ✓ **Environment-friendly oil production.** An endorsement sustains and underpins an exemplary practice already in place in your company, or sets in motion a process to ensure cleaner operations, reducing your company's carbon footprint.
- ✓ **Global recognition.** An endorsement communicates to the world that despite an industry downturn, your company is a responsible oil producer with strong environmental stewardship.
- ✓ **Regional impact.** Your company's endorsement demonstrates leadership and sets an example for others to follow, thereby impacting flaring practices at other oil companies.
- ✓ **Levelling the playing field.** If you are among the many oil companies that already have a no-flaring policy for new oil field developments, the flaring Initiative helps level the playing field – other companies would adopt the same good practice, and endorsing governments would require it. The Initiative may also reduce regulatory uncertainty and flaring-related risk.
- ✓ **Foster innovation.** Abiding by the flaring Initiative could foster innovation in gas monetization.
- ✓ **Network advantages.** An endorsement connects your company to a network of leading oil-producing countries and companies that sets a de facto new global industry standard for gas flaring. This will provide companies valuable opportunities to exchange knowledge and experience, and to interact with the world's leading multilateral financial institutions.
- ✓ **Your legacy.** The Initiative provides company management an opportunity to establish a positive environmental legacy for all employees; one that will be carried on well into the future.

Commitments:

- ✓ **What you endorse** is laid out in the text of the Initiative, and relates to (a) avoiding routine flaring in new oil field developments; and (b) making efforts to end ongoing routine flaring over time.
- ✓ **Reporting.** Based on the Initiative's text on reporting, the World Bank will request and then publish as received (1) overall annual gas flaring from oil production in oil fields the company operates; and (2) the share of flaring that is routine flaring. The World Bank will not request data for individual flares and only has a reporting role, not an auditing role. The numbers are for "operated flaring" (all flaring in fields the company operate, irrespective of owner structure), and not for "equity flaring" (the company's share of flaring based on its equity share). The Bank may re-report the company's own public reporting on progress towards flaring reduction goals.
- ✓ **Not legally binding, but...** The Initiative is not a legally binding document. An endorsement does, however, establish a public commitment.

Gaffney Cline

Tackling Flaring: Learnings from Leading Permian Operators

June 2020

CA Ex. 8

About this Report

This research was prepared on behalf of the Environmental Defense Fund.

About GaffneyCline

GaffneyCline is a global consultancy that has been offering technical, commercial, and strategic advice to the oil and gas sector since 1962. GaffneyCline's reputation demonstrates that the advice delivered, together with its industry insights, is of high-quality, impartial, technically based, and commercially astute. GaffneyCline is well known as one of the leading suppliers of Reserves and Resources assessments, which are required for many purposes including statutory reporting, stock exchange listing, development planning, project finance, and asset valuation.

In addition, GaffneyCline offers a full range of upstream, midstream and downstream technical and commercial consultancy services. These range from seismic interpretation, static and dynamic reservoir modelling, field development planning, facilities and pipeline engineering, gas monetization, LNG/GTL, mergers and acquisitions, economics and project finance, unitization & redetermination, and expert witness work, exploration prospect assessment, fiscal & regulatory advice, negotiation support , strategic consulting on energy matters, carbon intensity assessments, new technology assessments, and site visit assessments.

GaffneyCline operates worldwide from three main offices located in London, Houston and Singapore, and supported by offices in Buenos Aires, Sydney and Dubai.

Author

Jennifer Stewart
Carbon Management Strategy and Policy Lead

Acknowledgements

The author is grateful to the interviewees who generously contributed their time and expertise to this project, including all producers highlighted therein as well as University Lands.

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Foreword

At J.P. Morgan Asset Management, creating value for our clients is central to everything we do. As fiduciaries, sustainability factors, including those related to environmental, social and governance (ESG) practices are an important component of our investment decision-making process.

The oil and gas sector produces social, environmental and economic costs that must be evaluated and measured. Decarbonizing the global economy is a priority but will take time. There are a variety of technologies and operational practices that can be applied today at reasonable cost to significantly reduce the environmental and social costs of extraction. The Permian basin represents an opportunity for substantial emissions reductions with the potential to deliver one of the oil and gas industry s smallest comparative environmental footprints.

Carbon dioxide (CO_2) combustion of flaring and methane from unlit and partially burning flares contribute unnecessarily to greenhouse gas (GHG) emissions without economic benefit. Societal and economic costs manifest themselves in foregone revenue streams to federal and state governments and private mineral owners because gas been not been captured and sold. Operators must preserve their social and regulatory license to operate.

Flaring is a problem with multiple solutions and a compelling long-term economic proposition. A number of industry participants – including those profiled in this report - have begun to differentiate operating practices, delivering substantial emissions reductions. Some have delivered flaring intensity as low as 1% (versus others greater than 20%) because of more deliberate planning and the adoption of widely available technologies and equipment.

Voluntary operator actions to reduce routine flaring, while necessary, have proven insufficient to deliver on the industry's full potential. Government and policymakers are well-positioned to ensure successful achievement of zero routine flaring.

J.P. Morgan Asset Management supports policymakers developing regulations to achieve the objective of zero routine flaring by 2025. With related policies, regulations and enforcement mechanisms, zero routine flaring by 2025 represents an important and achievable goal.

Our ongoing engagement with operators emphasizes the importance of establishing suitably ambitious objectives to reduce their environmental footprint through deliberate, practical business plans supported by enhanced emissions transparency. And we will hold companies accountable. The changing climate needs to be placed high on every corporate agenda as it poses both wide-ranging risks and opportunities that could impact company operations and investment valuations.

David Maccarrone, Fundamental Equity Research Analyst
Hunter Horgan, Fundamental Equity Research Analyst
J.P. Morgan Asset Management

Introduction

The practice of flaring and venting is in serious question, especially during an increasingly competitive oil & gas environment brought about by pandemic-constrained demand and a global supply glut. Flaring is a pressing challenge that industry and its stakeholders must address today.

Recent publicly available information indicate numerous Permian producers are consistently "best-in-class" with respect to flaring intensity, achieving rates from less than 1.0 to 2.6 percent where the basin average is about 4 percent.[1]

The two primary reasons industry often cites for flaring is the lack of takeaway transportation[2] and operational upsets. Our study indicates that top-tier producers treat gas takeaway capacity as a manageable constraint and handle operational upsets with both just-in-time planning and taking action to increase reliability within the operational supply chain.

We are grateful that a subset of Permian producers in this top tier – **Chevron, EOG Resources, Occidental, Parsley Energy, and Pioneer Natural Resources** – were willing to share their journey to eliminating flaring as well as their best practices when flaring is necessary. We conducted in-depth interviews with leadership in each organization, along with reviewing sustainability reports, SEC filings, Texas Railroad Commission filings, public reports, and public statements to round out the discussion and provide additional perspective.

Industry, scientific, and academic literature is rife with potential solutions, and some in industry are taking collaborative steps in the right direction[3] but others may fall short of ensuring meaningful flaring reductions. To effectively develop and implement solutions, Permian stakeholders can learn from these best-in-class producers that demonstrate reducing flaring is practical and achievable industry-wide. Our intention is that this brief report generates discussion and accelerates industry action and, ultimately, accountability by all stakeholders – communities, investors, banks, and regulators.

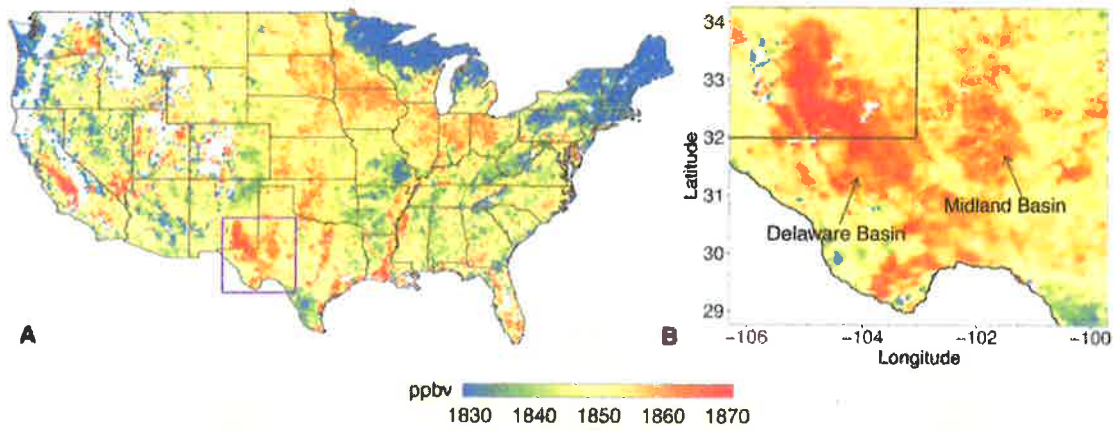
Impact of flaring on Permian methane emissions

Flaring has always been a concern from an economic waste perspective, but new science is indicating it is also an important source of greenhouse gas emissions. It is now known that reducing greenhouse gas emissions is required to prevent the earth from warming more than 2 degrees Celsius (3.6 degrees Fahrenheit).[4] Recent studies suggest extensive flaring is not only a primary source of upstream CO2 emissions,[5] but also a significant source of methane emissions in the Permian due to malfunctioning and unlit flares. Increased scrutiny of incomplete flare combustion and venting is warranted as the warming potential of methane is approximately 84 times that of carbon dioxide over a 20-year period.[6]

Through its Permian Methane Analysis Project (PermianMAP), the Environmental Defense Fund found that around 11% of Permian flares surveyed were either unlit or malfunctioning. Of that 11%, 5% were unlit

and directly venting methane, and the remaining 6% were lit but malfunctioning, leading to inefficient combustion.[7] As a result of these flaring issues, an estimated 7% of Permian gas sent to flares is escaping directly into the atmosphere, translating to a combustion efficiency closer to 93%, rather than the US Environmental Protection Agency's assumed 98%.[8]

Both PermianMAP and a recently released peer-reviewed scientific study of individual satellite readings from the Tropospheric Monitoring Instrument (TROPOMI) found similarly high methane leakage rates in the Permian basin. Adding to PermianMAP's flaring findings, the TROPOMI study also speculated that flaring and venting was likely a major contributor to the high methane emission rates detected.[9]



TROPOMI satellite observations of the Permian methane anamoly. Source: Quantifying methane emissions from the largest oil-producing basin in the United States from space; Science Advances, April 22, 2020

Given this recent flare performance data, Permian producers with near-zero methane emission targets, such as members of the Oil & Gas Climate Initiative, will likely find it difficult if not impossible to achieve these commitments without significant reductions in flaring. Eliminating routine flaring is an important step to credible methane mitigation.[10]

Flaring creates waste and financial/investment risk

As investors take a sharp look at industry investments during this challenging time, the financial and ESG case for reducing flaring has never been more important.

Permian flaring has reached such a sufficient scale that the premise of "burning gas to allow oil extraction" is really "wasting one resource to produce another."[11] When translated into exportable volumes, the numbers are striking: Gas flared in just the third quarter in 2019 would have yielded more than 15% of the total LNG volumes exported in 2018, with a value of approximately a billion dollars depending on price. At those flaring rates, if all flared or vented gas in the Permian was captured and liquefied, it could fill a Q-Max LNG carrier (the world's largest carrier size) every 10 days.[12]

Asset managers with trillions under investment are quite clear: Larry Fink, Chairman and CEO of BlackRock, the world's largest asset manager, stated in his 2020 annual letter to Chief Executive Officers that "climate risk is investment risk," as climate change concerns are driving a reassessment of risk and asset values in the investment community. He stated "In the near future – and sooner than most anticipate – there will be a significant reallocation of capital."[13] Reallocation is indeed taking place; for instance, the University of California system recently announced it divested more than $1 billion in fossil fuel investments within its $126 billion portfolio.[14] JPMorgan, historically a top financier of the energy industry, has brought climate into its investment framework, saying climate change is "no longer simply a risk, climate change and global warming are now realities that continue to reshape the corporate and investment landscape."[15] BlackRock also recently issued a report indicating that oil and gas companies with better sustainability characteristics were more likely to outperform in the marketplace.[16] Reducing flaring is a clear opportunity for industry to respond to increased investor calls for improved financial and environmental performance.


Bloomberg Green

Finance

A $1.4 Trillion Asset Manager Is Zeroing In on Methane Leaks

In 2020, Legal & General Investment Management stated a "zero tolerance" for methane leaks in the energy industry.

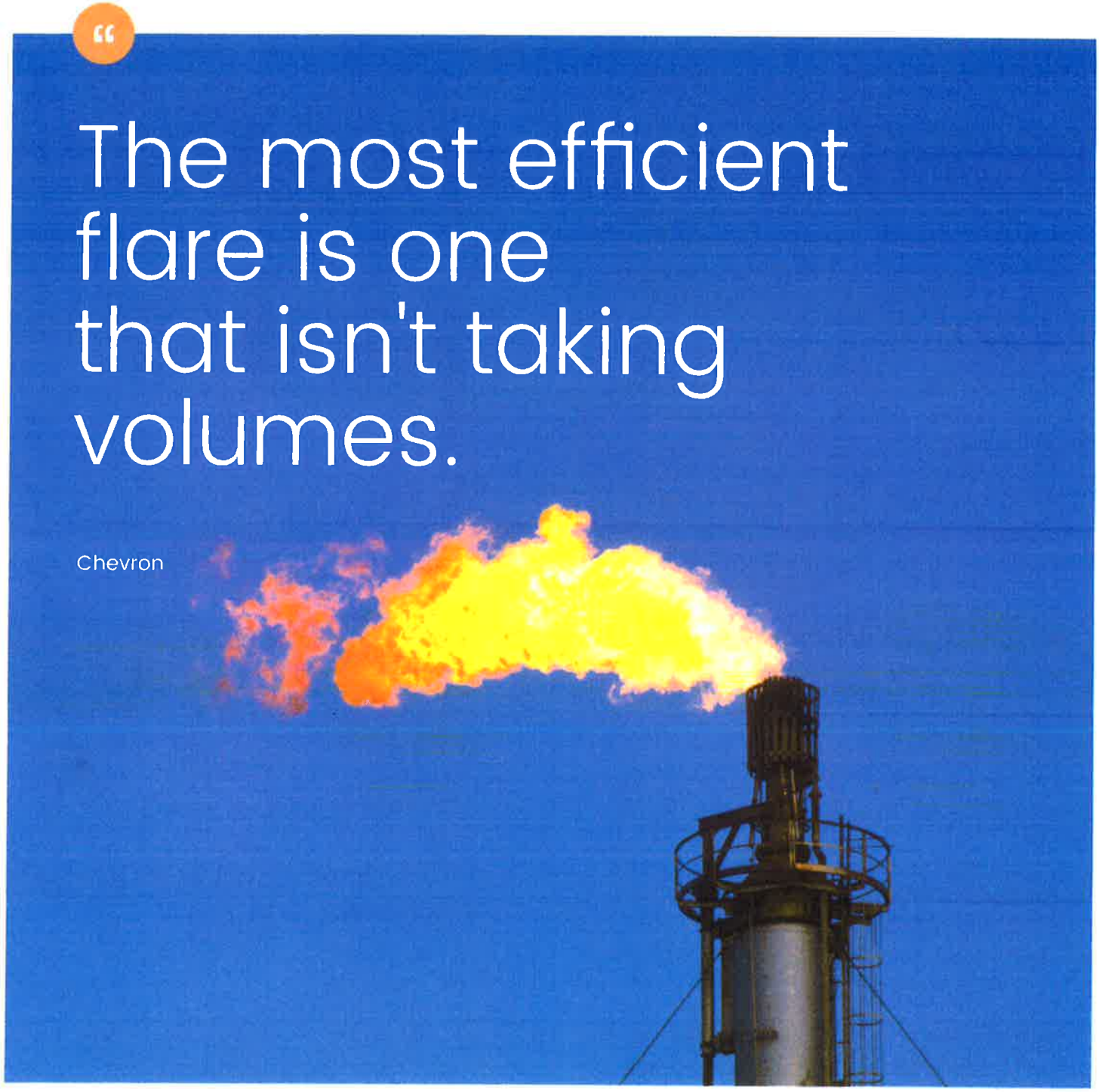
It is not just banks and asset managers who see flaring as an investment risk. In a recent earnings call, Pioneer CEO Scott Sheffield suggested that if companies are not flaring at 2% or less, public investors, private equity, and banks should either "not [do] business or sell whatever [they] have in regard to that company" to also help the flaring issue.[17]

With flaring challenges come flaring solutions that work - today

Average Permian Basin Natural Gas Flaring Rate vs. top-tier operators interviewed (2019)

Gas flared/vented as a percent of total gas production

Source: Texas Railroad Commission (RRC) and New Mexico Energy, Minerals and Natural Resources Department (EMNRD). Public flared/vented and gas production data as of May 27, 2020. Note: Parsley Energy excludes Jagged Peak 2020 acquisition



Flaring intensity data is readily available and provides an objective measurement of a producer's commitment to reducing or eliminating flaring. Thus, it is a straightforward process to identify those top tier producers with the lowest flaring intensity relative to other producers in the Permian.[18]

Not surprisingly, the participants in our study are transparent about their flaring practices, and their leadership speaks with candor, acknowledging publicly that flaring is a serious, immediate problem that must be solved quickly.

In Texas, an operator must obtain a permit from the Railroad Commission to flare gas. Concern and critique over the RRC's application and interpretation of existing flaring rules and what role that plays in contributing to excessive flaring is an ongoing debate. The companies profiled in this report are making an intentional, strategic decision to ensure they have takeaway before their wells go online. If most associated gas goes to sales, the dilemma about how to manage it becomes largely moot.

Therefore, each producer's success is due almost entirely to intentional decisions to preventing flaring in the first place. Eliminating flaring is accomplished by ensuring adequate takeaway infrastructure is in place before bringing a well online, and includes the willingness to shut a well in until takeaway capacity is secure if necessary. This commitment is shared with all stakeholders to ensure accountability, starting with the Board of Directors and extending across the organizational hierarchy from senior leadership to the field.

Whether the producer was integrated or independent, multinational or domestic was not a relevant indicator of flaring reduction success in our study.

Further, these flaring reduction commitments are not changing in the face of today's challenged price environment. Producers in this study were unanimous that their flaring and GHG emissions reduction strategies and processes are not changing despite unprecedented reductions to cash flows caused by a Saudi-Russia price war combined with demand destruction due to the COVID-19 pandemic. Some operators shared that they were actually taking advantage of the brief lull in operations by re-assigning certain employees to teams dedicated to finding and developing flaring solutions.

We focus on infrastructure planning to make sure we have gas takeaway, thus reducing the need for flaring in the first place. If you don't have the volume of gas going to the flare, then you're not going to have the issues with flaring emissions or flare functionality."

Chevron

Nothing changes in a low commodity environment. We think ESG leadership, when we come out on the other side of this thing, will be more important than ever. To be the company of the future, you've got to continue progress on this path. So we're not taking our eye off the ball."

David Dell'Osso
COO, Parsley Energy

We found three main themes facilitating best-in-class flaring performance, discussed in detail below:

1

a strong governance structure coupled with leadership on environmental stewardship;

2

a commitment to reduce or eliminate flaring by ensuring that wells do not go online until gas takeaway is in place; and

3

best-in-class practices to ensure flare functionality and reduced vapor emissions.

1 Strong Governance and Culture of Environmental Stewardship Leadership

Corporate culture around safety and environment drives low flare intensity. Each organization in our study indicated an effective, strong culture that is demonstrated in numerous ways.

Some producers set the tone outside the organization, issuing a call to their peers, employees, and contractors to align in the commitment to eliminate routine flaring. For example, in the 2019 Q4 earnings call, in his introductory remarks Pioneer CEO Scott Sheffield committed to 100% of wells being tied into gas gathering before going to production, called flaring a "black eye", and recommended that "every CEO set a [flaring] target of 2% or less."[19] In his 2020 Q1 earnings call, Mr. Sheffield recommended that the Texas Railroad Commission "shut in all companies that are above 2% in regard to [flaring] intensity."[20]

Parsley CEO Matt Gallagher gave a speech at the annual NAPE industry conference in early 2020 calling current flaring levels "unacceptable" and that the industry "must come together on this. We must commit to spending the capital dollars and pouring resources into it."[21] The speech was posted on Parsley's intranet and employees were encouraged to watch.

Methane management values expressed at the executive level and supported through standards and measurable performance expectations are reflected at the operational level. For example, when a field operator with a busy schedule and pressure to "do more with less" is faced with the choice to vent gas and quickly accomplish the work, or take the time to minimize the amount of gas vented before proceeding, what decision will they make? The choice will reflect the cultural values of an organization, and what field personnel believe will be supported.[22]

> "Reducing flaring requires executive and board leadership; it is a commitment to not put wells on production until takeaway is available."
>
> **Chevron**

> "Parsley is taking leadership in this space, and we wanted to make sure everybody understood the message that was sent outside. People took a lot of pride that we were vocal and put a flag in the ground."
>
> **David Dell'Osso**
> **COO, Parsley Energy**

So while the strategic decisions and polices are made at the Board and executive levels, thousands of day-to-day decisions impacting flaring intensity are made in the office and field front lines. The producers in our study exhibit strong governance by ensuring an engaged workforce is committed to making the right decisions regarding reducing flaring and GHG emissions. Best governance and employee engagement practices in our study include:

- Tying **compensation metrics** to flaring performance goals.
- **Sharing best practices** with other producers via technical forums and trade associations.
- Establishing cross-functional **working committees** dedicated to reducing flaring through regular design reviews, after-action analyses, and/or vetting and implementation of employee ideas.
- **Communicating** flaring targets and progress against targets in group settings such as town halls and quarterly operational meetings. EOG's executives travel to each division office across the company at least three times a year holding day long reviews to gather information, provide direction, and review ESG performance.
- Conducting internal **learning** and **technical** conferences. Occidental holds "**Environmental Boot Camps**" where it brings operations, engineering, and environmental staff to field offices to understand environmental problems such as flaring, enabling them to better design solutions.
- Making flaring intensity **data transparent** and visible to employees. One producer publishes a daily flaring report showing the previous day's performance, and the performance to date against their flaring intensity target. This is shared across all levels and functions; field, geosciences, engineering, land, and executives. Others produce similar reports weekly.
- And finally, the most impactful best governance practice is **setting aggressive flare intensity goals**, which provides employees and contractors a target to aim for and creates accountability from the Board of Directors down to the tool pusher. Some have intensity-based or absolute reduction targets, while others do not yet have stated targets but have made public statements on what they believe is the appropriate level of flaring intensity. Setting goals or targets creates accountability within the entire organization, and makes leadership accountable to investors, banks, nongovernmental organizations, and other key stakeholders.

We think it's important to set a percent target. Pioneer would like to be able to continue to produce below 2%."

Scott Sheffield
CEO, Pioneer Natural Resources

Producer	2020 Flaring Intensity Target, Goal, or Reduction Target
Chevron	Committed to reducing its global flaring intensity by 25 percent to 30 percent from 2016 levels by 2023. Chevron is unique among the study participants as it uses an equity method in determining its progress against goals, holding joint venture partners accountable for their flaring and emissions performance.
eog resources	Takes a continuous improvement approach. Executive compensation is tied to reducing 2020 flaring rates below 2019 flaring rates.
OXY	Committed to eliminating all routine flaring. Occidental is the first U.S. producer to endorse the World Bank's Zero Routine Flaring by 2030 initiative.
PARSLEY	Below 2.5% for 2020. Importantly, this goal includes full year results of Jagged Peak, which had a flaring intensity rate of 20% at the time of the January 2020 acquisition.
PIONEER NATURAL RESOURCES	Currently evaluating a flaring intensity target. CEO Scott Sheffield has stated publicly that Pioneer would like to be below 2.0%, and further "every CEO has to set a target of 2% or less."[23]

2 The best flaring practice is not to flare at all

Each producer we spoke to attributes their top-tier performance with the strategic decision to require a gas line be connected on all new wells, eliminating the need to flare associated gas in the first place. Thus, each producer mandates that infrastructure takeaway be in place before a well comes online. This is coupled with the willingness to shut in wells if the infrastructure is not in place.

Interestingly, these producers don't consider the lack of takeaway as a barrier but a constraint, i.e., a condition that needs to happen before a project is successful. One producer offered an insightful analogy: Just as permitting is built into the process as an additional constraint, meaning a producer would not drill a well without a permit, a producer should not drill a well without takeaway.

Another important point is that necessity of takeaway is in no way an unexpected event. It takes planning, communication, and coordination, which implies the need for time. However, producers suggested there is plenty of time, usually years in advance, considering the months it takes to create a production schedule and budget, construct a pad, and then drill and complete the well.

> "Routine flaring should not be a normal practice in the Permian."
>
> **Chevron**

> "Our goal isn't to reduce flaring, it's to eliminate flaring. We see this as business critical to sustain our ability to operate."
>
> **Occidental**

Strategic partnerships with midstream

For producers that don't own their own gathering and/or processing, they stressed the importance of establishing a mutual trusting relationship with gathering partners. Commercial arrangements are transformed into long-term, strategic partnerships instead of merely a tactical means to sell hydrocarbons.

Strong partnerships are important. A possible reason for the lack of takeaway capacity is information barriers combined with a lack of trust with producers, preventing midstream companies from acquiring adequate information about operators' production plans. Without this information, they are not incented to invest in infrastructure without some assurance of supply and a return on investment that meets investors' hurdle rates.

To build trust, several producers mentioned the need (if firm transportation is not in place) to not just develop but protect these relationships by ensuring that gathered volumes are maintained at a sufficient level to meet the gatherer's business plans, while at the same time meeting producers' own financial and production forecasts.

While some producers have entered into traditional firm transportation commitments designed to increase over time to accommodate expected production growth, some prefer shorter-term contracts to

avoid long-term fixed commitments, while others have created innovative, more complex arrangements that get their associated gas to sales. Although the terms of these contracts are confidential, producers shared with us that they provide timing and location of well development and projected production volumes well enough in advance to enable midstream companies to respond with adequate gathering and processing capacity. In the spirit of partnership, midstream companies share existing and planned future capacity additions and constraints to better align drilling schedules.

> "Anticipating and developing infrastructure needs to transport our products well ahead of our development plans lowers costs, maximizes efficiencies and netbacks, and minimizes flaring."
>
> **Billy Helms**
> **COO, EOG Resources**

An integrated model

At the other end of the spectrum is investing in an integrated model in which the producer owns and operates its own gathering systems to ensure takeaway. For example, EOG owns and operates compressors and low pressure gathering systems, which, in addition to ensuring reliability, may open up multiple markets and create optionality with processors.

Occidental cited a recent example where they completed a development program tying 395 wells into a single gathering system to prevent flaring from both infield development and existing wells. In this system, they installed both high and low pressure systems to maximize takeaway capacity and eliminate the need to flare gas.

Pioneer owns interests in 11 gas processing plants, including the related gathering systems.

3 Best flaring and emission reduction operational practices

Despite all efforts to eliminate routine flaring, at times producers have no choice but to flare in the case of operational upsets and high gas line pressures.

Operational upsets primarily occur due to unplanned upsets or malfunctions at gas gathering or processing facilities. Failure of equipment in the midstream sector, such as a compressor, can cascade to upstream facilities. For example, a compressor engine failure can cause an unanticipated increase in the pressure on a low-pressure gathering pipeline system. This pressure increase can cause fail-safe devices at upstream production facilities to send gas to flare automatically.

Ensuring flaring functionality and efficiency

When flaring does occur, producers use myriad equipment and processes to ensure flare tips are lit and that the flares are functioning properly. Each company discussed numerous emissions monitors and controls incorporated into facilities design. For example, EOG utilizes data collection and analysis tools to constantly monitor flared volumes at the facility, route, and foreman levels. Monitored flaring is discussed with engineering, foremen, and lease operators based on data collected from these tools. Real time, automatic changes in operating pressure are investigated with the goal to reduce flaring. When considering cost, they are incorporated into facilities budgets routinely and are considered nondiscretionary elements of facilities design. One producer pointed out that any of these types of emissions controls are relatively inexpensive or are already embedded in facilities design (i.e., SCADA). Pioneer has remote monitoring of these flares via SCADA system and failure alarms that are directed to a technician for quick repairs.

Utilizing trained staff or contractors to routinely and frequently check flares was cited as one of the best practices in terms of both operational efficacy and cost efficiency.

Flaring and emissions controls practices commonly cited by study participants

Daily AVO (auditory, visual, olfactory) observation of flare stacks	Monthly preventive maintenance	High pressure alarms on production separators
Remote observation of tank batteries by integrated operation centers	Thermocouples (temperature sensors) to ensure pilot stays lit	Designing flares to handle wide range of production rates
Continual flare vs auto-ignite to prevent foul out ignition issues	Flares designed at correct velocity to ensure gas flow does not cause pilot light to extinguish	Blower packages to introduce oxygen to efficiently combust high BTU gas
Dual tip flares (high pressure and low pressure) sized for maximum production flow in an emergency situation	Ensure that production levels stay below flare capacity to ensure combustion efficiency	Low level alarms to prevent gas blowby to tanks which prevents venting
Tie in to SCADA systems and programmable logic controllers ("PLCs") to monitor flare ignition	Flare failure alarms directed to technicians for immediate repairs	

Planning for operational upsets and increasing reliability

Operational upsets and high pressure issues are usually out of a producer's control, but leading producers take a pro-active, strategic approach to manage these upsets. Strategic solutions include:

- Escalation processes for unplanned flaring events to ensure decisions are made at the right level so an individual with the resources and authority can do things like authorize overtime, expedite parts, move crews around, or ultimately decide to shut in production if necessary to reduce flaring.

- Ensuring reliability by installing and maintaining company-owned rather than third-party compressors or, similarly, low-pressure gathering systems. Owning infrastructure and equipment provides a higher level of control and ensures maintenance and repairs are done expeditiously and correctly.

> "An escalation process for unplanned flaring allows decisions to be made by an individual with the resources and authority."
>
> Chevron

- Adding compression to counter the effect of higher pressure new wells pushing lower pressure older wells off the gathering system. Occidental provided an example where, in order to eliminate flaring, it installed its own compression because the third-party gatherer would not be able to make the installations for an extended period of time.

The producers in our study stressed that no matter who owns, operates, or maintains the equipment, midstream companies and producers should work together to avoid circumstances such as operational upsets that require flaring.

Use of Vapor Recovery Units

All participants in the study use vapor recovery units ("VRUs") on the majority of their production facilities. Pioneer installs multiple VRUs at all horizontal tank batteries regardless of the economics of recovered gas to ensure 100% VRU capture efficiency. In addition, to minimize the safety and environmental impact,

Pioneer utilizes flares as back-up to VRUs for emergencies that would otherwise be vented. Additionally, Pioneer's engineering design process considers VRU capacities as a limiting factor for facility design. They measure the gas off the tanks across several facilities to create a conservative benchmark for the amount of gas to be recovered per barrel of oil produced for future VRU designs.

Over 90% of Parsley's production flows through facilities with a VRU, and their VRUs have a 99% emissions capture efficiency manufacturer rating on all new facilities. In addition, Pioneer and Parsley both use a redundant low pressure stack system in case a VRU goes down. If a VRU fails or malfunctions, the low pressure gas that comes off the tanks is routinely vented by some operators, but in the dual pressure design used by these producers, vapors are routed to a flaring system and combusted rather than vented.

When we started the study, we asked each producer what technologies and solutions were being utilized and/or explored to handle associated gas and eliminate routine flaring (e.g., microscale LNG, CNG,

enhanced oil recovery using gas, onsite power generation, distributed generation, and injection into storage sites). Each producer responded they continuously look to improve existing, and innovate new, flaring technology and processes. Occidental has had success in the Permian with piloting enhanced oil recovery projects using reinjected associated gas, and Chevron is in the permitting process for a pilot reinjection well as a means for temporary storage. But producers were also unanimous in the view that the only viable, long term solution is getting gas to market, which prevents the need to find a use or temporary home for it. A participant from Chevron summed it up best, saying "the most efficient flare is one that isn't taking volumes."

How does a responsible flaring practice translate to the financials?

Each company participating in this study is publicly traded, so not only do they have responsibility to protect the environment, they also have a duty to their shareholders to protect value and provide an acceptable return on investment. The producers in this study saw the bridge from responsible flaring practices to the financial statements in terms of protecting cash flow, risk mitigation, and access to capital markets.

Protecting cash flow. The producers recognized that flaring is financially wasteful and it is a protection of shareholder resources to not combust natural gas and the more profitable natural gas liquids, but rather sell it, adding to production, cash flows and top line revenues.

Risk mitigation. In terms of risk, it was noted that long-term investors are not just interested in a dividend but in the long term stability of their investment. Direct evidence such as public reports of flaring intensity vis-a-vis peers indicate these companies are managing their assets responsibly and for the long-term.

> "Overall ESG accountability is something that's going to differentiate companies in their performance over the long term. We don't think this is something that's going away."
>
> **David Dell'Osso**
> **COO, Parsley Energy**

Access to capital markets. One-on-one meetings at investor conferences are confidential, but Parsley CEO Matt Gallagher has stated publicly that "investors are so focused on [flaring] that they spend as much as 15 minutes of an hour-long one-on-one meeting on 'in the weeds' questions about flaring, venting, and other environmental issues."24 So producers are certainly listening to their investors, meaning they understand that a responsible approach to flaring can attract investment (or prevent divestment), facilitate access to capital markets (when they eventually open), and possibly drive a premium to multiples. David Dell'Osso of Parsley stated, "We think that the companies that demonstrably lead in the ESG space will ultimately compete better for investor

dollars. We could see a higher earnings multiple over time. Ultimately, it could become conditional for competitive access to low-cost capital."

A call to action for both industry and their stakeholders

We see that solutions to eliminating flaring exist despite complex economic and infrastructure issues. But while the industry holds a significant share of responsibility for reducing and eliminating flaring, this complexity requires collective action. Producers and trade associations cannot solve the problem completely by themselves. Policy makers, investors, banks, midstream companies, and regulators not only have a stake in a financially and environmentally positive outcome, but a role to play in making sure routine flaring is a thing of the past.

Footnotes

1. Texas Railroad Commission (RRC) and New Mexico Energy, Minerals and Natural Resources Department (EMNRD). Public flared/vented and gas production data as of May 27, 2020.
2. In a late 2019 Federal Reserve Bank of Dallas survey of 146 oil and gas companies, 73% indicated a lack of pipeline takeaway as a reason for routine flaring. https://www.dallasfed.org/-/media/Documents/research/surveys/des/2019/1904/des1904.pdf
3. For example, a recent invitation-only Permian flaring workshop sponsored by Columbia University and the University of Texas at Austin, brought together producers, pipeline companies, policymakers, non-governmental organizations, academics and analysts to talk about Permian Basin flaring (https://energypolicy.columbia.edu/research/global-energy-dialogue/columbia-global-energy-dialogue-natural-gas-flaring-workshop-summary).
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5. https://www.epa.gov/sites/production/files/2019-10/documents/subpart_w_2018_industrial_profile.pdf
6. https://www.epa.gov/ghgemissions/understanding-global-warming-potentials
7. Data as of March 2020. The study is ongoing, collecting methane data across a 10,000 square-kilometer study area within the basin via fixed-wing aircraft, helicopters, towers, and ground-based mobile sensors. Flare performance estimates are based on helicopter-based optical gas imaging.
8. The Environmental Protection Agency assumes a 98% efficiency flare rate, but flare performance studies show that observed combustion efficiency can be as low as 62%. Douglas M. Leahey , Katherine Preston & Mel Strosher (2001) Theoretical and Observational Assessments of Flare Efficiencies, Journal of the Air & Waste Management Association, 51:12, 1610-1616, DOI: 10.1080/10473289.2001.10464390 and Kleinberg, Robert. (2019). Greenhouse Gas Footprint of Oilfield Flares Accounting for Realistic Flare Gas Composition and Distribution of Flare Efficiencies. 10.1002/essoar.10501340.1.
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Finance

Investment Giants Urge Texas to End Most Natural Gas Flaring

By Kevin Crowley
September 4, 2020, 8:00 AM MDT
Updated on September 4, 2020, 2:54 PM MDT

- Group tells regulators that routine flaring should end by 2025
- AllianceBernstein, CalSTRS, LGIM: Industry hasn't done enough

Investors managing more than $2 trillion are calling on Texas regulators to ban the routine burning of natural gas from shale fields, arguing that the energy industry hasn't moved quickly enough to curb the controversial practice.

AllianceBernstein, California State Teachers' Retirement System and Legal & General Investment Management said they support eliminating gas flaring by 2025, according to a letter to the Texas Railroad Commission, which oversees oil and gas in the state. All three investors have been vocal on environmental issues before, but it's the first time large institutional investors have taken such a public stance to the Texas regulator.

CA
Ex. 9

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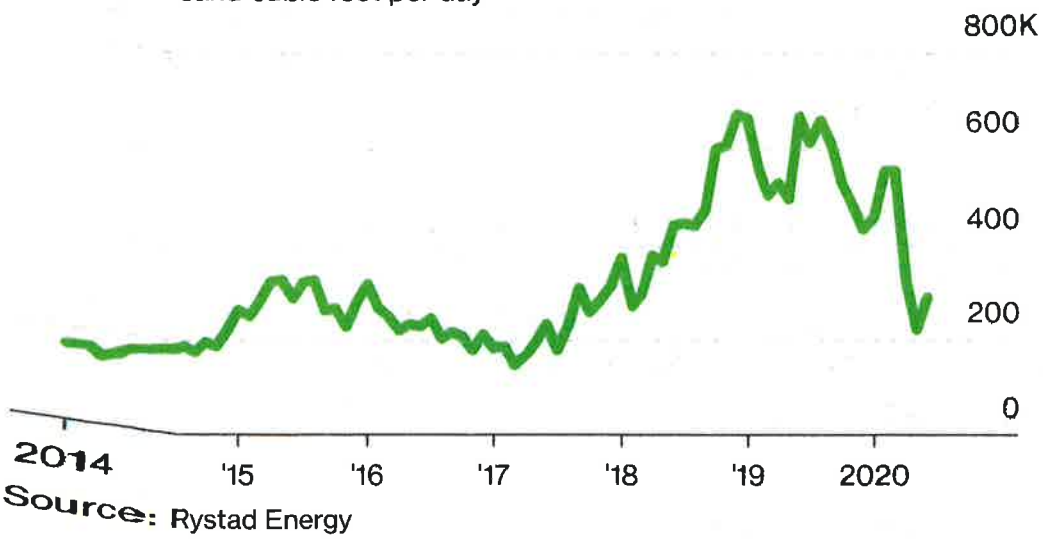
Open the Data Dash

"Actions of leading operators demonstrate the financial and technical viability of ending routine flaring," the fund managers said in the letter, which was seen by Bloomberg. "It is clear, however, that voluntary actions alone have been insufficient to eliminate routine flaring industry-wide."

Investors and environmentalists are increasingly drawing attention to flaring because of its wastefulness and contribution to climate change. Flaring is utilized around the world as a way to deal with gas that producers can't -- or don't want to -- transport or store. Much of what's burned, especially in the shale fields of Texas, is so-called associated gas coming from oil wells.

Up in Smoke

Gas flaring in the Permian Basin surged 2014-2019 but dropped this year



Source: Rystad Energy

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The sheer abundance of gas in the Permian Basin of West Texas and New Mexico means local prices for the fossil fuel are often so low that it's cheaper for shale operators to burn it rather than pay for pipeline connections and storage. Last year the Permian flared enough gas to supply 5 million U.S. homes, according to Oslo-based Rystad Energy.

Related: Permian's Gas-Flaring Is Much Worse Than Previously Thought

The Texas Railroad Commission has come under attack for allowing companies to effectively flare at will over the past decade as shale production boomed and helped make the U.S. the world's top oil producer. The commission allows companies to flare during the start-up of wells and during emergencies. It also issues waivers that can be utilized right through the early and most productive phase of a shale well's operation.

After more than a year of public pressure, the commission recently proposed reducing the amount of flaring time allowed under some waivers and requiring operators to provide information on why they need to flare, but it set no targets and resisted calls for an outright ban. Lower oil production due to the Covid-19 pandemic has meant flaring rates have dropped significantly this year, the commission said in a statement last month.

"Strong and effective regulatory action -- beyond initial steps to improve data gathering and transparency -- is essential to build stakeholder confidence and solve this challenge across industry," the investors said in the letter, which is part of the commission's public consultation.

The commission "has been taking steps to further reduce flaring" in its recent proposals, spokesman Andrew Keese said in an emailed statement. The changes are "within parameters of existing rules," he said.

LGIM, the U.K.'s biggest asset manager, supports the role of gas in the transition to cleaner energy sources but the industry "must get hold of its emissions challenges," said John Hoeppner, head of the firm's U.S. stewardship and sustainable investment unit.

The Railroad Commission had a "hands-off policy" on flaring for too long, he said. The letter aims to establish a common goal that companies, regulators and investors can rally around and help solve the problem, Hoeppner said. In May, LGIM said it would oppose the re-election of Darren Woods as Exxon Mobil Corp. chairman over what it called a lack of ambition on tackling climate change.

LGIM has about $1.6 trillion of assets under management. AllianceBernstein oversees roughly $600 billion and CalSTRS manages more than $200 billion.

(Updates with comment from regulator in ninth paragraph.)

In this article

1824483D
LEGAL & GENERAL INVESTMENT M
Private Company

NG1
Generic 1st 'NG' Future
2.59 USD/MMBtu ▲ +0.04 +1.49%

CL1
WTI Crude
46.57 USD/bbl. ▼ -0.21 -0.45%

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TEXAS RAILROAD COMMISSION
Private Company

AB
ALLIANCEBERNSTEI
32.10 USD ▲ +0.07 +0.22%

Investor Statement Urging Gov. Michelle Lujan Grisham's State Agencies to Strengthen Draft Rules to Reduce Methane Waste and Pollution from the Oil and Gas Industry

As the undersigned investors, representing more than $102 billion in assets under management, we write today to urge the New Mexico Environment Department (NMED) and Energy Minerals and Natural Resources Department (EMNRD) to strengthen draft Ozone Precursor and Methane Regulations to limit waste and pollution from the oil and gas industry.

While addressing the public health and economic impacts of the COVID-19 pandemic remains paramount at this time, we welcome Governor Michelle Lujan Grisham's continued efforts to cut energy waste and mitigate climate change – another impending public health and economic challenge – by reducing air and methane pollution from oil and gas operations. In fact, today's current public health crisis makes smart, cost-effective policies to cut air pollution and reduce greenhouse gas (GHG) emissions even more important.

In support of these goals, we urge our portfolio companies to support comprehensive, statewide air and methane pollution rules that address all oil and gas operators in New Mexico and support strengthening New Mexico's draft rules. The next iteration of the draft rules should eliminate loopholes that effectively exempt the vast majority of wells from oversight by the NMED, including leak detection and repair requirements, which are the single-most effective tool for reducing leaks.

Fortunately, these fixes are economic and eminently achievable. A recent analysis by Synapse Energy Economics found that for every dollar invested by New Mexico's oil and gas industry in emissions reductions, the proposed rules without any exemptions would offer the state a return on investment of more than 30%. This includes at least $126 million in public health benefits, $1.2 billion in avoided air quality nonattainment costs, and $730 million of captured methane gas between 2020 and 2030 that would generate $99 million in royalties to the state.

As investors, we collectively direct billions of dollars with a view to ensure sound financial returns for our beneficiaries. We recognize the significant financial risks posed by climate change as well as the enormous economic opportunities provided by low-carbon and climate-resilient technologies, markets and business models. The oil and gas sector is the largest industrial source of methane emissions in the U.S. and the largest source of GHG emissions in New Mexico. Therefore, it is critical that methane emissions from this sector are appropriately and comprehensively addressed.

Methane mitigation technologies have proven themselves cost-effective when implemented, driving additional revenue through the capture of an otherwise lost product. Moreover, improvements in technologies continue to drive declines in the capital and operational costs of methane mitigation, making them more affordable to producers large and small. As New Mexico's oil and gas industry recovers, strong air and methane pollution standards support global competitiveness in a world with increasingly stringent climate policies and corporate GHG emissions reduction goals.

Investors have made engagement with oil and gas companies on methane a key priority in recent years, working with companies to set targets and align their operational practices accordingly. Yet, while some companies are demonstrating leadership on managing methane emissions, industry performance is not uniform. A recent analysis by the Environmental Defense Fund (EDF) found that oil and gas operations in New Mexico emit at least one million metric tons of climate-warming methane a year and hundreds of thousands of tons of smog-producing volatile organic compounds (VOCs). Without a level playing field, the poorest performers will shape the public narrative on natural gas, overshadowing proactive measures of industry leaders and risking the industry's social license to operate. As the second largest]

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EX. 10

oil and ninth largest of natural gas, New Mexico has a key role to play in setting leading standards for other states to follow.

Unfortunately, the draft Ozone Precursor and Methane Regulations put forward by NMED and EMNRD fail to honor Gov. Lujan Grisham's commitment to protect the health of New Mexico families and the climate. We write today to urge the agencies to strengthen the draft rules in the following ways:

- NMED's rule would exempt the vast majority of wells in New Mexico from leak detection and repair requirements – one of the most effective ways to limit oil and gas pollution. Two proposed exemptions in the draft rules – one for low producing or stripper wells and the other for sites below a 15 ton per year pollution threshold would collectively mean 95% of the wells in New Mexico would go unchecked. NMED should remove these loopholes.

- EMNRD has set an appropriate goal that 98% of all gas be captured. However, if that requirement is not set by locality, for companies with operations in both the San Juan and Permian Basins, all of the reductions could occur in the Permian. This would disproportionately impact Navajo and Latino communities in the San Juan Basin. EMNRD should set the goal on the basis of locality such as county or basin.

- EMNRD should also improve enforcement provisions, including automatic triggers taking meaningful action to motivate companies to comply, denying drilling permits for applications without firm agreements for pipeline capacity, and removing exemptions for venting which is far more damaging to the climate than flaring. Meanwhile, routine flaring should be eliminated and only occur when absolutely necessary to protect health and safety. And in order to address waste and pollution from flares a requirement to use enclosed combusters or flares equipped with auto igniters or continuous pilots and capable of achieving a 98% destruction removal efficiency should be added.

We appreciate Gov. Lujan Grisham's leadership and NMED and EMNRD's efforts to move forward these important regulations. The finalization of strong regulations will help New Mexico's oil and gas sector maintain its viability while addressing the economy-wide risks of climate change.

Sincerely,

As You Sow
Boston Common Asset Management
Boston Trust Walden
Capricorn Investment Group
Committee on Mission Responsibility Through Investment of the Presbyterian Church U.S.A.
Congregation of Sisters of St. Agnes
Corporate Responsibility office - The Province of Saint Joseph of the Capuchin Order
Dana Investment Advisors
Domini Impact Investments LLC
Dominican Sisters of Grand Rapids
Dominican Sisters of Mission San Jose
Dominican Sisters of San Rafael
Dominican Sisters or Sparkill
EverWatch Financial
Friends Fiduciary Corporation
Horizons Sustainable Financial Services
Impax Asset Management LLC

Leadership Team of the Felician Sisters of North America
Maryknoll Sisters
Miller/Howard Investments, Inc.
Missionary Oblates International Pastoral Investment Trust
Natural Investments
NEI Investments
New Mexico State Treasurer's Office
Northwest Coalition for Responsible Investment
Progressive Investment Management
Region VI Coalition for Responsible Investment
Religious of the Sacred Heart of Mary
Seventh Generation Interfaith Coalition for Responsible Investment
Sisters of Charity of Nazareth
Sisters of Saint Joseph of Chestnut Hill, Philadelphia, PA
Sisters of St. Francis of Philadelphia
Sisters of St. Joseph of Orange
Sisters of the Humility of Mary
Sisters of the Presentation of the BVM of Aberdeen SD
Skye Advisors LLC
Socially Responsible Investment Coalition
Trillium Asset Management
Trinity Health
United Methodist Women
Ursuline Convent
Vert Asset Management

For more information or to contact the signatories, please contact Emily Duff at Ceres (duff@ceres.org).

EUROPEAN
COMMISSION

Brussels, 14.10.2020
COM(2020) 663 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

on an EU strategy to reduce methane emissions

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EX. 11

I. INTRODUCTION

Methane is a powerful greenhouse gas, second only to carbon dioxide in its overall contribution to climate change. On a molecular level, methane is more powerful than carbon dioxide. Although it remains for a shorter time in the atmosphere, it has a significant effect on the climate[1] and contributes to tropospheric ozone formation, a potent local air pollutant which itself causes serious health problems[2]. Reducing methane emissions therefore contributes to both slowing down climate change as well as improving air quality. Significant portions of methane emissions can be mitigated cost-effectively.

The Regulation on the Governance of the Energy Union and Climate Action[3] calls on the Commission to deliver a strategic plan for reducing methane emissions. Furthermore, in the European Green Deal Communication[4], the Commission indicated that energy-related methane emissions needed to be addressed as part of the commitment to reach climate neutrality by 2050. In this way, policy action to reduce methane emissions will contribute to both the EU's decarbonisation efforts towards the 2030 Climate Target Plan and the EU's zero-pollution ambition for a toxic-free environment.

Current policies for non-CO_2 emissions are projected to reduce methane emissions in the EU by 29% by 2030 compared to 2005 levels[5]. Nevertheless, the 2030 climate target plan's impact assessment[6] found methane will continue to be the EU's dominant non-CO_2 greenhouse[7]. It concluded that stepping up the level of ambition for reductions in greenhouse-gas emissions to at least 55% by 2030 compared to 1990 would also require an accelerated effort to tackle methane emissions, with projections indicating a step up needed to 35% to 37% methane emission reductions by 2030 compared to 2005. At a global level, reducing methane emissions associated with human (anthropogenic) activity by 50% over the next 30 years could reduce global temperature change by 0.18 degrees Celsius by 2050[8].

The EU has reduction targets for 2030 for all greenhouse gases, with anthropogenic methane emissions covered by binding national emission reduction targets under the Effort Sharing Regulation (ESR)[9]. However, there is currently no policy dedicated to the reduction of anthropogenic methane emissions. Approximately 41% of global methane emissions come from natural sources (biogenic), like wetlands or wildfires[10]. The remaining 59% are

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[1] IPCC AR5, (2014). IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[2] European Environment Agency (EEA), (2016). Premature deaths attributable to air pollution (EU 28). https://www.eea.europa.eu/media/newsreleases/many-europeans-still-exposed-to-air-pollution-2015/premature-deaths-attributable-to-air-pollution. In the EU, premature deaths due to ozone exposure are estimated at between 14,000 and 16,000 per year for the years 2015 to 2017. JRC modelling results estimate that by 2030, depending on levels of methane concentrations, the difference in associated premature deaths would be between 1,800 and 4,000, annually. These results are likely under-estimates as they do not take into account recent re-evaluations of mortality risks associated with long-term ozone exposure, which suggest a factor 2.3 times higher.

[3] (EU) 2018/1999.

[4] COM(2019) 640 final.

[5] EU 2030 climate target plan Impact Assessment, https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_2&format=PDF.

[6] EU 2030 climate target plan Impact Assessment, https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_2&format=PDF.

[7] Significant quantities of non-CO2 greenhouse gases are still being emitted in the EU today, representing around 20% of total emissions. In 2015, methane represented around 60% of total non-CO2 greenhouse gas emission, followed by nitrous oxides and F-gas emissions (EU 2030 climate target plan Impact Assessment).

[8] Climate and Clean Air Coalition Scientific Advisory Panel, (2020).

[9] Regulation, (EU) 2018/842.

[10] International Energy Agency (IEA), World Energy Outlook, (2018), https://edgar.jrc.ec.europa.eu/overview.php?v=50_GHG.

anthropogenic, of which the largest sources are agriculture (40-53%) – in particular linked to intensive production, fossil fuel production and use (19-30%), and waste (20-26%). In the EU, 53% of anthropogenic methane emissions come from agriculture, 26% from waste and 19% from energy[11]. The reported distribution of emissions per sector continues to evolve as reporting and data collection improve. Nevertheless, these three sectors account for up to 95% of global anthropogenic methane emissions, and should therefore be the focus of mitigating action[12].

The EU should also play a role in ensuring methane emission reductions at global level. While the EU contributes only to 5% of global methane emissions[13], it can use its position as the largest global importer of fossil fuels and as a strong player in the agriculture sector to support similar action from global partners. The EU is also a technical leader in satellite imagery and methane emission leak detection through the Copernicus program and can lead international collaboration to improve the monitoring and mitigation of global methane emissions.

The Communication sets out a strategy for reducing methane emissions. It outlines a comprehensive policy framework combining concrete cross-sectoral and sector-specific actions within the EU, as well as promoting similar action internationally. While in the short-term, the strategy encourages global level voluntary and business-led initiatives to immediately close the gap in terms of emissions monitoring verification and reporting, as well as reduce methane emissions in all sectors, it foresees EU level legislative proposals in 2021 to ensure widespread and timely contributions towards the EU decarbonisation objectives.

II. A NEW STRATEGY TO REDUCE METHANE EMISSIONS: COMBINING CROSS-SECTOR AND SECTOR-SPECIFIC ACTIONS

The EU first addressed methane emissions with a strategy adopted in 1996[14]. In the following years, the EU adopted regulatory initiatives that contributed to methane emission reductions in key sectors[15]. Relative to 1990 levels, energy-sector methane emissions have halved, while emissions from waste and agriculture have fallen by a third and just over a fifth respectively[16]. Nevertheless, methane emissions remain a significant challenge in each of these sectors.

In the energy sector, methane leaks from fossil fuel production sites, transmission systems, ships and distribution systems. Methane is also vented (released intentionally) into the atmosphere. Even when flared (burnt), carbon dioxide is released and methane can still escape during flaring as a result of incomplete combustion[17]. According to current estimates, 54% of

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[11] European Environment Agency (EEA), (2018). EEA greenhouse gas - data viewer. https://www.eea.europa.eu/ds_resolveuid/f4269fac-662f-4ba0-a416-c25373823292.

[12] Climate and Clean Air Coalition (CCAC) Scientific Advisory Panel, (2020).

[13] Climate Watch Data, (2016).

[14] Strategy paper for reducing methane emissions. Communication from the Commission to the Council and to the European Parliament. COM (96) 557 final, 15 November 1996.

[15] Such as in the waste sector - to address site management, including landfill gas – but which also contributed to mitigating methane emissions. Also, methane emissions are covered by the binding national greenhouse gas targets set under the effort sharing legislation (Decision No. 406/2009/EC).

[16] In depth analysis in support of the Commission Communication COM(2018) 773

[17] Flaring and venting occurs at coal, oil and fossil gas production sites. It also occurs (to a much lesser extent) at landfill gas and biogas facilities. Flaring is the controlled burning of gases produced or released in association with: fossil-fuel extraction and transportation; and certain agricultural and waste practices. Venting is the controlled release of unburned gases directly into the atmosphere. Venting is arguably more harmful to the environment as the released gas typically contains high-levels of CH_4, whereas flaring converts the CH_4 into less

methane emissions in the energy sector are fugitive emissions from the oil and gas sector, 34% fugitive emissions from the coal sector and 11% from residential and other final sectors[18]. The EU's climate target plan impact assessment indicates that the most cost-effective methane emission savings can be achieved in the energy sector. Upstream oil and gas operations generally have a variety of mitigation options that have no net costs[19], or near zero costs[20].

Agriculture is the second sector with the highest potential in overall benefits for reducing methane emissions[21]. There are also potential synergies and trade-offs for mitigating the cost of emission reductions in agriculture through the reduction of nutrient losses in animal feed by enteric fermentation[22] and by producing biogas[23]. Methane emissions from livestock originate mainly from ruminant species (enteric fermentation) (80.7%), manure management (17.4%), and rice cultivation (1.2%). Sources of methane emissions are often diffuse in the agriculture sector, which can make measurement, reporting and verification challenging. They also differ noticeably across the EU. Nevertheless, technologically feasible mitigation practices do exist, and their deployment should be facilitated, along with reporting on their effects.

In the waste sector, the main identified sources of methane are uncontrolled emissions of landfill gas in landfill sites, the treatment of sewage sludge and leaks from biogas plants due to poor design or maintenance. Emissions from the landfilling of waste fell by 47% between 1990 and 2017[24], following better compliance with EU waste legislation on emissions from landfill. This was achieved primarily by diverting biodegradable waste to other waste-treatment options higher in the waste hierarchy[25] such as composting and anaerobic digestion, as well as ensuring the stabilisation of biodegradable waste before disposal. However, more stringent compliance practices are needed to further reduce methane emissions from waste.

An effective EU strategy to reduce methane emissions must therefore provide stronger measures to address methane emissions in each sector, but also take greater advantage of synergies across sectors and policy areas. Adopting a holistic approach brings clear advantages, as it allows for more cost-effective and evidence-based mitigation of methane emissions. It also makes it possible to build an enabling framework and strengthen the business case for capturing methane emissions. Given the high share of methane emissions in agriculture that result from livestock, lifestyle and diet changes can also contribute

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harmful CO_2. Nevertheless, the process of flaring can release other emissions such as SO_2 and NO_2 which, when combined with moisture in the atmosphere, can form acid rain.

[18] Climate and Clean Air Coalition (CCAC) Scientific Advisory Panel, (2020).

[19] International Energy Agency (IEA), (2020). Methane Tracker 2020, https://www.iea.org/reports/methane-tracker-2020/methane-abatement-options.

[20] EU 2030 climate target plan Impact Assessment, https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_2&format=PDF.

[21] EU 2030 climate target plan Impact Assessment, https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_2&format=PDF.

[22] Formation of methane by microbes in the gut of animals. Ruminant animals are a subset of mammals that ferment food in their 'rumen' (first stomach) using bacteria, before further digestion in subsequent stomachs. This 'enteric fermentation' generates methane, which the animal releases. The largest sources of methane emissions in the EU agricultural sector are from cows and sheep.

[23] [EU 2030 climate target plan Impact Assessment, https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_2&format=PDF.

[24] https://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2020

[25] 'The waste hierarchy generally lays down a priority order of what constitutes the best overall environmental option in waste legislation and policy. Further details in , Directive 2008/98/EC and https://ec.europa.eu/environment/waste/framework/

significantly to reducing EU methane emissions. Beyond reducing emissions, the strategy will also provide for opportunities to generate additional revenue streams and development and investment in rural areas.

1. CROSS-SECTORAL ACTIONS WITHIN THE EU

a. Reporting

A priority objective of the strategy is to ensure that companies apply considerably more accurate measurement and reporting methodologies for methane emissions, across sectors, than is currently the case. This will contribute to a better understanding of the problem and better inform subsequent mitigation measures[26].

The United Nations Framework Convention on Climate Change (UNFCCC) has a three-tier reporting framework for methane emissions, which is applicable across all relevant emitting sectors. Tier 1 constitutes the most basic approach, involving simple estimations based on activity data and emission factors. Tier 3 is the most demanding in terms of methodological complexity and data requirements, involving complex modelling based on multiple data sources or specific, individual measurement. Tier 2 is intermediate in complexity and may combine elements of both Tiers 1 and 3.

Currently, the level of monitoring and reporting varies considerably between sectors and Member States, with very few Member States consistently applying Tier 3 standards. One of the key objectives of this strategy is to make Tier 3 methane reporting by energy, chemical and agricultural companies more widespread across the EU, where possible. This would allow Member States to move to higher tier reporting when submitting national emissions data to the United Nations Framework Convention on Climate Change (UNFCCC), for example. Nevertheless, a certain level of flexibility in reporting is required to account for the different challenges to improving monitoring and reporting across the different sectors, as well as to concentrate reporting efforts on key categories of sources, in line with the International Panel on Climate Change (IPCC) guidelines[27].

In the energy sector, Tier 3 reporting is achievable for industry and will therefore be the EU target standard. Widespread adoption of the measurement and reporting framework developed under the Climate and Clean Air Coalition (CCAC) Oil and Gas Methane Partnership (OGMP)[28] will accelerate this transition (see more details under actions in the energy section). The new OGMP standard (OGMP 2.0) commits participating companies to increase the accuracy and granularity of their methane emissions reporting for operated and non-operated assets in 3 and 5 years respectively.

In the agricultural sector, the challenges associated with a higher number of different actors involved in adjusting to new targets justifies a temporary objective of applying Tier 2 approaches, with improving disaggregation of emission factors and a final objective of achieving Tier 3. In the waste sector, the quality of reporting is already robust for waste

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[26] Measurement, reporting, verification (MRV), integrity and validation (IV).

[27] Intergovernmental Panel on Climate Change (IPCC), 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, https://www.ipcc.ch/site/assets/uploads/2019/12/19R_V0_01_Overview.pdf

[28] Climate and Clean Air Coalition (CCAC) Oil and Gas Methane Partnership (OGMP). https://ccacoalition.org/en/activity/ccac-oil-gas-methane-partnership#:~:text=The%20Climate%20and%20Clean%20Air,New%20York%20in%20September%202014.

disposal in landfills sites (under the scope of Directive 2010/75/EC[29]) through the European Pollutant Release and Transfer Register[30]. Conversely, as regards the wastewater sector, improvements are needed.

b. Establishing an international methane emissions observatory

Currently, there exists no independent, international body which collects and verifies methane emissions data. In partnership with the United Nations Environmental Programme (UNEP), the Climate and Clean Air Coalition (CCAC)[31] and the International Energy Agency, the Commission will support the establishment of an independent international methane emissions observatory, tasked with collecting, reconciling, verifying and publishing anthropogenic methane emissions data at a global level. The observatory would be anchored in a United Nations framework. The observatory would build on a number of work streams such as the Oil and Gas Methane Partnership (OGMP) and the global methane science studies[32] as part of the Climate and Clean Air Coalition.

Initially, the observatory would cover methane from the oil and fossil gas sectors as robust methodologies that can deliver credible data are already well defined, for example through OGMP 2.0. The Commission envisages extending the scope of the observatory to cover coal, waste and agricultural activities once comparably reliable monitoring and reporting methodologies are established for those sectors. Actions to define these methodologies should start immediately.

For the purpose of data verification and reconciliation of energy related methane emissions, company reporting needs to be complemented with data from national emission inventories, scientific research, as well as satellite observations and other remote sensing technologies verified by ground-level observations. The observatory would also be tasked with testing new monitoring and reporting technologies and assessing how these technologies could be used within existing methodologies, as well as assessing the level of improvement these technologies provide to the quality of data submitted by companies. The Commission expects that the observatory would help to improve understanding of the sources of emissions also within sectors, for example regarding differences in methane emissions from intensively reared livestock versus pasture raised livestock[33].

The Commission is ready to mobilise funding from the Horizon 2020 programme to kick-start the establishment of such an international methane emissions observatory. In cooperation with the United Nations Environmental Programme and the Climate and Clean Air Coalition, the

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[29] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0075

[30] https://prtr.eea.europa.eu/#/home

[31] The **Climate and Clean Air Coalition (CCAC)** is a voluntary partnership of governments, intergovernmental organizations, businesses, scientific institutions and civil society organizations committed to improving air quality and protecting the climate through actions to reduce short-lived climate pollutants. https://ccacoalition.org/en/content/who-we-are. The **United Nations Environment Programme (UNEP)** is the leading global environmental authority that sets the global environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations system, and serves as an authoritative advocate for the global environment. https://www.unenvironment.org/about-un-environment.

[32] Climate and Clean Air Coalition (CCAC) methane science studies https://ccacoalition.org/en/activity/oil-and-gas-methane-science-studies.

[33] Knapp, et al., (2014). Enteric methane in dairy cattle production: Quantifying the opportunities and impact of reducing emissions, https://www.sciencedirect.com/science/article/pii/S0022030214002896

Commission envisages organising a donor conference to encourage national governments to contribute towards the financing of the observatory.

c. Satellite detection, Copernicus and aerial monitoring

The EU's Copernicus programme for earth observation is contributing to improved indirect air surveillance and the monitoring of methane emissions. In particular, Copernicus can contribute to an EU-coordinated capability for detecting and monitoring global super-emitters[34], principally via its Copernicus Atmosphere Monitoring Service (CAMS)[35]. Globally, 5% of methane leaks in the coal, oil and fossil gas sectors contribute to 50% of the energy sector's emissions[36] and based on a first analysis of EU emissions data, a similar pattern emerges for the EU[37]. Satellite technology is key to identifying these hotspots and guiding leak detection and repair on the ground as well as reconciling bottom-up data from company reporting.

When launched in 2025, the Copernicus CO_2-monitoring (CO2M) mission, which involves a constellation of three satellites, will support the identification of smaller and more prevalent sources of emissions. It will also be able to monitor global atmospheric methane. This will represent significant additional capacity to the capabilities of the Copernicus Atmosphere Monitoring Service and the Tropospheric Monitoring Instrument (TROPOMI), two existing Copernicus capabilities on board of the Sentinel 5P satellite, that are able to detect larger emission sources.

Improved top-down data from satellites will help to target bottom-up leak detection on the ground as well as aerial monitoring. There have been significant technological advances made in these areas in recent years with improved accuracy and cost-effectiveness. For example, the use of drones makes it possible to survey large amounts of infrastructure and facilitates more widespread use of aerial monitoring as well as increased frequency, which is key to addressing intermittent leaks. Sophisticated analytical programs allow for the reconciliation of data at different levels and can guide abatement efforts. The Commission intends to support the sharing of information and technology across stakeholders to enhance access and catalyse abatement efforts.

d. Review and possible revisions of relevant environmental and climate legislation

In the European Green Deal, the Commission announced that in 2021 it would review EU legislation, with the overall aim of delivering increased climate ambition as contained in the 2030 climate target plan impact assessment. A number of pieces of legislation are within the scope of this review which have a bearing on methane emissions. This includes the EU Emissions Trading System (ETS) and the Effort Sharing Regulation (ESR), the latter covering all methane emissions in the EU next to all other greenhouse gases not covered by the

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[34] The term 'super-emitter' in this general context refers to a specific site or facility with disproportionately high-emissions for a site or facility of that kind. In specific sectors, there are individual definitions of super-emitters. For example, in the fossil gas supply chain the term can refer to sites with the highest proportional loss rates, i.e. the greatest loss of methane emitted for methane produced/processed (Zavala-Araiza, et al., 2015).

[35] CAMS analyses global fluctuations in methane emissions on a daily and monthly basis. It can also provide full emissions datasets with comparisons between the main global and regional inventories. To derive more accurate data, CAMS methane products are reconciled with other independent measurement sources, such as surface-monitoring stations, ships, and aircraft programmes.

[36] Brandt, Cooley, Heath, (2016) (DOI: 10.1021/acs.est.6b04303).

[37] 10-20% of sites are responsible for 60-90% of emissions. Source: 'Tackling energy-related methane emissions', 2020. Consortium led by Wood Environment & Infrastructure Solutions GmbH.

emissions trading system. The assessment supporting the 2030 climate target plan underlined that also for these gases increased incentives will be required to reduce emissions further. The achievement of this strengthening of ambition will benefit from the sectoral actions in this strategy.

Revision of environmental legislation will include measures to address pollution. The Commission will for instance assess whether the role of the Industrial Emissions Directive (IED)[38] in preventing and controlling methane emissions could be enhanced. This could be both from expanding the scope of the IED to cover methane emitting sectors not yet included in its scope and a greater focus on methane during the reviews of Best Available Techniques (BAT) Reference Documents (BREF). This would mean ensuring that techniques to reduce methane emissions are identified in BREF reviews and methane BAT-associated emission levels (BAT-AELs) are included in BAT conclusions. The Commission will also assess the potential to expand the sectoral scope of the European Pollutant Release and Transfer Register (E-PRTR) Regulation[39] to report methane emissions.

The Commission will consider including methane in the zero-pollution monitoring framework to be developed under the Zero Pollution Action Plan announced for 2021 and the third edition of the EU Clean Air Outlook in 2022. The Commission will also review the National Emission Reduction Commitments (NEC) Directive by 2025 and, as part of this review, explore the possible inclusion of methane among the regulated pollutants.

e. Opportunities in biogas production

Non-recyclable human and agricultural waste (i.e. manure) and residue streams can be utilised in anaerobic digesters to produce biogas or in biorefineries to produce bio-materials and intermediate bio-chemicals. When used for biogas production, such raw materials can effectively contribute towards reducing methane emissions from anaerobic decomposition processes in nature. Simultaneously, biogas production can also generate additional revenue streams for farmers and provide opportunities for development and investment in rural areas. To that end, cooperation with and amongst farmers and local communities is essential, with opportunities to improve local economies and promote circularity. This cooperative approach in promoting opportunities for rural areas will also be part of the Long Term Vision for Rural Areas the Commission will put forward in 2021.

The biogas resulting from such feedstocks is a source of highly sustainable and useful renewable energy with multiple applications, while the material that remains after anaerobic digestion (digestate) can, after further processing, be used as a soil improver. This in turn reduces the requirement for alternative soil improving products, such as synthetic fertilisers of fossil origin. Moreover, in line with the waste hierarchy, the waste-based biodegradable input into biorefineries and biogas plants can count towards municipal waste recycling targets as set out in Directive 2018/98/EC. The role of sustainable biogas production in contributing to the EU's decarbonisation objectives has been recognised in the recently published EU strategies for energy-system integration and hydrogen[40].

According to the EU's long-term decarbonisation strategy[41], by 2050, the EU's annual consumption of biogases (biogas and biomethane) is projected to grow to between 54 and 72 Mtoe, from around 17 Mtoe in 2017. This growth in production will contribute towards the

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[38] Directive 2010/75/EU.
[39] Regulation (EC) No 166/2006 on the establishment of a European Pollutant Release and Transfer Register.
[40] COM(2020) 299 and 301; https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1259.
[41] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0773

EU's renewable energy and climate targets modelled in the long-term strategy. Biogas from agricultural waste or residues can also cost-effectively mitigate methane emissions in the agriculture and the waste sectors. Conversely, biogas derived from food or feed crops increases methane emissions, and thus can undermine the mitigation benefits of biogas. It is therefore essential for biogas developments to be based primarily on waste or residues.

The collection and use of high methane emitting organic wastes or residues from farming as biogas substrates should be further incentivised. This can be achieved, for example, through identifying best practices for collection and/or harvesting of sustainable wastes and residues or by incentivising the use of digestate as a sustainable soil improver in lieu of mined fertilisers. Sequential cropping can also be used in combination with manure as feedstock for sustainable biogas production, while contributing to sustainable farming practices, and as such could also be further incentivised [42]. National strategic plans for the Common Agricultural Policy (CAP), among other instruments and in line with the objectives set out in the national energy and climate plans, should encourage an integrated intervention that may encompass support for suitable agricultural practices, sustainable use of digestate and nutrients therein, investments in efficient installations, and services such as advisers, training and innovation. To that end the Commission will address this issue in specific Member State recommendations by the end of 2020.

As announced in the EU strategy for energy-system integration[27], the Commission will re-examine the gas market regulatory framework to facilitate the uptake of renewable gases, including by considering issues such as the connection to infrastructure and the market access for distributed and locally connected production of renewable gases. In addition, the upcoming revision of the Renewable Energy Directive in June 2021, will present opportunities for further targeted support to accelerate the development of the market for biogas.

Any measures to support biogas production must be carefully assessed to avoid perverse incentives that could lead to an overall increase in emissions from the waste, land and agricultural sectors, as well as to avoid an increase in the landfilling of unutilised digestate as soil improvers. Actions promoted under the methane strategy should be in line with the general sustainability criteria for bioenergy developed in the context of renewable energy legislation and with the taxonomy regulation[43].

Cross-sectoral actions

1. The Commission will support **improvements in measurement and reporting of methane emissions by companies** across all relevant sectors, including through sector-specific initiatives.
2. The Commission will support the establishment of an **independent international methane emissions observatory** anchored in the United Nations framework, in cooperation with international partners. The observatory would be tasked with collecting, reconciling, verifying and publishing anthropogenic methane emissions data at a global level.
3. The Commission will strengthen **satellite-based detection and monitoring** of methane emissions through the EU's Copernicus programme, with a view to

[42] These and other recommendations were conveyed by stakeholders at a workshop organised by the Commission on 17 July 2020 entitled 'The opportunities and barriers to achieving methane emission reductions in waste and agriculture through biogas production'.

[43] Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088.

contribute to an EU-coordinated capability for detecting and monitoring global super-emitters.

4. In order to deliver on the increased climate ambition of the 2030 climate target plan impact assessment, the Commission will **review relevant EU climate and environmental legislation** to more effectively address methane-related emissions notably the Industrial Emissions Directive and the European Pollutant Release and Transfer Register.
5. The Commission will provide targeted support to **accelerate the development of the market for biogas from sustainable sources** such as manure or organic waste and residues via upcoming policy initiatives. This will include the future gas market regulatory framework and the upcoming revision of the Renewable Energy Directive. The Commission will propose a pilot project to support rural areas and farming communities in building biogas projects and accessing funds for biogas production from agricultural waste.

2. ACTIONS IN THE ENERGY SECTOR

The scope of actions for energy-related methane covers the entire oil, gas and coal supply chains. It includes liquefied natural gas (LNG), gas storage and biomethane introduced into gas systems. Achieving emissions savings in this sector is feasible, with at least one third of reductions possible at no net cost to industry[44]. The greatest benefits in net economic, environmental and social terms would be achieved by reducing venting and flaring, reducing leaks in fossil gas and oil production, transmission and combustion, and reducing methane emissions from coalmines[45]. Venting and routine flaring should be restricted to unavoidable circumstances, for example for safety reasons, and recorded for verification purposes.

Supporting voluntary initiatives

In the energy sector, the approach of the Commission is to support voluntary initiatives while simultaneously preparing legislation to build on and consolidate the progress made through voluntary actions.

As part of this approach, the Commission is actively promoting the widespread implementation of the measurement and reporting framework devised by the Oil and Gas Methane Partnership (OGMP) measurement and reporting framework. The OGMP is a voluntary initiative that currently covers oil and gas upstream companies. In cooperation with the United Nations Environment Programme (UNEP) and the Climate and Clean Air Coalition, the Commission is working to extend the OGMP framework to more companies in the gas upstream, midstream and downstream, as well as to the coal sector and closed or abandoned sites[46]. The OGMP framework is the best existing vehicle for improving measurement, reporting and verification capability in the energy sector.

In addition, the Commission calls on companies in the oil, gas and coal sectors to set up more robust leak detection and repair (LDAR) programmes to prepare for upcoming proposals for legislation that would make such programmes mandatory (more details in the next section).

Legislative action

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[44] International Energy Agency (IEA), Methane Tracker, (2020).
[45] Unintended leaks from all equipment.
[46] Ongoing coordination with relevant stakeholders is supporting the development of revised MRV methodologies, adapted for these sectors and sections of supply chains.

The Commission will table in 2021 a legislative proposal on compulsory measurement, reporting and verification for all energy-related methane emissions, building on the Oil and Gas Methane Partnership (OGMP) methodology. Improving the quality of emissions data through mandatory higher-tier reporting by companies will also help Member States to improve their reporting to the United Nations Framework Convention on Climate Change (UNFCCC). It may therefore also lead to an increased share of higher-tier reporting for the concerned key categories in the EU inventory.

In addition, such legislation should include an obligation to improve leak detection and repair (LDAR) of leaks on all fossil gas infrastructure, as well as any other infrastructure that produces, transports or uses fossil gas, including as a feedstock. In an effort to tackle emissions from venting and flaring, LDAR obligations will address flaring efficiency as a priority. Furthermore, the Commission will examine options as regards possible methane emission reduction targets or standards or other incentives on fossil energy consumed and imported in the EU.

Upstream gas companies have a certain but limited financial incentive to implement LDAR programmes, as they can sell the gas that they prevent from leaking[47]. Transmission, storage, and distribution systems operators (including many LNG terminals) are regulated businesses and do not own the gas. For this reason, the Commission will promote the recognition by National Regulatory Authorities (NRAs) of LDAR and methane reduction investments as allowed costs for regulated entities in transmission, storage and distribution, including through possible guidance to regulators.

The proposed revision of the Non-Financial Reporting Directive (NFRD) could lead to the development of European non-financial-reporting standards. To ensure appropriate alignment, the development of such standards could take account of the pre-existing Oil and Gas Methane Partnership (OGMP) standards for supply chains in oil, fossil gas and coal supply chains.

The Commission will examine the options available in view of proposing legislation on eliminating routine venting and flaring in the energy sector covering the full supply chain, up to the point of production.[48]. This would complement the 2030 objectives of the World Bank's Zero Routine Flaring initiative[49], which the Commission intends to support alongside its support for the World Bank's Global Gas Flaring Reduction Partnership [50]. The Commission will also make it a priority to explore a more precise standard for flaring efficiency, with the objective of further reducing both fugitive emissions and emissions from incomplete combustion of fuels. These mitigation options are generally cost-effective, and a key component of methane-emission mitigation in the energy sector, with combustion accounting for a significant portion of EU emissions[51].

Address coalmines and abandoned production sites

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[47] However, this would only reduce leakage if (and to the extent that) the cost of abatement is lower than the additional sale price achievable. However, as these companies do not own the resource they are using (those are generally owned by the country of production) and not accountable for losses, they often have little interest in reducing them. Also, oil producers often have little or no incentive (other than regulatory) to reduce their emissions of methane or other gases that are not in their core business.

[48] This would exclude flaring that is necessary, for example for safety reasons.

[49] https://www.worldbank.org/en/programs/zero-routine-flaring-by-2030#1

[50] https://www.worldbank.org/en/programs/gasflaringreduction

[51] EU 2030 climate target plan Impact Assessment, https://eur-lex.europa.eu/resource.html?uri=cellar:749e04bb-f8c5-11ea-991b-01aa75ed71a1.0001.02/DOC_1&format=PDF.

The Commission encourages remedial work to eliminate methane emissions from the EU's active or unused coalmines and abandoned oil and gas sites. Experience in non-EU countries and certain Member States shows that these sites can have significant levels of emissions[52]. However, at present, there are no EU-wide rules on checking, measuring or utilising methane leakage or emissions from coalmines or oil and gas wells after their closure. The forthcoming Commission proposal to reform the Research Fund for Coal and Steel also supports research in this field. The initiative for Coal Regions in Transition, now part of the Just Transition Platform, can serve as a forum for discussing good practices and best available techniques.

The Commission will support either the effective closure and sealing of coalmines or their utilisation for residual energy production (collecting methane for local use). Technologies to achieve this are available and already operational in certain parts of Europe. This will require the local workforce to be trained in these areas, funds to be allocated to underpin non-commercial definitive closure and opportunities to be developed for commercial companies to collect methane from abandoned sites. The Commission will bring forward recommendations for best practices and/or enabling legislation if necessary.

Actions in the energy sector

6. The Commission will deliver **legislative proposals in 2021** on:

- Compulsory **measurement, reporting, and verification** (MRV) for all energy-related methane emissions, building on the Oil and Gas Methane Partnership (OGMP 2.0) methodology.
- Obligation to **improve leak detection and repair** (LDAR) of leaks on all fossil gas infrastructure, as well as any other infrastructure that produces, transports or uses fossil gas, including as a feedstock.

7. The Commission will consider legislation on eliminating routine venting and flaring in the energy sector covering the full supply chain, up to the point of production.
8. The Commission will work to **extend the OGMP framework to more companies in the gas and oil upstream, midstream and downstream as well as to the coal sector and closed as well as abandoned sites**.
9. The Commission will promote **remedial work under the initiative for Coal Regions in Transition**. Best-practice recommendations and/or enabling legislation will be brought forward if necessary.

3. ACTIONS IN THE AGRICULTURAL SECTOR

Overall, methane emissions from EU agriculture have decreased by approximately 22% since 1990, mainly due to a reduction in ruminant livestock numbers. However, in the past 5 years, herd sizes have increased again, leading to a slight upturn in methane emissions in that period. The methane emissions intensity of meat and milk (in terms of methane emissions per weight of meat or milk) has also decreased over time as a result of changes in production methods. Further decreases can be achieved by more sustainable production through innovation and technology on the one hand and by more sustainable diets on the other hand. Therefore a strategic vision needs to be based on a balance of technologies, markets and dietary changes, reduced fossil hydrocarbon inputs and that ensure a livelihood and sustainable business

[52] Kholod, et al., (2020). (https://doi.org/10.1016/j.jclepro.2020.120489).

opportunities for farmers while upholding the fundamentals of the EU's food policy, as described in the Farm to Fork strategy[53].

There are inherent complexities involved in achieving methane emissions reductions in agriculture as well as in accurately monitoring, verifying and reporting these emissions in that sector. Trade-offs in mitigation actions must be minimised. For example, increasing the use of confinement housing for livestock typically leads to reduced methane emissions. However, it could increase carbon dioxide emissions through increased energy use inside the housing. Other questions to be taken into account include that benefits from grazing ruminants especially in terms of carbon sequestration and biodiversity in grassland and pastures would be lost.

A range of mitigation technologies and practices are available that have the potential to deliver emission reductions decoupled from production. These are mainly related to improvement of animal diets, herd management, manure management (notably its use in fertilisers and biogas generation), breeding, herd health and animal welfare.

The most-effective ways of reducing emissions from enteric fermentation[54] include improving the health and fertility of the herds, improving animal diets (mix of feed materials), feed additives, and feeding techniques. Approximately 7-10% of the energy in the feed of ruminants is metabolised into methane. The biggest potential for reducing emission intensity is in novel approaches to feeding, as mentioned in the Farm to Fork Strategy, which can achieve very substantial methane reductions[55]. In addition to reducing emissions, these actions could also benefit farmers and animals by contributing to reduced costs and improved animal welfare.

Actions that lead to reduced emissions from manure provide additional income to farmers. Through cooperation among farmers as well as within communities, waste and residue streams from agriculture and waste sectors through anaerobic digestion should be valorised. Barriers such as insufficient knowledge and expertise that prevent their wider uptake should be addressed[56]. This underlines the need for the systemic promotion of the related expertise and enabling frameworks, taking into account the specificities of different Member States and production systems.

Methane emissions from rice fields can be reduced by rewetting, drying, and other appropriate agricultural practices. The high costs of these practices, and the reorganisation of farm management they require, need to be addressed.

To promote wider uptake of methane-reducing approaches in agriculture, by the end of 2021 the Commission will develop an inventory of best practices, available technologies and innovative technologies. The Commission will update this inventory with technologies gradually coming onto the market. The development and updating of the inventory will be carried out in cooperation with sectoral experts, key stakeholders and Member States.

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[53] COM(2020) 381.

[54] https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/economic-assessment-ghg-mitigation-policy-options-eu-agriculture-ecampa-2

[55] One novel approach to feeding that holds great promise is incorporating seaweed into cattle feed. One in vitro study found that seaweed could powerfully inhibit methane production even at very low levels. See https://www.publish.csiro.au/an/AN15576.

[56] https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_fg_livestock_emissions_final_report_2017_en.pdf

In the first half of 2021, the Commission will support setting up an expert group to analyse life-cycle methane emissions metrics. This group will look at livestock, manure and feed management, feed characteristics, new technologies and practices and other issues, based on relevant international work[57]. This life cycle analysis will seek to distinguish to what extent (1) specific livestock management and animal welfare choices; (2) imported or domestic feeds and (3) intensive or pastoral farming choices affect methane emissions. The Commission will also introduce this topic into the CCAC Agriculture programme as a work stream and will consult the CCAC Scientific Advisory Board for its appreciation. Moreover, to help data collection and measurement, by 2022 the Commission will propose a digital carbon-navigator template and will encourage the development and use of such templates at farm level. This will also improve farmers' awareness of greenhouse gas emissions and of the effects of mitigation technologies on their farms.

Other initiatives stemming from the Green Deal and a reformed Common Agricultural Policy (CAP) will further contribute to an effective and steady decrease in the overall methane emissions from the EU livestock sector. In line with the 2030 Climate Target Plan the Effort Sharing Regulation (ESR) (which covers methane emissions from agriculture), will now be reviewed to reflect the increased carbon reduction target providing for increased incentives to reduce methane emissions.

The Commission will encourage Member States to include methane reduction schemes in their strategic plans for the CAP such as carbon farming initiatives. These can help to develop a new green business model by rewarding farmers for applying farming practices that remove CO_2 from the atmosphere and contribute to the climate neutrality objective (including in the animal sector), as mentioned in the Farm to Fork strategy[58]. Strategic plans for the CAP and the national recovery and resilience plans can also support investments in biogas plants, as well as cooperation among farmers and local communities to maximise added value. Such investments can contribute to the EU's economic recovery and increase quality of life in rural areas.

Technical mitigation measures will complement other important developments for the sector and rural areas, in particular an expected societal shift to more balanced diets, with less red and processed meat, more fruits, vegetables and plant-based protein sources, in line with the EU Farm to Fork Strategy. These lifestyle changes can 'not only reduce the risks of life-threatening diseases, they can also reduce the environmental impact of the food system'[59]. Finally, the Commission will advance its research agenda in this area, and in particular through targeted research in its Strategic Plan 2021-2024 for Horizon Europe.

Actions in the agricultural sector

10. In the first half of 2021, the Commission will support setting up **an expert group to analyse life-cycle methane emissions metrics**. This group will look at livestock, manure and feed management, feed characteristics, new technologies and practices and other issues. It will also work in setting up a life cycle methodology on the overall emissions for livestocks.

11. By the end of 2021, the Commission – in cooperation with sectoral experts and Member States – will develop an **inventory of best practices and available**

[57] The LEAP Partnership (Livestock Environmental Assessment and Performance) under the auspice of FAO
[58] Farm to Fork Strategy (COM(2020) 381).
[59] Farm to Fork Strategy (COM(2020) 381).

technologies to explore and promote the wider uptake of innovative mitigating actions. These actions will have a special focus on methane from enteric fermentation.

12. To encourage carbon-balance calculations at farm level, the Commission will by 2022 provide a **digital carbon navigator template and guidelines on common pathways for the quantitative calculation of greenhouse gas emissions and removals**.

13. The Commission will promote the uptake of **mitigation technologies** through the wider deployment of 'carbon farming' in Member States and their Common Agricultural Policy Strategic Plans, as from 2021.

14. In the Horizon Europe strategic plan 2021-2024, the Commission will consider proposing **targeted research** on the different factors that effectively lead to methane emission reductions, focusing on technology and nature based solutions as well as on the factors leading to dietary shift.

4. ACTIONS IN THE WASTE AND WASTEWATER SECTOR

In waste management, the Landfill Directive[60] adopted in 1999, requires landfill operators to manage landfill gas by either using it to generate energy or flaring it. Flaring still generates pollutants and CO_2. According to the waste hierarchy, landfilling is the least preferable option and should be limited to the necessary minimum. In 2018, 24% of all municipal waste generated in the EU was landfilled[61], with significantly higher shares in a number of Member States due to legal and investment shortcomings. Biodegradable waste is responsible for the generation of landfill gas.

Recent changes to EU waste legislation (2018) introduced an obligation to collect biodegradable waste separately by 2024, and set a new target of a maximum 10% landfilling of waste by 2035. As a result of these changes, it is expected that methane emissions from landfills will decrease further. Minimising the disposal of biodegradable waste in landfills and its utilisation for climate-neutral circular bio-based materials and chemicals is critical to avoid the formation of methane, whilst providing a substitute for fossil and carbon intensive products. For these reasons, Member States should more strictly enforce existing legal requirements such as the landfill diversion targets for biodegradable waste and the treatment of biodegradable waste prior to disposal to neutralise its degradability[62]. Member States should also clamp down on the operation of illegal landfill sites. Enhanced monitoring, reporting and verification in this field is also necessary to forecast the impacts these measures will have on the climate ambitions for 2030 and beyond.

More data and information is necessary to ascertain the need for and scope of further action. Ideally, all landfill sites should use the gas they produce until the energy content drops below

[60] Directive 1999/31/EC.
[61] Eurostat, env_wasmun.
[62] As interpreted by the EUCJ ruling Case C-323/13, European Commission v. Italian Republic. http://curia.europa.eu/juris/liste.jsf?language=en&num=C-323/13.

a useful value. Once it is no longer viable to utilise landfill gas, it may be recommended to use bio-oxidation technology[63] in 'hot spots' identified across the site to neutralise the remaining methane.

With respect to the treatment and use of wastewater and sewage sludge under the current regulatory framework, namely the Urban Waste Water Treatment Directive and the Sewage Sludge Directive, emissions of greenhouse gases are not specifically tackled. Over the past 29 years, the implementation of the Urban Waste Water Treatment Directive has helped to prevent significant methane emissions due to the collection and treatment of wastewater in efficient centralised facilities. These facilities emit significantly less methane and other greenhouse gases than alternative treatment approaches.

The Sewage Sludge Directive, adopted more than 30 years ago, regulates the use of sewage sludge to protect the environment, and in particular soil, against the harmful effects of contaminated sludge when used in agriculture. The Urban Waste Water Treatment Directive is currently being reviewed[64]. In parallel to the impact assessment on the Urban Waste Water Treatment Directive, starting in the third quarter of 2020, the Commission will carry out a study to support the evaluation of the Sewage Sludge Directive. It will also carry out an additional study that will assess the scope for further action on greenhouse-gas emissions, including methane from sewage sludge. Based on the outcomes of the evaluation of the Sewage Sludge Directive and further research and the impact assessment for the revision of the Urban Waste Water Treatment Directive, the Commission will consider taking measures to limit the emission of greenhouse gases from sewage sludge.

In the review of the Landfill Directive required for 2024, the Commission will consider several actions related to landfill gas management. Firstly, it will consider new techniques to reduce methane emissions. This may include aeration of landfill mass to inhibit the generation of methane, increasing the use of landfill gas to generate energy, or when neither option is possible, the use of techniques that effectively oxidise the methane such as bio-oxidation or flaring. Secondly, the Commission will consider enhanced monitoring, reporting and verification, which is key to gauge impacts and improve performance in this field over time. Following on from the above actions and where necessary, the existing guidance document on the implementation of the Landfill Directive on gas control requirements[65] will be updated accordingly.

New technologies for better conversion of waste to biomethane can be effective in further reducing methane emissions in the sector. In this respect, the Commission will support targeted research on technology-based solutions in its Strategic Plan 2021-2024 of Horizon Europe.

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[63] LIFE Project RE MIDA - Innovative Methods for Residual Landfill Gas Emissions Mitigation in Mediterranean Regions LIFE14 CCM/IT/000464. The project demonstrated the technical and economic viability of two technologies (biofiltration and biowindows) implemented to biologically oxidise landfill biogas with low calorific value. The technologies resulted in gains related to: oxidation efficiency, abatement of odorous compounds, minimisation of the risk associated with emissions of carcinogenic compounds and reductions in the cost of landfill post treatment when compared to a conventional combustion system.

[64] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12405-Revision-of-the-Urban-Wastewater-Treatment-Directive.

[65] https://ec.europa.eu/environment/waste/landfill/pdf/guidance%20on%20landfill%20gas.pdf.

Actions in the waste and wastewater sector

15. The Commission will continue to **tackle unlawful practices and provide technical assistance** to Member States and regions. This assistance will address issues such as sub-standard landfills. The Commission will also help Member States and regions to stabilise biodegradable waste prior to disposal and its increasing use for the production of climate-neutral, circular bio-based materials and chemicals, and divert this waste to biogas production.

16. In the **review of the Landfill Directive in 2024**, the Commission will consider further action to improve the management of landfill gas, minimise its harmful climate effects, and harness any of its potential energy gains.

17. In the Strategic Plan 2021-2024 of Horizon Europe, the Commission will consider proposing **targeted research** on waste to biomethane technologies.

III. INTERNATIONAL ACTION

The EU will seek to tackle methane emissions in the energy, agriculture and waste sectors in cooperation with partner countries and international organisations. This work will build on existing partnerships in international fora, such as through the Climate and Clean Air Coalition (CCAC), the Arctic Council and the Association of Southeast Asian Nations (ASEAN). The EU will also engage with international organisations.

As the largest importer of oil and gas, the EU has the leverage to promote energy-related methane emission reductions globally. Estimates show that the external carbon or methane emissions associated with EU fossil gas consumption (i.e. the emissions released outside the EU to produce and deliver fossil gas to the EU) are between three to eight times the quantity of emissions occurring within the EU[66]. The Commission therefore intends to mobilise a coalition of key import countries to coordinate efforts on energy sector methane emissions.

Moreover, the EU will leverage its leadership in the circular economy and its advanced agricultural practices that balance animal welfare with productivity to accelerate international action. The Commission will also support international data sharing on methane emissions through the foreseen international methane emissions observatory as well as by making EU satellite data available to global partners. In this way, the EU will lead by example in international collaboration on data sharing. These cross-sectoral actions will be complemented by specific actions in each sector, as described below.

1. ENERGY

a. Reach out to international energy supplier and buyer countries and support multilateral cooperation

The EU will lead a diplomatic outreach campaign to fossil fuel producer countries and companies, and encourage them to become active in the Oil and Gas Methane Partnership (OGMP)[67]. The EU will also pursue closer cooperation with the US, Canada and Mexico

[66] Environmental Defense Fund (EDF), (2019).

[67] Current members are: BP, Ecopetrol, Eni, Equinor, Neptune Energy International SA, Pemex, PTT, Repsol, Shell, and Total.

(countries with existing methane-regulation and country-level methane-reduction targets) to share experiences and identify joint actions. Through its bilateral dialogues, the EU will advocate for the need to properly measure and reduce methane emissions at a global level.

The Commission will explore the possibility of providing partner countries with **technical assistance** in gas and oil production so these countries can improve their methane regulatory frameworks and their capacity in monitoring, reporting and verification.

The scope for coordinated international action among **fossil fuel buyer countries** in reducing methane emissions in the fossil gas sector is particularly significant. The EU, together with China, South Korea and Japan account for more than 75% of the global trade in fossil gas[68]. The EU will reach out to these partners to create a coalition among buyer countries to support an ambitious international monitoring, reporting and verification standard, thus promoting the global uptake of emission-reduction technologies.

Moreover, the international methane emissions observatory would be tasked with compiling and publishing a **methane-supply index (MSI)** at EU and international level. Initially, the index could be composed using existing and reported data from countries' emissions inventories as submitted to the UNFCCC, empowering buyers to make informed choices when purchasing fuels. With time, the index could benefit from global data supplied by the international methane emissions observatory.

In order to incentivise accurate measurement, reporting and verification (MRV) on fossil gas (including imports), the Commission will propose to use a default value for volumes that do not have adequate MRV systems in place. The default value will be applied where necessary until a compulsory MRV framework for all energy-related methane emissions building on the OGMP 2.0 methodology is implemented. These steps will increase transparency in international gas trade flows.

Minimum methane emission standards, targets or other such incentives based on robust scientific analysis can play an effective role to ensure methane emission reductions in the EU and globally. The Commission will examine all the options available, informed by the work of the foreseen independent international methane emissions observatory - building on the **methane supply index**. In the absence of significant commitments from international partners on methane emissions reductions, the Commission will consider proposing legislation on targets, standards or other incentives to reduce methane emissions from fossil energy consumed and imported in the EU. This will be based on an impact assessment which will comprehensively assess the implications of putting such an instrument in place, including in terms of the independent verification and compliance checks that will be required to effectively enforce it, and in terms of potential contributions towards overall reductions in global methane emissions. This impact assessment will be conducted in close consultation with international partners, civil society and key stakeholders.

The EU will also join and actively support initiatives, including the international public-private Global Methane Initiative, the World Bank's Global Gas Flaring Reduction initiative, and the World Bank's initiative on Zero Routine Flaring by 2030. EU collaboration with the United Nations Environment Programme (UNEP), the IEA and the Climate and Clean Air Coalition (CCAC) on the international emissions observatory is a core component of multilateral efforts across these organisations to tackle global methane emissions in the short-term.

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[68] International Energy Agency (IEA), (2019).

The Commission will contribute to a series of key international events in the build up to the UN General Assembly in New York in September 2021, with the objective of securing at that meeting a UN-based pathway to reduce methane emissions in the years 2021-2031. The goal will be to provide support for the coordination of international actions to rapidly reduce global atmospheric methane and promote longer-term action, notably through the creation of a legally-binding framework at international level for methane emission reduction.

b. Satellite data sharing on super-emitters

Addressing super-emitters both in the EU and internationally is a cost-effective action that is feasible with currently available data and with established leak-detection and repair (LDAR) measures. Methane leakages from coalmines are often also very significant and more data is required to understand this area in detail[69].

The EU will promote the worldwide extension of the capability to detect and monitor super-emitters in the foreseen international methane emissions observatory. The EU will offer this capability to international partners and take energy-diplomacy action to monitor and work to achieve reductions in emissions from super-emitters globally. This information will be based on satellite data reconciled with bottom-up detection processes. As of 2021, this detection and monitoring capability will form the basis for the establishment of a procedure that alerts the EU and national governments both within the EU and internationally about major emission sources. Further improvements in detection capability will be available starting in 2023[70].

The EU is a technical leader in satellite imagery and methane emission leak detection through Copernicus, in particular the global and freely available CAMS and Sentinel 5P products. Other satellites will be launched by the EU and by the US and Japan in the coming years covering the same spectrum as Sentinel 5P. Data sharing among international actors will set an example of international collaboration to improve the monitoring of global methane emissions.

2. AGRICULTURE

A significant share of global methane emissions in the agricultural sector originates outside of the EU, and this share is projected to increase. An international vision and the promotion of mitigation actions is therefore paramount. The Commission and Member States have been, and will continue to be, very active in various international fora for reducing emissions from agricultural and agro-food systems.

The EU will intensify collaboration with non-EU countries as part of the Koronivia Joint Work on Agriculture[71] (KJWA) under the United Nations Framework Convention on Climate Change (UNFCCC). This framework covers a range of interrelated topics such as soil, livestock, nutrient and water management, food security, the socioeconomic impacts of climate change across agriculture and methods for assessing climate change. At COP 26, the EU will work to extract best practices and knowledge from the KJWA work programme to help make the global food system more sustainable.

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[69] Saunois et al. (2019)

[70] The launch of satellites Sentinel 4 and 5 will provide higher-frequency observations, increasing the likelihood of capturing intermittent sources.

[71] https://unfccc.int/topics/land-use/workstreams/agriculture

The EU is an active member of the Thematic Working Group on Agriculture[72], which is led by the UN's Food and Agriculture Organization. In this role, the EU will help to foster both collaboration and the exchange of knowledge and best practices to improve implementation of climate action in agriculture. This work will cover livestock and focus on improving the implementation of Nationally Determined Contributions (NDCs) pledged by countries as part of the Paris Agreement.

The Climate and Clean Air Coalition (CCAC) agriculture initiative[73] also aims to increase the ambition of NDCs. It focuses on reducing emissions of methane from livestock (from enteric fermentation and manure management) and paddy rice production. As a main partner in this initiative, the Commission will ensure that it continues to help non-EU countries with knowledge exchange, best practices, and the setting up of pilot projects to better manage and mitigate methane emissions from agriculture. Future work will focus on best practices and technologies to reduce enteric fermentation globally.

The EU's-international partnerships on research and cooperation will continue to support climate action in agriculture-related projects. These projects will cover livestock management, grazing land management and forestry[74]. Forestry-based actions relevant to methane abatement include initiatives to reduce the conversion, draining and burning of peatland forests[75], managing and restoring forests in a way that reduces the incidence and severity of uncontrolled forest fires[76], and reducing firewood and charcoal use (switching to non-biomass fuels for cooking)[77]. Other target areas are cropland manure management as well as other land uses and ecosystems (managing prescribed/controlled fires, agricultural development in urban and peri-urban areas, and drying of wetlands).

The Commission will also promote the mitigation potential in the rice-cultivation sector in Asia through cooperation projects. These projects will be set up and monitored according to EU climate-tracking procedures and in line with NDCs and national adaptation plans.

3. WASTE

The Commission is actively participating in the revision of guidance on the landfilling of waste (including landfill-gas management) under the Basel Convention[78]. The guidance has been aligned with existing EU waste legislation

International actions

18. The EU will step-up its contribution to the work of **international fora**, such as through the Climate and Clean Air Coalition (CCAC), the Arctic Council and the Association of Southeast Asian Nations (ASEAN).

19. As part of the EU's **diplomatic and external relations** action, the Commission will address methane emission reductions in all relevant sectors with partner countries

[72] http://www.fao.org/climate-change/our-work/what-we-do/ndcs/twg/en/
[73] https://ccacoalition.org/en/resources/ccac-agriculture-initiative-infosheet
[74] EU Communication on Stepping up EU Action to Protect and Restore the World's Forests; 23 July 2019
[75] IPCC, (2019).
[76] Forest conservation and sustainable management also reduce flood risks, and thereby reduce the methane emissions associated with flooding.
[77] From the perspective of methane emissions, a switch to other biomass fuels, even if they are sustainably produced, is not ideal as all biomass burning generates methane.
[78] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf.

and promote **global coordination** of efforts to address energy-sector methane emissions.

20. The Commission will seek **increased transparency** in the energy sector by working with international partners to develop a **Methane Supply Index** in the foreseen international methane emissions observatory.

21. The Commission will consider methane emission reduction **targets, standards or other incentives** for fossil energy consumed and imported in the EU in the absence of significant commitments from international partners.

22. The Commission will support the establishment of a **detection-and-alert process for methane super-emitters using EU satellite capability**, and share this information internationally through the foreseen international methane emissions observatory.

23. The Commission will support cooperation with international partners, including the Global Methane Initiative, the World Bank's Global Gas Flaring Reduction initiative, and the World Bank's initiative on Zero Routine Flaring by 2030, as well as the International Energy Agency.

24. The Commission will contribute to a series of key **international events** in the build up to the UN General Assembly in New York in September 2021, with the objective of securing a UN based pathway on coordinated actions at international level to reduce methane emissions.

IV. CONCLUSIONS

This strategy identifies a set of actions that will achieve significant reductions in methane emissions across the energy, agriculture and waste management sectors at EU and international level. These measures will help to deliver on the EU's commitments under the European Green Deal and the Paris Agreement towards climate neutrality, as well as reducing air pollution. Effective emission reductions will require resolute action by EU Member States, non-EU countries and stakeholders.

The Commission will continue to monitor progress in relation to methane emission reductions in the EU greenhouse gas inventories, while reporting under the United Nations Framework Convention on Climate Change (UNFCCC) and United Nations Environment Programme (UNEP) frameworks will monitor progress at international level.

The Commission invites the European Parliament, Council, Committee of the Regions, European Economic and Social Committee, Member States, non-EU countries, international organisations and stakeholders at EU and international level to support and cooperate on the further development of this strategy to urgently address methane emissions across the energy, agriculture and waste management sectors.

David C. McCabe
Atmospheric Scientist
Clean Air Task Force
dmccabe@catf.us
626-710-6542

EDUCATION

Ph.D. University of Colorado 2004
Physical Chemistry, with research focused on Atmospheric Kinetics
Research: Vibrational Quenching Kinetics of the OH radical
Advisor: A.R. Ravishankara (NOAA)

A.B. University of Chicago 1994
Chemistry; also fulfilled requirements for A.B. in Geography
General Honors and Honors in Chemistry

PROFESSIONAL EXPERIENCE

Atmospheric Scientist — Clean Air Task Force — 2010 - present

Coordinate research on methane emissions from oil and gas operations in United States; Analyze US emissions data to understand uncertainties in current emissions inventories and the differences between official inventories and findings from ambient air measurements; Coordinate with advocacy staff at CATF and partner groups to develop policy goals and prepare technical information for legal, advocacy, and public outreach materials.

AAAS Science & Technology Policy Fellow — US EPA Office of Research and Development — 2007 - 2009

Coordinated and promoted work at US EPA and elsewhere to develop GEOSS, a global effort to improve Earth science data availability and usability.

Postdoctoral Research Fellow — California Institute of Technology — 2004 - 2007

Research: Built and operated an aircraft-based chemical ionization mass spectrometry system to measure trace species (acids and peroxides) in the remote and polluted troposphere
Advisor: Paul Wennberg

SELECTED REFEREED PUBLICATIONS

Weyant, C.L., P.B. Shepson, R. Subramanian, M.O.L. Cambaliza, A. Heimburger, D. **McCabe**, *et al.* (2016) "Black Carbon Emissions from Associated Natural Gas Flaring," *Environ. Sci. Technol.* **50**, 2075, doi:10.1021/acs.est.5b04712.

Kleinman, M.T., J.D. Bachmann, H.J. Feldman, D. **McCabe**, J.J. West, and A.F. Fiore (2015) "Connecting air quality and climate change," *J. Air Waste Manage.* **65**, 1283, doi: 10.1080/10962247.2015.1095599.

Swarthout, R.F., R.S. Russo, Y. Zhou, B.M. Miller, B. Mitchell, E. Horsman, E. Lipsky, D.C. **McCabe**, *et al.* (2015) "Impact of Marcellus Shale natural gas development in southwest Pennsylvania on volatile organic compound emissions and regional air quality." *Environ. Sci. Technol.* **49**, 3175, doi:10.1021/es504315f.

Caulton, D.R., P.B. Shepson, M.O.L. Cambaliza, D. **McCabe**, E. Baum, and B.H. Stirm (2014) "Methane destruction efficiency of natural gas flares associated with shale formation wells," *Environ. Sci. Technol.* **48**, 9548, doi:10.1021/es500511w.

St. Clair, J.M., D.C. **McCabe**, J.D. *et al.* (2010) "Chemical ionization tandem mass spectrometer measurement of methyl hydrogen peroxide," *Rev. Sci. Instru.* **81**, 094102, doi:10.1063/1.34805

CA
Ex. 12

Avery, M., C. Twohy, D. **McCabe**, *et al.* (2010) "Convective distribution of tropospheric ozone and tracers in the Central American ITCZ region: Evidence from observations during TC4," *J. Geophys. Res.*, **115**, D00J21, doi:10.1029/2009JD013450.

Spencer, K.M., D.C. **McCabe**, *et al.* (2009) "Inferring ozone production in an urban atmosphere using measurements of peroxynitric acid," *Atmos. Chem. Phys.*, **9**, 3697, doi:10.5194/acp-9-3697-2009.

McCabe, D.C., *et al.* (2006) "The relaxation of OH (v = 1) and OD (v = 1) by H_2O and D_2O at temperatures from 251 to 390 K," *Phys. Chem. Chem. Phys.*, **8**, 4563, doi:10.1039/B609330B.

McCabe, D.C., *et al.* (2003) "Kinetics of the Removal of OH (v = 1) and OD (v = 1) by HNO_3 and DNO_3 from 253 to 383 K," *J. Phys. Chem. A*, **107**, 7762, doi:10.1021/jp0346413.

McCabe, D.C., T. Gierczak, R.K. Talukdar, and A.R. Ravishankara (2001) "Kinetics of the reaction OH + CO under atmospheric conditions," *Geophys. Res. Lett.*, **28**, 3135, doi:10.1029/2000GL012719.

SELECTED CONFERENCE PRESENTATIONS (ORAL AND POSTER)

Fleischman, L., **D. McCabe**, D. Lyon, M. D'Antoni, J. Anhalt, "Tank Emissions from Controlled Tanks," Stakeholder Workshop on EPA GHG Data for Petroleum and Natural Gas Systems, Oct. 2017, Houston, TX.

Field, R., J. Soltis, D. Snare, R. Edie, D. **McCabe**, S. Murphy, "Reconciling Airborne Basin Scale Methane Flux Estimates with Ground Based Quantification of Methane and VOC Emissions from Well Pads," American Geophysical Union Fall Meeting, Presentation A11L-03, Dec. 2014, San Francisco, CA, USA.

McCabe, D.C., E. Baum, S. Saunier, "Quantifying Methane Mitigation Costs from US Oil and Natural Gas," Air and Waste Management Association, Climate Change: Impacts, Policy, and Regulation Conference, Presentation 11, Sept. 2013, Herndon, VA, USA.

McCabe, D., P. Groisman, *et al.*, "Open Burning and the Arctic: Current Knowledge and Priorities for Future Research," European Geophysical Union General Assembly 2011, Presentation EGU2011-12855, Apr. 2011, Vienna, Austria.

Dickerson, P., J. Szykman, D. **McCabe**, "Integrating Satellite Observations into AIRNow: Providing Real Time Air Quality and Forecasts in the US and Elsewhere," CEOS Atmospheric Composition Constellation Workshop on Air Quality, June 2009, Frascati, Italy.

McCabe, D.C., *et al.*, "Measurements of Isotopic Composition of Water Vapor Using CIMS From the NASA DC-8 During TC4," American Geophysical Union Fall Meeting, Presentation A31C-0114, Dec. 2008, San Francisco, CA, USA.

PROFESSIONAL ACTIVITIES

Expert Testimony

Colorado Air Quality Control Commission, Oil and Gas Rulemakings, February 2014 and October 2017

Invited Reviewer

Referred Journals: *Environmental Science and Technology, Atmospheric Chemistry and Physics, Environmental Research Letters, Journal of Industrial Ecology*

EPA's *Methodologies for U.S. Greenhouse Gas Emissions Projections: Non-CO_2 and Non-Energy CO_2 Sources*, Natural Gas Systems and Petroleum Systems Sections, 2013, 2014.

EPA's *Global Mitigation of Non-CO_2 Greenhouse Gases*, Natural Gas and Oil Systems Section, 2013.

EPA's *Inventory of US Greenhouse Gas Emissions and Sinks.* 2013 – 2018.

Don Schreiber

Gobernador, NM | 505-320-0032 | vivarioarriba@gmail.com |

SUMMARY

Provide information to New Mexico Oil Conservation Commission regarding proposed changes to NMAC 19.15.27.8 and other sections

EXPERIENCE

December 1998-Current

Owner, Operator Devil's Spring Ranch, Gobernador, NM

- Member Lujan Grisham Energy Transition Team
- Member EMNRD/NMED Methane Advisory Panel
- Member State Land Office Oil Advisory Council
- Board Member Western Leaders Network
- Witness Subcommittee on Energy & Mineral Resources, Natural Resources Committee, US House of Representatives field hearing on methane waste and pollution
- Witness EPA DC on methane pollution
- Declarant federal courts on methane waste and pollution
  * Wyoming v. Department of Interior (D.Wyo.)
  *California v. BLM (N.D. Cal.)
  *California v. BLM (N.D. Cal.)
  *California v. Bernhardt (N.D. Cal.)
  *Clean Air Council v. Pruitt (D.C. Cir.)
  *California v. Wheeler (D.C. Cir.)
  *New York v. Wheeler (D.D.C.)
- Testimony Office of Management & Budget on methane waste and pollution
- Testimony Royalty Policy Committee, Interior Department on methane waste & pollution
- Evidence presentations New Mexico Oil Conservation Commission hearings on methane waste & pollution
- Developer Open Space Pilot Project (OSPP) w/Bureau of Land Management, ConocoPhllips & Holistic Management International for new drilling land conservation in San Juan Basin
- Developer Green Completion Initiative w/Burlington and ConocoPhillips OSPP drilling program
- Interface w/oil producers/contractors/regulators re:impacts of oil & gas drilling and production
- 122 active gas wells w/i OSPP/ranch & grazing permit
- Holistic management contract w/BLM for remediation of oil & gas surface damage using animal impact
- Cow/calf, feeder operation using sustainable agriculture practice in partnership w/Diamond S Ranch.

CA
Ex. 13

February 1976 - December 1998

Owner, Schreiber Insurance Agency, Inc., Farmington, NM

- Risk management services for oil & gas geologists, drillers, producers, transport, service contractors
- Claims investigation and adjustment for oil and gas industry San Juan Basin
- Rig inspection for drilling, completion and workover equipment San Juan Basin
- Member national faculty for Oil & Gas, Certified Insurance Counselors

REFERENCE

h ttps://nmpoliticalreport.com/2018/12/05/lujan-grisham-names-transition-team-for-environment-energy- and-water-issues-en/

https://www.env.nm.gov/new-mexico-methane-strategy/methane-advisory-panel/

https://www.congress.gov/116/meeting/house/109319/documents/CHRG-116hhrg36076.pdf

https://holisticmanagement.org/images/stories/Services/ospp_brochure_51.pdf

https://www.westernleaders.org/staff-and-board

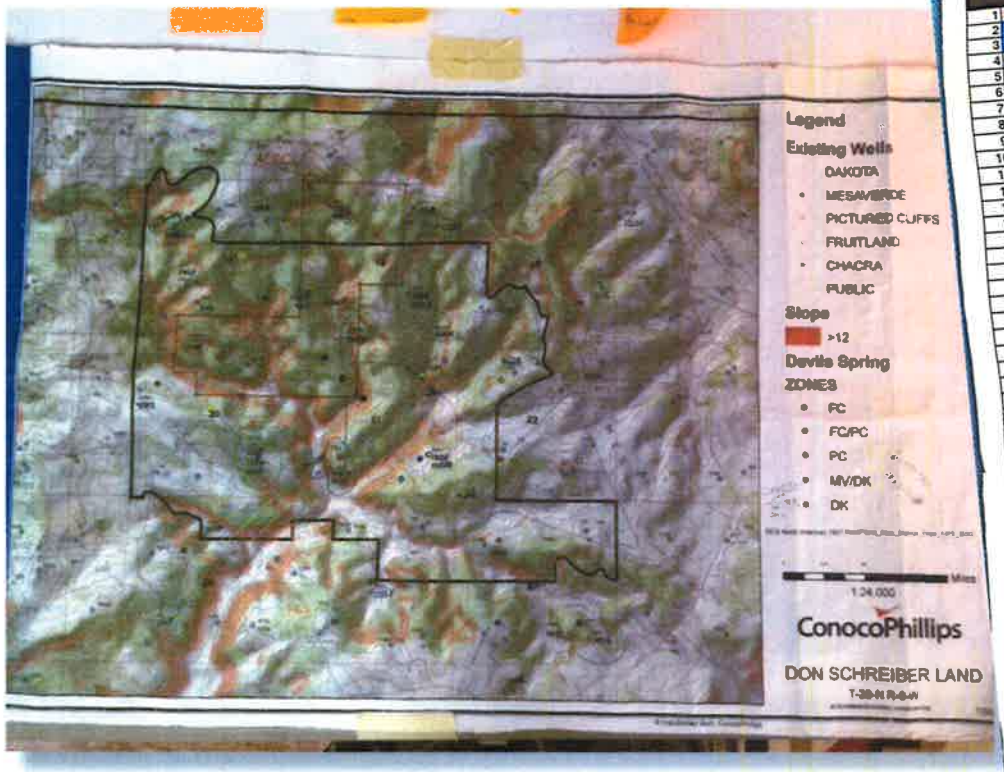
EDUCATION

1971

University of New Mexico
Bachelor of Science

1982

University of Texas
Petroleum Production Technology
Certified



ConocoPhillips Wells in Inventory
28N 6W Sections 15,16,17,20,21,22,27,28,29

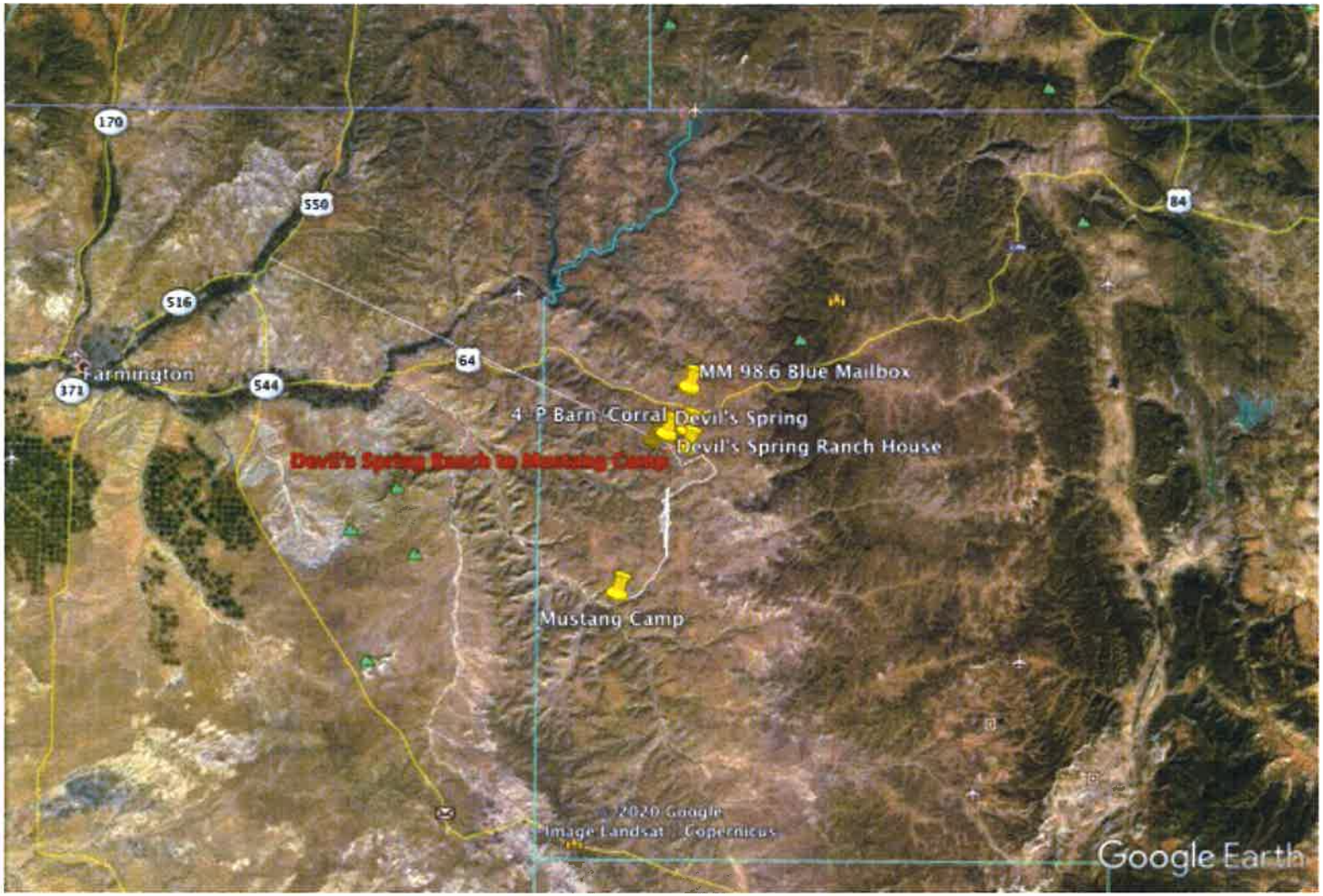
	Well Name	Zones	Sec	Spot	Twin Opt	Dir	Twinned Well
1	SAN JUAN 28-6 UNIT 125M	MV/DK	21	O	Y	Y	60A
2	SAN JUAN 28-6 UNIT 142N	MV/DK	21	F	Y	Y	144
3	SAN JUAN 28-6 UNIT 144N	MV/DK	17	M	Y	Y	119
4	SAN JUAN 28-6 UNIT 119N	MV/DK	22	A	Y	Y	142
5	SAN JUAN 28-6 UNIT 142P	MV/DK	21	K	Y	Y	143
6	SAN JUAN 28-6 UNIT 143P	MV/DK	20	N	Y	Y	438
7	SAN JUAN 28-6 UNIT 122N	MV/DK	15	L	Y	Y	221
8	SAN JUAN 28-6 UNIT 157N	MV/DK	20	G	Y	Y	125
9	SAN JUAN 28-6 UNIT 125N	MV/DK	21	G	Y	Y	154
10	SAN JUAN 28-6 UNIT 154E	DK	27	L	Y	Y	154M
11	SAN JUAN 28-6 UNIT 154N	MV/DK	27	F	Y	Y	223
12	SAN JUAN 28-6 UNIT 128N	MV/DK	17	A	Y	Y	128M
13	SAN JUAN 28-6 UNIT 128P	MV/DK	17	P	Y	Y	49
14	SAN JUAN 28-6 UNIT 126M	MV/DK	16	L	Y	Y	121
15	SAN JUAN 28-6 UNIT 121N	MV/DK	15	H	Y	Y	48
16	SAN JUAN 28-6 UNIT 142E	MV/DK	16	A			
17	SAN JUAN 28-6 UNIT 142M	MV/DK	21	D			475
18	SAN JUAN 28-6 UNIT 147P	MV/DK	29	H	Y		439
19	SAN JUAN 28-6 UNIT 156P	MV/DK	29	M	Y		49A
20	SAN JUAN 28-6 UNIT 126N	MV/DK	16	D			60A
21	SAN JUAN 28-6 UNIT 125E	DK	21	P	Y		14A
22	SAN JUAN 28-6 UNIT 144E	DK	17	D	Y		46A
23	SAN JUAN 28-6 UNIT 121G	DK	15	O	Y		48A
24	SAN JUAN 28-6 UNIT 123E	DK	16	I	Y		31B
25	SAN JUAN 28-6 UNIT 155F	DK	28	M	Y		44A
26	SAN JUAN 28-6 UNIT 127E	DK	20	P	Y		49A
27	SAN JUAN 28-6 UNIT 126E	DK	16	D	Y		60A
28	SAN JUAN 28-6 UNIT 459S	FC/PC	21	I	Y		156M
29	SAN JUAN 28-6 UNIT 439S	FC	29	F			142M
30	SAN JUAN 28-6 UNIT 460S	FC/PC	21	D			149M
31	SAN JUAN 28-6 UNIT 419S	FC	27	P	Y		29A
32	SAN JUAN 28-6 UNIT 149G	DK	27	P	Y		48A
33	SAN JUAN 28-6 UNIT 436S	FC/PC	16	P	Y		143N
34	SAN JUAN 28-6 UNIT 458S	FC	20	E	Y		128M
35	SAN JUAN 28-6 UNIT 441S	FC/PC	17	P	Y		49A
36	SAN JUAN 28-6 UNIT 440S	FC/PC	16	D	Y		124M
37	SAN JUAN 28-6 UNIT 462S	FC/PC	22	D	Y		62A
38	SAN JUAN 28-6 UNIT 461S	FC/PC	22	P	Y		142
39	SAN JUAN 28-6 UNIT 237	PC	21	M	Y		125
40	SAN JUAN 28-6 UNIT 240	PC	21	A	Y		14A
41	PCNM028N006W17NW1	PC	17	D	Y		49
42	SAN JUAN 28-6 UNIT 239	PC	16	M	Y		63
43	SAN JUAN 28-6 UNIT 241	PC	22	M	Y		455
44	PCNM028N006W17SW1	PC	17	M			

= Directional due to topo anyway
= Must be directional if twinned w/ existing
= Vertical if twinned w/ existing
= Schreiber's Fee Surface

New Pads Req'd to Drill These Wells

C.A
EX. 14

ConocoPhillips / Devil's Spring Ranch drilling program, 2008

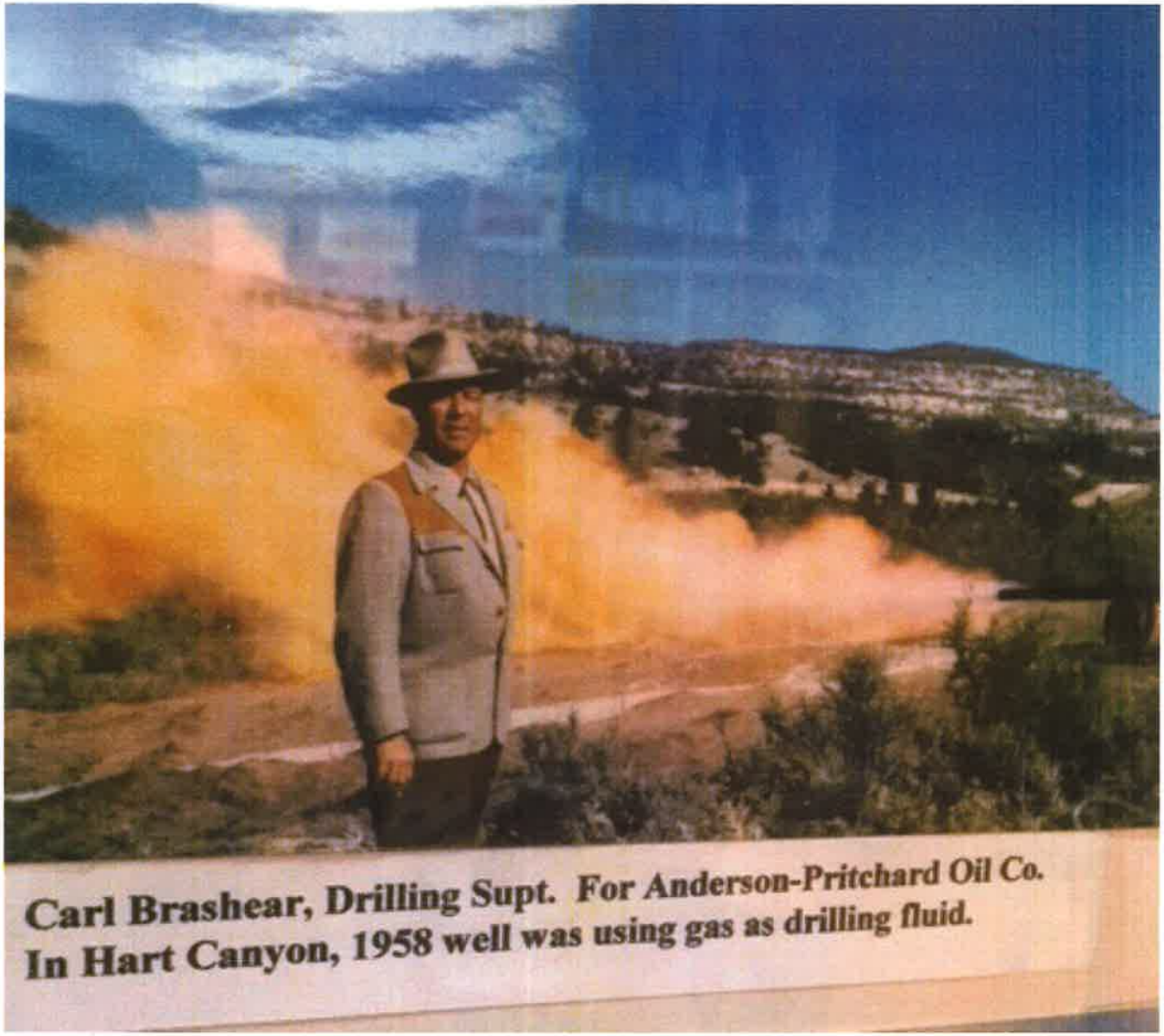


Don and Jane Schreiber's Ranch,
Navajo Dam area, Northwest New Mexico

DEVIL'S SPRING RANCH

Well density typical of San Juan Basin

About 122 wells are on or around our ranch. Drilled from the early 1950s up to 2012 when gas prices crashed.

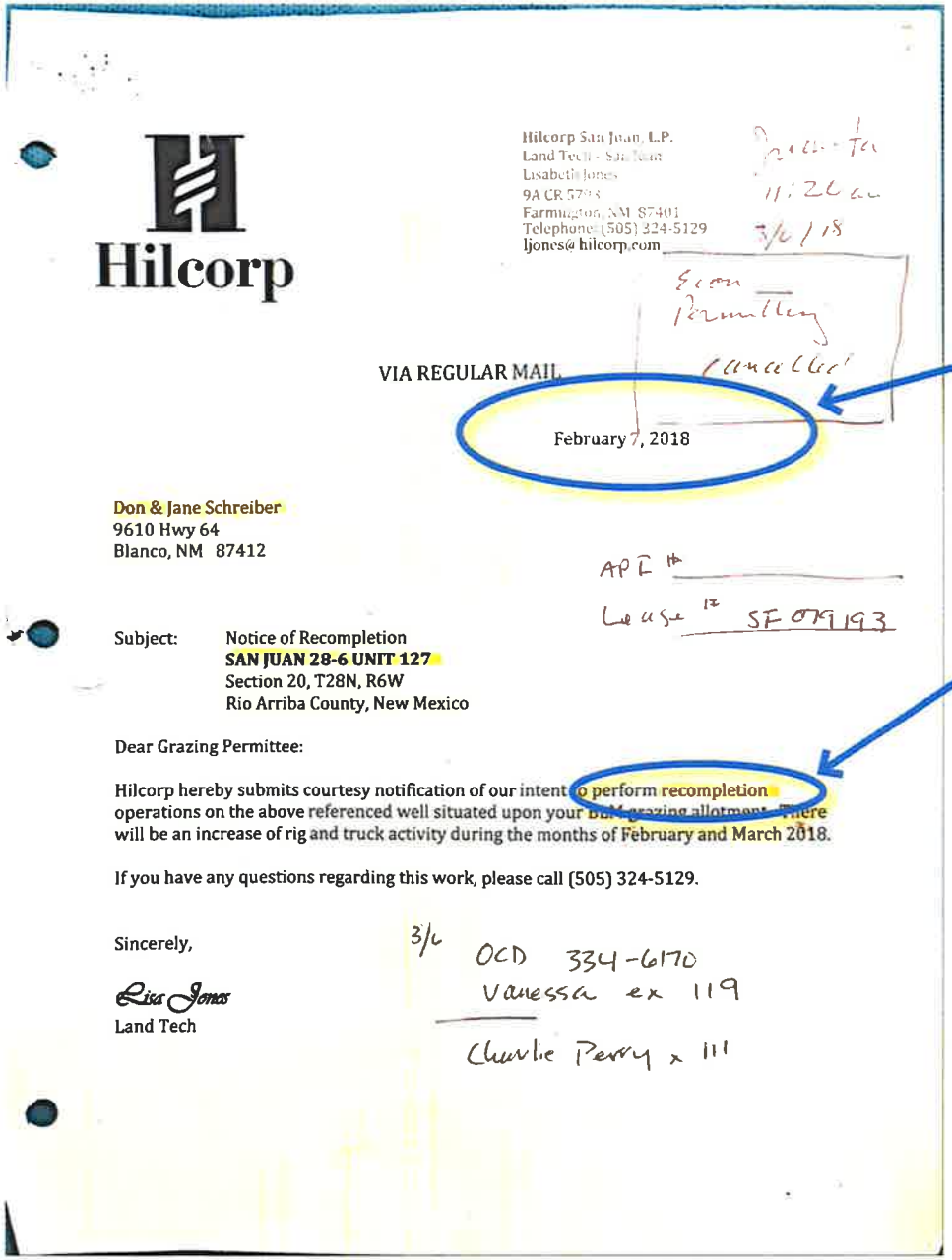


Carl Brashear, Drilling Supt. For Anderson-Pritchard Oil Co.
In Hart Canyon, 1958 well was using gas as drilling fluid.

Blewie line completions were typical in San Juan Basin for about 75 years

Slide 5

Blewie line completions near ranch ~ 2005-2006



Hilcorp

Hilcorp San Juan, L.P.
Land Tech - San Juan
Lisabeth Jones
9A CR 5798
Farmington, NM 87401
Telephone: (505) 324-5129
ljones@hilcorp.com

VIA REGULAR MAIL

February 7, 2018

Don & Jane Schreiber
9610 Hwy 64
Blanco, NM 87412

Subject: Notice of Recompletion
SAN JUAN 28-6 UNIT 127
Section 20, T28N, R6W
Rio Arriba County, New Mexico

Dear Grazing Permittee:

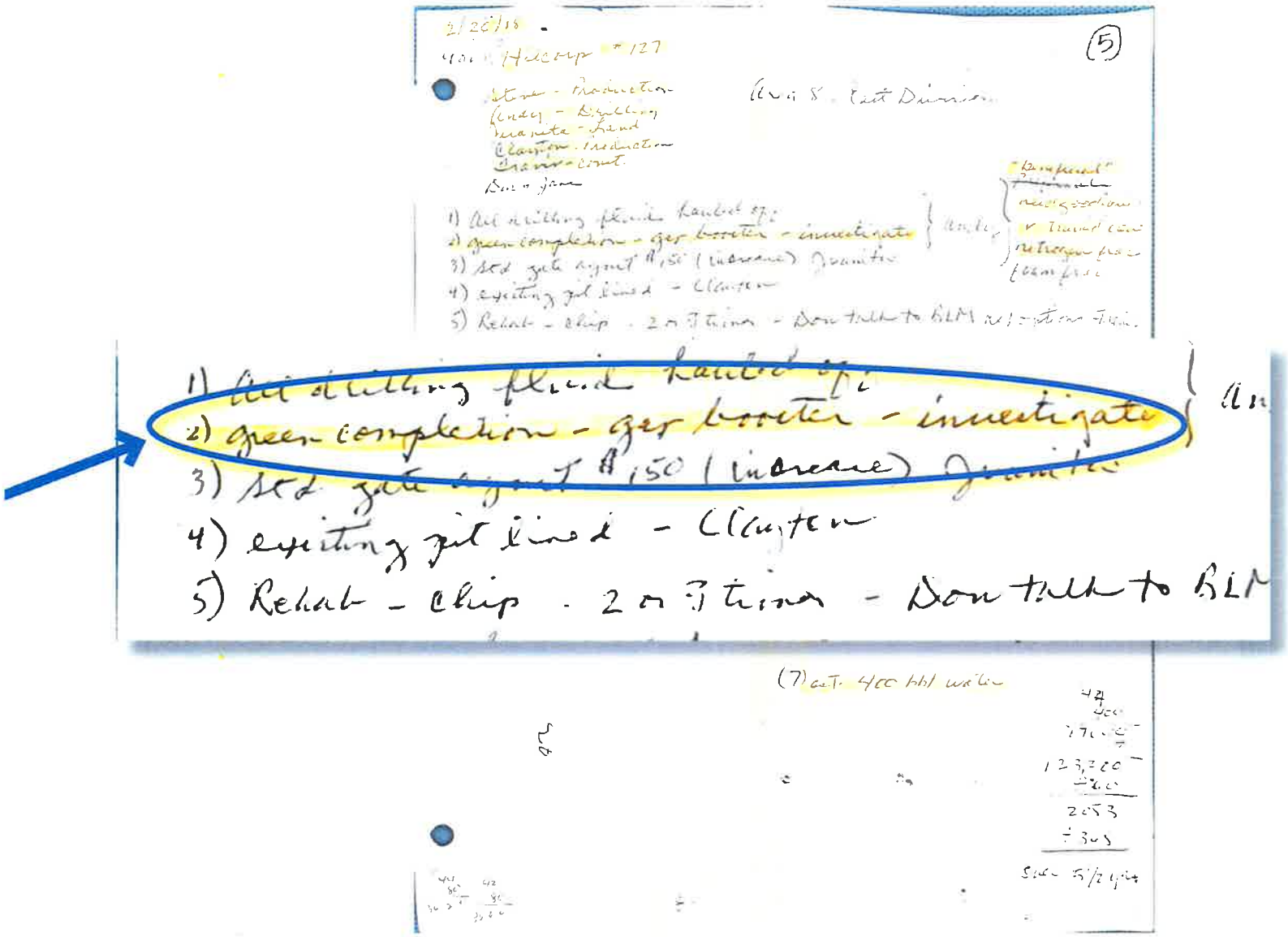
Hilcorp hereby submits courtesy notification of our intent to perform recompletion operations on the above referenced well situated upon your BLM grazing allotment. There will be an increase of rig and truck activity during the months of February and March 2018.

If you have any questions regarding this work, please call (505) 324-5129.

Sincerely,

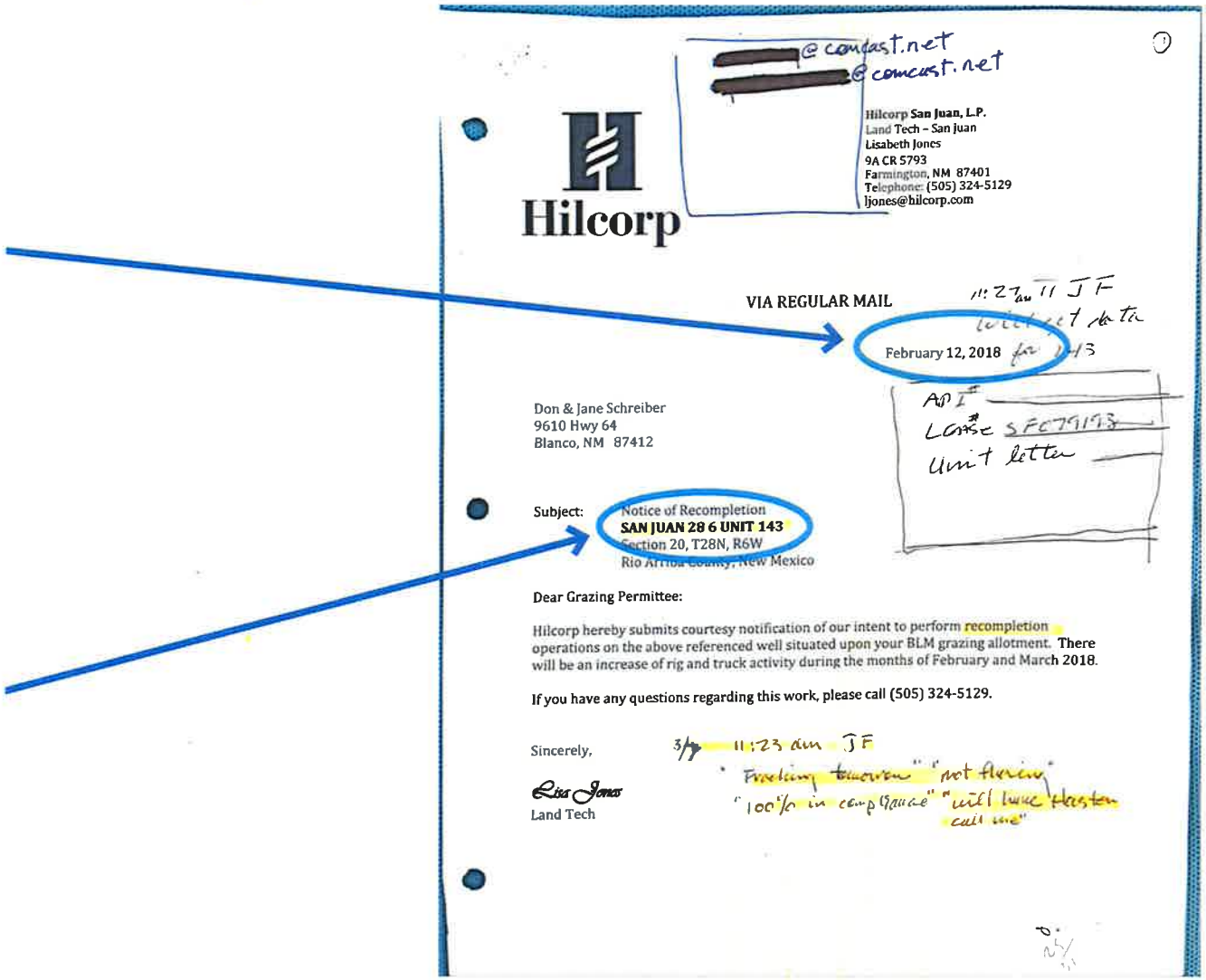
Lisa Jones
Land Tech

Hilcorp #127 recompletion notice, February 2018



Schreiber field notes #127 onsite 2/20/18

Hilcorp representatives present declined to honor our ConocoPhillips agreement to green complete wells, and listed a variety of reasons which made no sense to us.



@comcast.net
@comcast.net

Hilcorp San Juan, L.P.
Land Tech – San Juan
Lisabeth Jones
9A CR 5793
Farmington, NM 87401
Telephone: (505) 324-5129
ljones@hilcorp.com

Hilcorp

VIA REGULAR MAIL

11:27 am 11 JF

February 12, 2018

Don & Jane Schreiber
9610 Hwy 64
Blanco, NM 87412

Subject: Notice of Recompletion
SAN JUAN 28 6 UNIT 143
Section 20, T28N, R6W
Rio Arriba County, New Mexico

Dear Grazing Permittee:

Hilcorp hereby submits courtesy notification of our intent to perform recompletion operations on the above referenced well situated upon your BLM grazing allotment. There will be an increase of rig and truck activity during the months of February and March 2018.

If you have any questions regarding this work, please call (505) 324-5129.

Sincerely,

Lisa Jones
Land Tech

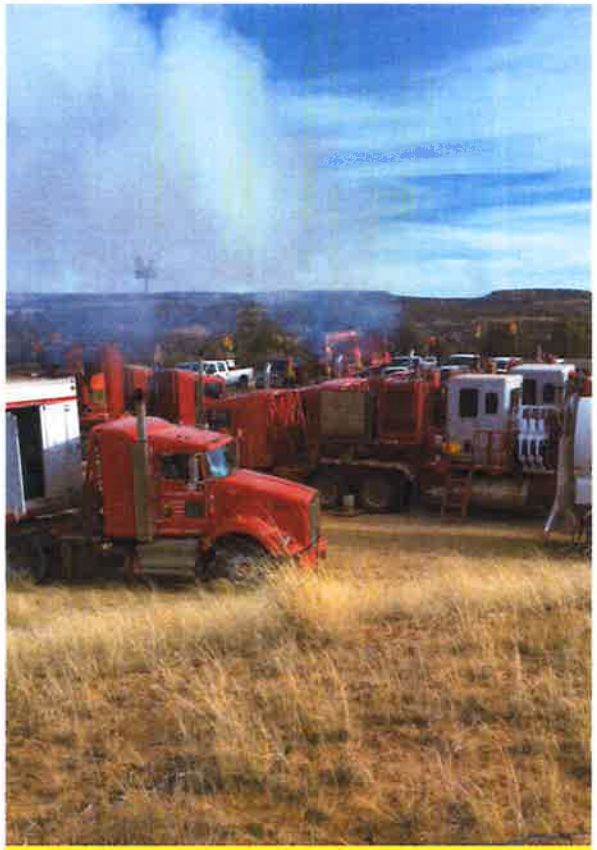
3/9 11:23 am JF
Fracking tomorrow" "not flaring"
"100% in compliance" "will have Hooten call me"

Hilcorp #143 recompletion notice, February 2018

Notes of our scramble for assistance to require Hilcorp to green complete the #127, the #143 shown here, and all well recompletions per our understanding with ConocoPhillips. We discovered that Region 6 had no number to contact Hilcorp.

Slide 9

Hilcorp Recompletion of #143 venting to atmosphere 3/8/18



See separate video

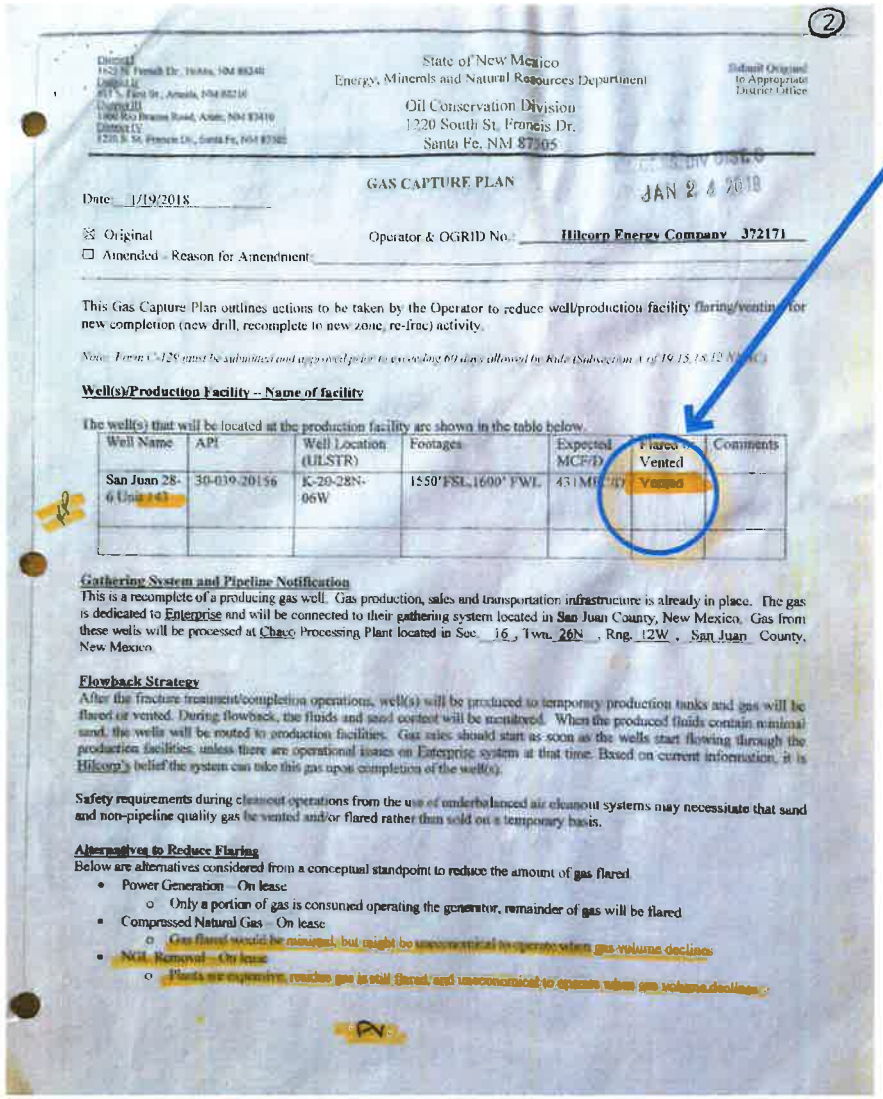
Hilcorp #143 recompletion frack equipment start up 3/8/18

See separate video

Hilcorp #143 recompletion frack panorama 3/8/18

Slide 12

Setup for initial flowback with no REC in place as frac finishes.
Well will vent to atmosphere through open flowback container.



State of New Mexico
Energy, Minerals and Natural Resources Department

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

GAS CAPTURE PLAN

Date: 1/19/2018

☒ Original
☐ Amended - Reason for Amendment:

Operator & OGRID No.: Hilcorp Energy Company 372171

This Gas Capture Plan outlines actions to be taken by the Operator to reduce well/production facility flaring/venting for new completion (new drill, recomplete to new zone, re-frac) activity.

Note: Form C-129 must be submitted and approved prior to exceeding 60 days allowed by Rule (Subsection A of 19.15.18.12 NMAC)

Well(s)/Production Facility – Name of facility

The well(s) that will be located at the production facility are shown in the table below.

Well Name	API	Well Location (ULSTR)	Footages	Expected MCF/D	Flared or Vented	Comments
San Juan 28-6 Unit 143	30-039-20156	K-20-28N-06W	1550'FSL,1600' FWL	431MCFD	Vented	

Gathering System and Pipeline Notification

This is a recomplete of a producing gas well. Gas production, sales and transportation infrastructure is already in place. The gas is dedicated to Enterprise and will be connected to their gathering system located in San Juan County, New Mexico. Gas from these wells will be processed at Chaco Processing Plant located in Sec 16, Twn. 26N, Rng. 12W, San Juan County, New Mexico.

Flowback Strategy

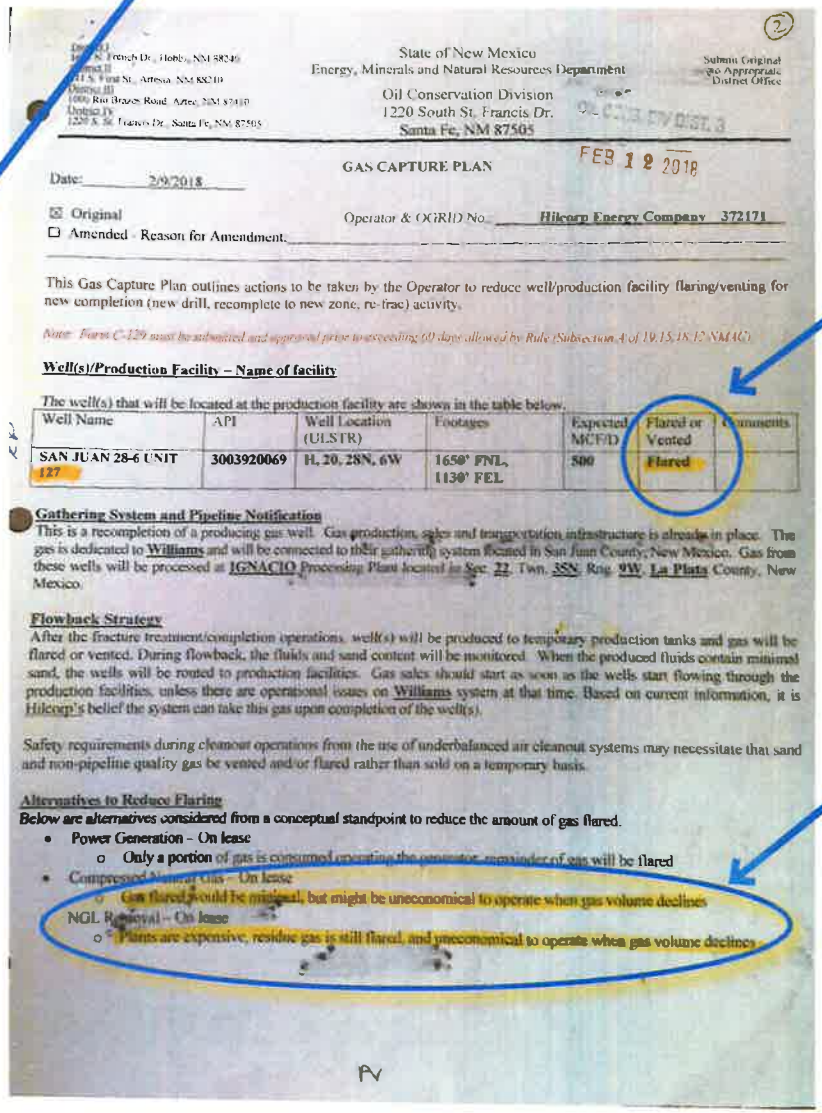
After the fracture treatment/completion operations, well(s) will be produced to temporary production tanks and gas will be flared or vented. During flowback, the fluids and sand content will be monitored. When the produced fluids contain minimal sand, the wells will be routed to production facilities. Gas sales should start as soon as the wells start flowing through the production facilities, unless there are operational issues on Enterprise system at that time. Based on current information, it is Hilcorp's belief the system can take this gas upon completion of the well(s).

Safety requirements during cleanout operations from the use of underbalanced air cleanout systems may necessitate that sand and non-pipeline quality gas be vented and/or flared rather than sold on a temporary basis.

Alternatives to Reduce Flaring

Below are alternatives considered from a conceptual standpoint to reduce the amount of gas flared.

- Power Generation – On lease
  - Only a portion of gas is consumed operating the generator, remainder of gas will be flared
- Compressed Natural Gas – On lease
  - Gas flared would be minimal, but might be uneconomical to operate when gas volume declines
- NGL Removal – On lease
  - Plants are expensive, residue gas is still flared, and uneconomical to operate when gas volume declines



State of New Mexico
Energy, Minerals and Natural Resources Department

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

GAS CAPTURE PLAN

Date: 2/9/2018

☒ Original
☐ Amended - Reason for Amendment:

Operator & OGRID No.: Hilcorp Energy Company 372171

This Gas Capture Plan outlines actions to be taken by the Operator to reduce well/production facility flaring/venting for new completion (new drill, recomplete to new zone, re-frac) activity.

Note: Form C-129 must be submitted and approved prior to exceeding 60 days allowed by Rule (Subsection A of 19.15.18.12 NMAC)

Well(s)/Production Facility – Name of facility

The well(s) that will be located at the production facility are shown in the table below.

Well Name	API	Well Location (ULSTR)	Footages	Expected MCF/D	Flared or Vented	Comments
SAN JUAN 28-6 UNIT 127	3003920069	H, 20, 28N, 6W	1650' FNL, 1130' FEL	500	Flared	

Gathering System and Pipeline Notification

This is a recompletion of a producing gas well. Gas production, sales and transportation infrastructure is already in place. The gas is dedicated to Williams and will be connected to their gathering system located in San Juan County, New Mexico. Gas from these wells will be processed at IGNACIO Processing Plant located in Sec. 22, Twn. 35N, Rng. 9W, La Plata County, New Mexico.

Flowback Strategy

After the fracture treatment/completion operations, well(s) will be produced to temporary production tanks and gas will be flared or vented. During flowback, the fluids and sand content will be monitored. When the produced fluids contain minimal sand, the wells will be routed to production facilities. Gas sales should start as soon as the wells start flowing through the production facilities, unless there are operational issues on Williams system at that time. Based on current information, it is Hilcorp's belief the system can take this gas upon completion of the well(s).

Safety requirements during cleanout operations from the use of underbalanced air cleanout systems may necessitate that sand and non-pipeline quality gas be vented and/or flared rather than sold on a temporary basis.

Alternatives to Reduce Flaring

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- Compressed Natural Gas – On lease
  - Gas flared would be minimal, but might be uneconomical to operate when gas volume declines
- NGL Removal – On lease
  - Plants are expensive, residue gas is still flared, and uneconomical to operate when gas volume declines

NMOCD Gas Capture Plans are the same

The only variations in OCD form are well details and whether vented or flared. Pre-printed exceptions exploit OOOO regulation language regarding separators and technical infeasibility.

Comments on New Mexico Environment Department's draft Oil Precursor Rule for Oil and Natural Gas Sector ("Draft Rule").

7. Completions and Recompletions[68]

Completions and recompletions are an important source of methane emissions, that will increase in importance if changing commodity prices lead to another wave of build-out. Although this topic was discussed extensively by the Methane Advisory Panel, it is conspicuously missing from NMED's proposed rule. NMED should correct this oversight by requiring the use of green completions except in strictly limited circumstances.

Although EPA requires green completions at most wells under Subpart OOOOa,[69] some operators have been exploiting ambiguities in this regulation to avoid deploying reduced emission completion ("REC") equipment. NMED should adopt regulations that are more protective of public health and the environment. Canada's federal regulations which provide that "Hydrocarbon gas associated with flowback at a well at an upstream oil and gas facility ***must not be vented*** during flowback but must instead be captured and routed to hydrocarbon gas conservation equipment or hydrocarbon gas destruction equipment."[70] There is only one exception to this flat ban on venting: the prohibition does not apply "if all the gas associated with flowback at the well does not have sufficient heating value to sustain combustion."[71] Similarly, Colorado regulators have recently proposed to require control of at least 95% of emissions during the entire flowback period.[72]

These regulations are more protective than the regulations in Subpart OOOOa, for two reasons. First, unlike EPA's regulations, the Canada and Colorado regulations do not allow venting during the initial flowback stage (unless the gas produced at this stage does not have sufficient heating value to sustain combustion). Second, neither regulation contains the frequently abused "technical infeasibility" exemption that is found in EPA's regulations.

The "technical infeasibility" exemption is unnecessary and undermines the effectiveness of Subpart OOOOa. We are skeptical that there are in fact normal flowback situations where REC cannot be designed to address. Studies have shown that REC can be successfully deployed even on low-pressure wells.[73] But to the extent there are normal flowback situations where REC cannot be deployed, industry should be required to specifically identify them so the exemption can be narrowly tailored.

Another problem is that the "technical infeasibility" exemption has been interpreted to allow operators to obtain an exemption from green completion requirements *even when the grounds for the exemption (e.g., lack of gathering lines) are known in advance.* In adopting this rule, EPA considered but rejected comments urging the agency to disallow technical infeasibility exemptions in these cases.[74] As EPA's discussion indicates, in many cases operators know in advance that it is not feasible to comply with green completion requirements due to lack of gathering lines, right of way issues, or similar factors. In these cases, there is a technically feasible alternative to wasting the gas: delay drilling until these infrastructure concerns are addressed. Exemptions to green completion requirements should be permitted only in true emergencies. We encourage NMED to adopt a provision for completions and recompletions modeled after Canada's rule and Colorado's proposal.

8. Other Issues

[64] Cal. Code Regs. tit. 17, § 95668 (c)(3), (d); *see* *Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)* (SOR/2018-66) [hereinafter "Canada Federal Regulations"], § 14.

[65] 5 Colo. Code Regs. § 1001-9:D.II.B.3.b.

[66] *See* Canada Federal Regulations, § 18(3)(b).

[67] Cal. Code Regs. tit. 17, § 95668(c)(4)(D).

[68] A more extensive discussion of this topic is found in Western Environmental Law Center, et al.'s comments on the Oil Conservation Division's Natural Gas Waste Draft Rule. We incorporate this discussion herein by reference.

[69] 40 C.F.R. § 60.5375a.

[70] Canada Federal Regulations, § 11(2).

[71] *Id.*, § 11(3).

[72] Proposed 5 CCR 1001-9, VI.D.1.a.

[73] https://www.epa.gov/sites/production/files/2017-08/documents/reduced_emission_completions_farm_2006.pdf at 8 (discussing Weatherford Green Completion equipment which can be used when well pressure is less than 80 psig).

[74] *See* 81 FR 35852.

Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20

19.15.27.8 NMAC Completion and Re-completion Operations
1 of 4

4. 19.15.27.8 NMAC Completion and Re-completion Operations

We strongly support requirements to reduce venting and flaring from completion and recompletion operations. We are concerned, however, that OCD's proposal does not require reduced emission completions (REC), and hence would continue to allow large quantities of gas to be vented directly to the atmosphere, with all of the resulting harms to human health and the environment from such methane and VOC releases and loss of state revenues from this wasted natural resource.

EPA regulations adopted for gas wells in 2011 and extended to oil wells in 2016 require the use of reduced emission completion (REC) equipment for completions and recompletions. The requirement for so-called "green completions" has been widely and appropriately acclaimed as a major advance in reducing the massive volumes of methane emissions associated with uncontrolled emissions during the completion process for hydraulically fractured or refractured wells. Unfortunately, over the past few years some operators have been increasingly exploiting ambiguities in the EPA regulatory text to avoid deploying and minimizing the use of REC equipment. In particular, extensive anecdotal evidence indicates that operators in NM are not always using REC equipment.

Specifically, there are issues with the EPA regulatory text regarding "separators," and with what was intended to be a narrow exception to address rare situations of infeasibility. A recent technical amendment to the EPA regulations helpfully clarifies the meaning of "separator," and adds a requirement that a separator be available for use during the entire flowback process.[1] The recent amendments do not, however, otherwise tighten the regulations as needed to ensure that the regulations fulfill the intent to require operators to deploy and use REC equipment for every completion and recompletion operation. OCD has the opportunity now to address this issue, and do so in a way that allows OCD to enforce the requirements. We urge you to seize this opportunity and ensure that operators are not allowed to vent gas during completions.

For over two decades, industry has been using REC equipment to handle initial flowback from hydraulically fractured wells and capture the gas. Natural gas producers developed and deployed this equipment because the gas was valuable and they could recover their costs through sales. Since 2011, hydraulically fractured natural gas wells have been required to use it by law, with hydraulically fractured oil wells added in 2016. REC equipment is designed to be temporary and easily moved from well-site to well-site. It normally includes filters such as plugs, sandcatchers, and one or more attached separators, and it is designed for the pressures and volumes associated with initial flowback. Where well pressures are too low for REC equipment to function properly, the pressures going into the REC equipment can be boosted with compressors.

[1] [INSERT CITE TO EPA TECHNICAL AMENDMENTS NSPS.]

Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20

The EPA regulations include an exemption if it is "technically infeasible" for a separator to function, but this exemption is not necessary and it is subject to abuse, substantially undermining the effectiveness of the requirement. The whole point of REC equipment is to allow gas capture during the entire flowback process, and if equipment is not able to accomplish that, it should not be considered REC equipment. The operator should be responsible for obtaining REC equipment adequate for the particular job, and if it is not adequate, either the equipment is insufficient, or the operator may be using a fracking technique that is not compatible with the equipment deployed. Either way, these are factors that are under the *operator's* control. If there is a problem, the burden should be on the operator to address it, not shifted onto the public health and the environment in the form of air pollution or to the state in the form of lost revenues.

Thus, we strongly urge OCD not to include an open-ended exemption for "technical infeasibility." We are skeptical that there are in fact normal flowback situations (absent emergencies, which are already exempted from the proposed venting prohibitions) that REC equipment cannot be designed to address and that operators cannot avoid through their choice of fracking techniques. But if such normal flowback situations exist, OCD should require industry to specifically identify them before making an attempt to draft regulatory exemptions. If OCD decides to include any such exemption, we urge OCD to do so only if it can be drafted in a way that it cannot be used as a loophole to evade the intent of the regulation to require the use of REC equipment and avoid the venting of gas.

The second problem with the EPA regulations is that some have been misreading the text to claim that the use of the terms "initial flowback" and "separation flowback" allows venting up until the point that the flowback gas is clean enough for a permanent onsite separator to function. As these separators are generally not designed to handle flowback gas, this interpretation allows venting throughout the flowback period. This is a blatant misreading of the text and intent of the EPA regulations, and EPA has just finalized amended text to disallow this interpretation. EPA has added: "The separator may be a production separator, but the production separator also must be designed to accommodate flowback." It is critical that any OCD reference to a "separator" during completion operations make it clear that this means a separator that is part of the REC equipment and hence is designed to accommodate the volumes and pressures associated with initial flowback. If OCD allows use of a permanent separator during the flowback period, it must be contingent upon such a separator being capable of handling the flowback, in conjunction with the REC equipment, when the flowback begins.

In summary, there is no circumstance in which an operator should be able to avoid routing the initial flowback through a set of REC equipment. The "flowback period" begins at the initiation of flowback and extends until well completion or recompletion is terminated and a (permanent) separator is connected to the wellhead. In practical terms, this means that the regulations should be structured to prohibit *any* venting during flowback.

The regulations should also include a requirement that the operator have REC equipment onsite and connected prior to initiation of flowback, and must use it to capture gas

19.15.27.8 NMAC Completion and Re-completion Operations
2 of 4

Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20

throughout the entire flowback period. A requirement to have the equipment onsite and connected is relatively easy to verify and enforce, and it reduces the incentive for operators to avoid the REC requirements overall (EPA's recent amendments also added language to require that the separator be available and ready for use during the entire flowback period).

This is consistent with the approach of other regulatory jurisdictions, which have recognized that venting during any stage of the completion/recompletion process is neither technically necessary nor hugely costly to avoid. For example, the CO Air Pollution Control Division has proposed to require control of at least 95% of emissions during the entire flowback period:

> Owners or operators of a well with flowback that begins on or after May 1, 2021, must collect and control emissions from each flowback vessel on and after the date flowback after drill-out is routed to the flowback vessel by routing emissions to and operating air pollution control equipment that achieves a hydrocarbon control efficiency of at least 95%. If a combustion device is used, it must have a design destruction efficiency of at least 98% for hydrocarbons. VI.D.1.a.(i) Owners or operators must use enclosed flowback vessels.

19.15.27.8 NMAC Completion and Re-completion Operations **3 of 4**

Similarly, the Canadian federal **[describe regs]** provide: "Hydrocarbon gas associated with flowback at a well at an upstream oil and gas facility must not be vented during flowback but must instead be captured and routed to hydrocarbon gas conservation equipment or hydrocarbon gas destruction equipment." The only exception to this venting prohibition is "if all the gas associated with blowback at the well does not have sufficient heating value to sustain combustion." We understand that this exemption is intended to address the flowback when nitrogen is used as the fracking material, but the exemption is overbroad. When nitrogen is used as the fracking material, the gas is not initially suitable for sales and it may be difficult to achieve sustained combustion. Operators can readily address the combustion issue, however, by providing sufficient additional combustible gas to sustain combustion.

Colorado and Canadian regulators recognize that venting is not necessary during initial or subsequent flowback from hydraulically fractured wells, and technology to control it is affordable and available, and we urge OCD to be no less protective of New Mexico.

In addition to prohibiting venting, OCD's completion regulations should also require operators to avoid flaring except as may be necessary in a few specific situations as part of the operation of the REC equipment. For example, we recognize that when nitrogen is used for fracking, the flowback gas may require flaring to be used an integral part of the REC process and equipment, while still allowing delivery of the remainder of the gas to the sales line, other beneficial use, or reinjection. Thus, OCD could allow for flaring during flowback, but only where it is an integral and necessary part of the REC process. As a general matter, the operator should be required to capture and route to a sales line, beneficially use, or re-inject the gas.

We urge OCD to adopt forward looking regulations that do more to reduce harms to public health through local air pollution, climate change and economic loss of the natural resource through waste from New Mexico's oil and gas industry. OCD must require operators not

Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20

only to deploy and connect REC equipment prior to flowback and use it upon initiation of flowback, but also to capture, use, or re-inject, the gas from the initiation of flowback until the well completion or recompletion is terminated and a separator is connected to the wellhead. Specifically, we suggest that the regulations provide the following:

19.15.27.7 Definitions.

* * *

"Reduced emissions completion equipment" means a collection of temporary equipment, including at minimum filters, containment vessels, and one or more separators, deployed during a fracturing or refracturing operation allowing gas flowback during well completion or recompletion to be captured, cleaned and routed to the sales line or collection system, re-injected into the well or another well, used as an onsite fuel source, or used for other useful purpose that a purchased fuel or raw material would serve, with no direct release to the atmosphere.

19.15.27.8 VENTING AND FLARING OF NATURAL GAS

* * *

C. Venting and flaring during completion or recompletion operations.

(1) Prior to initiating flowback, the operator shall locate reduced emissions completion equipment onsite and connect it to the wellhead.

(2) Beginning upon initiation of flowback, the operator shall capture and route recovered natural gas and fluids to reduced emissions completion equipment, including to one or more well completion vessels or storage vessels and a separator. The operator shall immediately commence operation of the reduced emissions completion equipment.

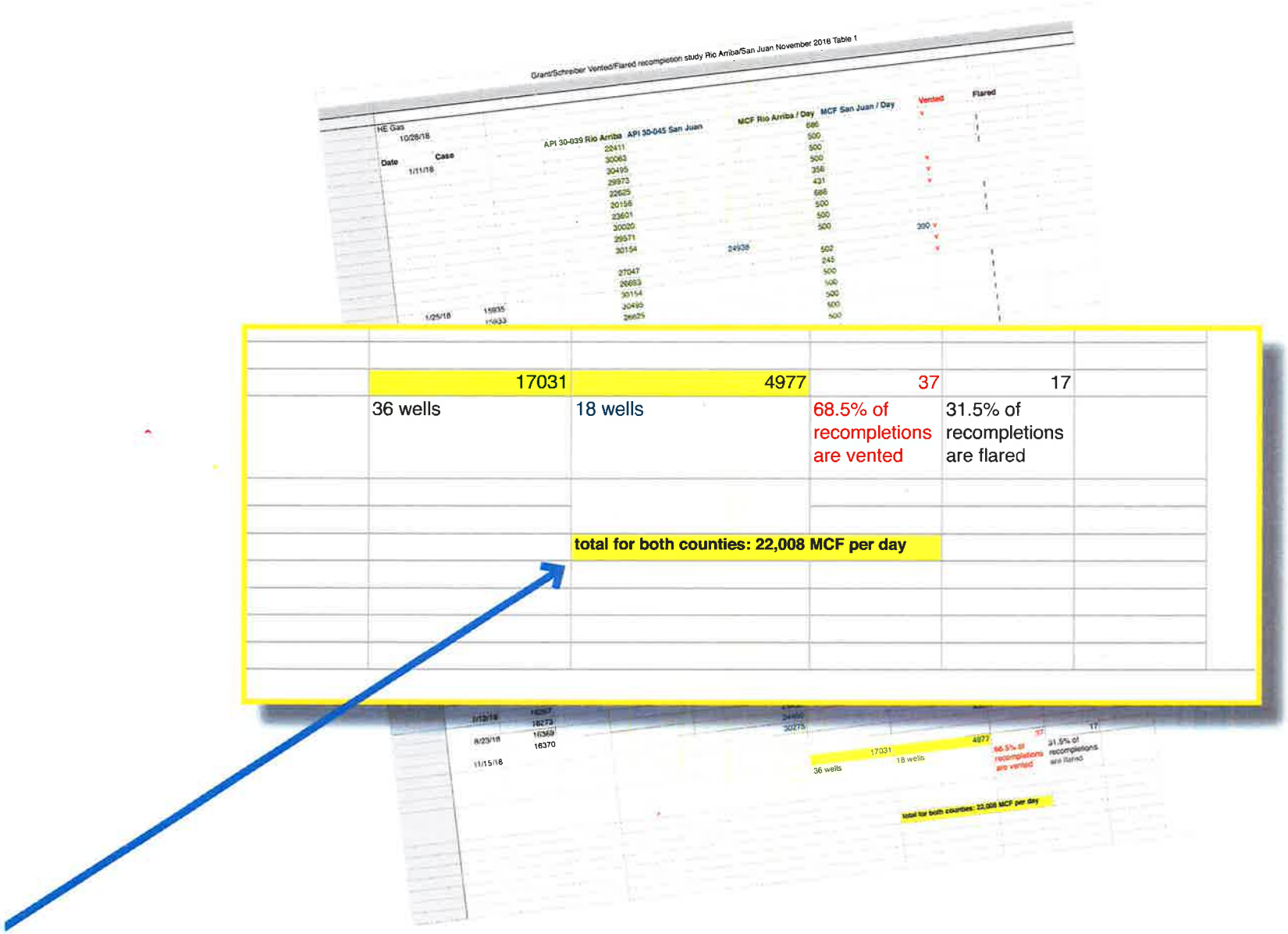
(3) The operator shall capture and route recovered natural gas to a sales line or collection system, re-inject it into the well or use it on-site as a fuel source or for another purpose that a purchased or raw material would serve.

(4) If formation pressure is inadequate for reduced emissions completion equipment to function, the operator shall use gas compression equipment to boost the pressure.

(5) The operator may route recovered natural gas to a flare only where flaring is an integral and necessary part of the operation of the reduced emission completion equipment, where the remainder of the flowback gas is routed to one or more of the uses specified in (3), and provided that the flare is equipped with an automatic igniter or continuous pilot.

19.15.27.8 NMAC Completion and Re-completion Operations **4 of 4**

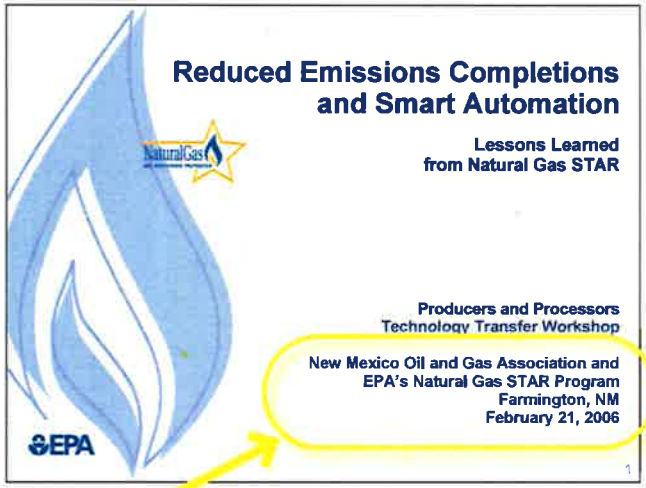
Analysis and comments regarding existing EPA regulation language failures submitted to NMED 9/16/20



2018 venting/flaring study of 54 Hilcorp recompletion in Rio Arriba and San Juan Counties—37 vented / 17 flared

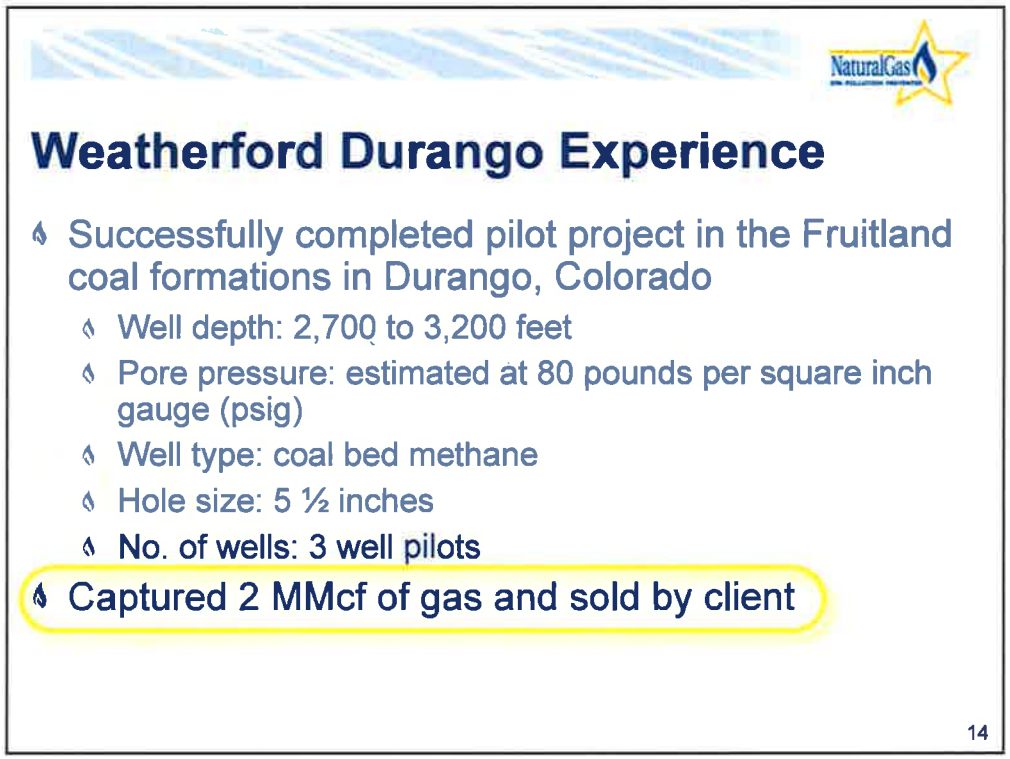
Slide 20

Hilcorp recompletion flare US Hwy 64 near Blanco, NM 2/23/18



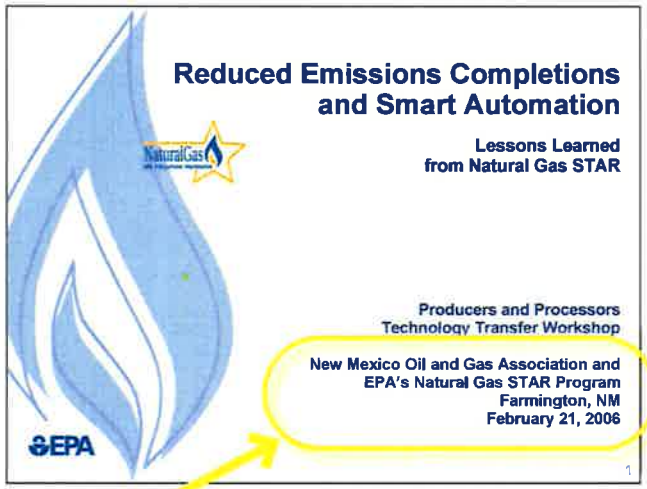
In just those 3 wells they captured and sold 2 MMcf of gas. The Williams Companies identify average household use as 196 cu ft per day. 2 MMcf = 2,000,000 cf

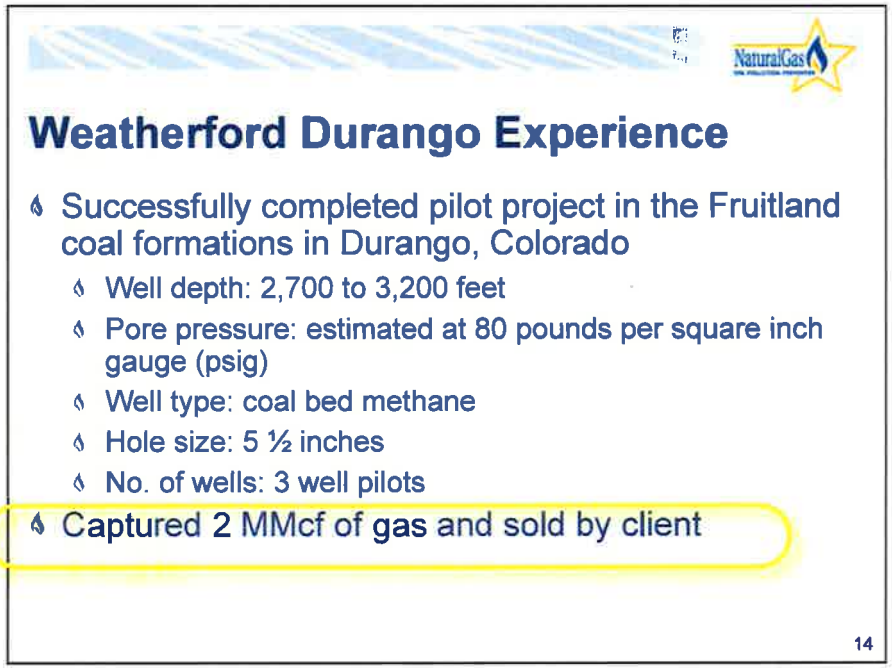
$$\frac{2{,}000{,}000}{196 \times 365 \text{ days/yr}} = \textbf{27.9 households for a year}$$



Weatherford green completion (REC) equipment in use in early 2000s

Weatherford REC Study 2004 in San Juan Basin, including low pressure wells
epa.gov/sites/production/files/2017-08/documents/reduced_emission_completions_farm_2006.pdf





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$$\frac{2{,}000{,}000}{196 \times 365 \text{ days/yr}} = \text{27.9 households for a year, 3 wells}$$

For 22 wells: $\frac{27.9}{3}$ **= 9.3 households per well**

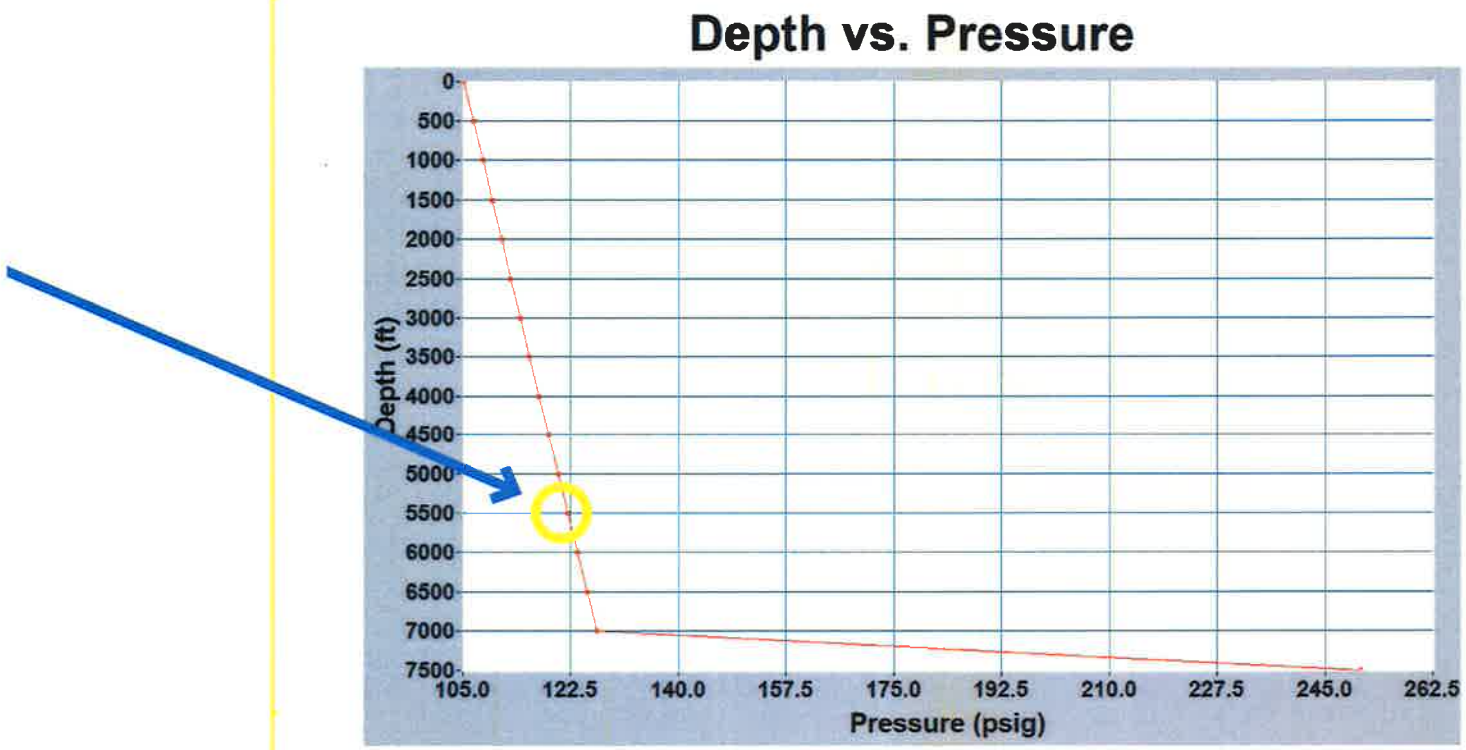
x 22

9.3 households per wells x 22 = 204.6

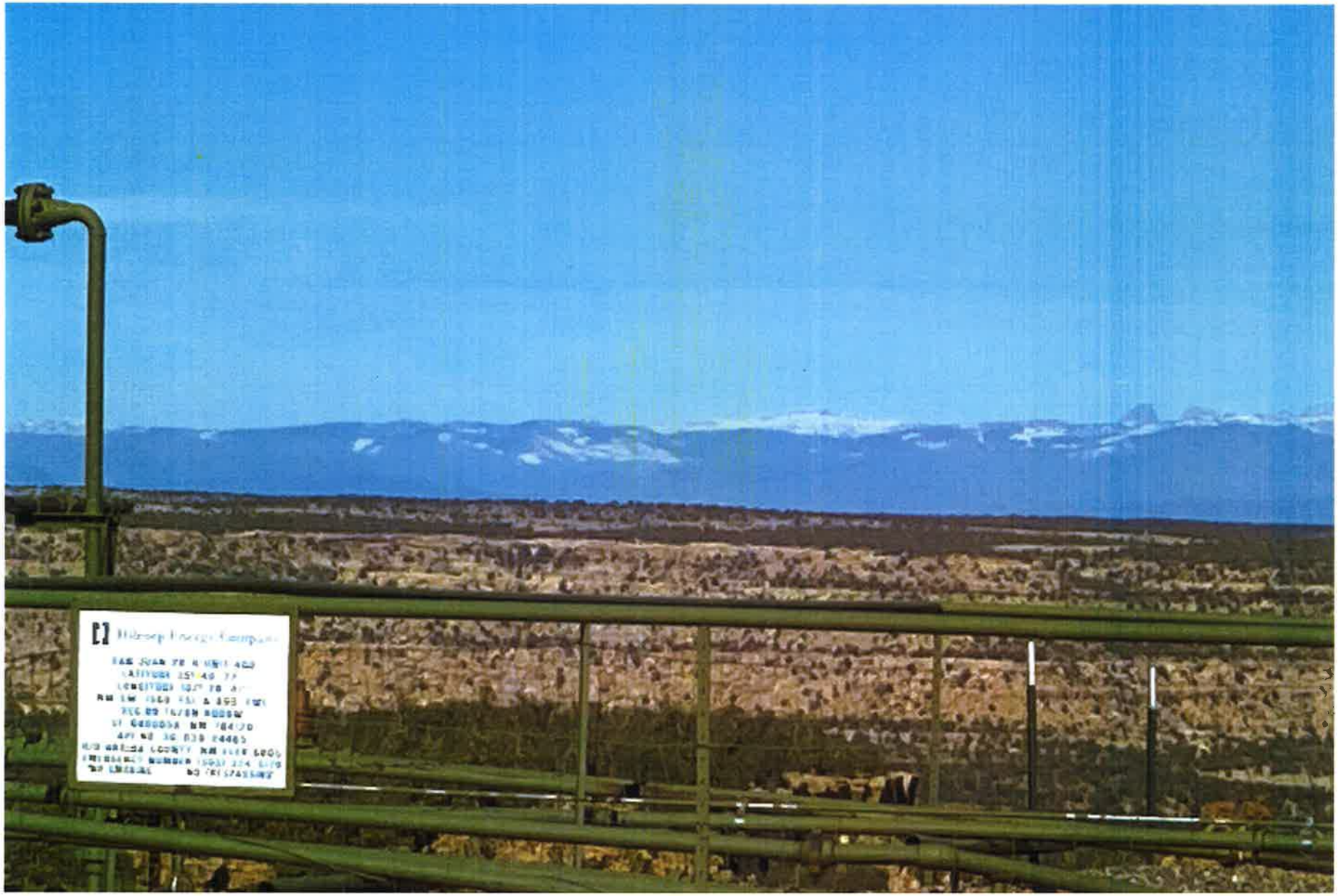
Hilcorp notifed us they intended to recomplete 22 wells in our area alone. Based on Weatherford numbers: 3 wells = 27 households, 22 wells = 205 households.

Company Name	HILCORP
Well Name	SAN JUAN 27-5 UNIT POW 916
Type of Test	POOH STATIC GRADIENT
Date(s) of Test	6/10/20

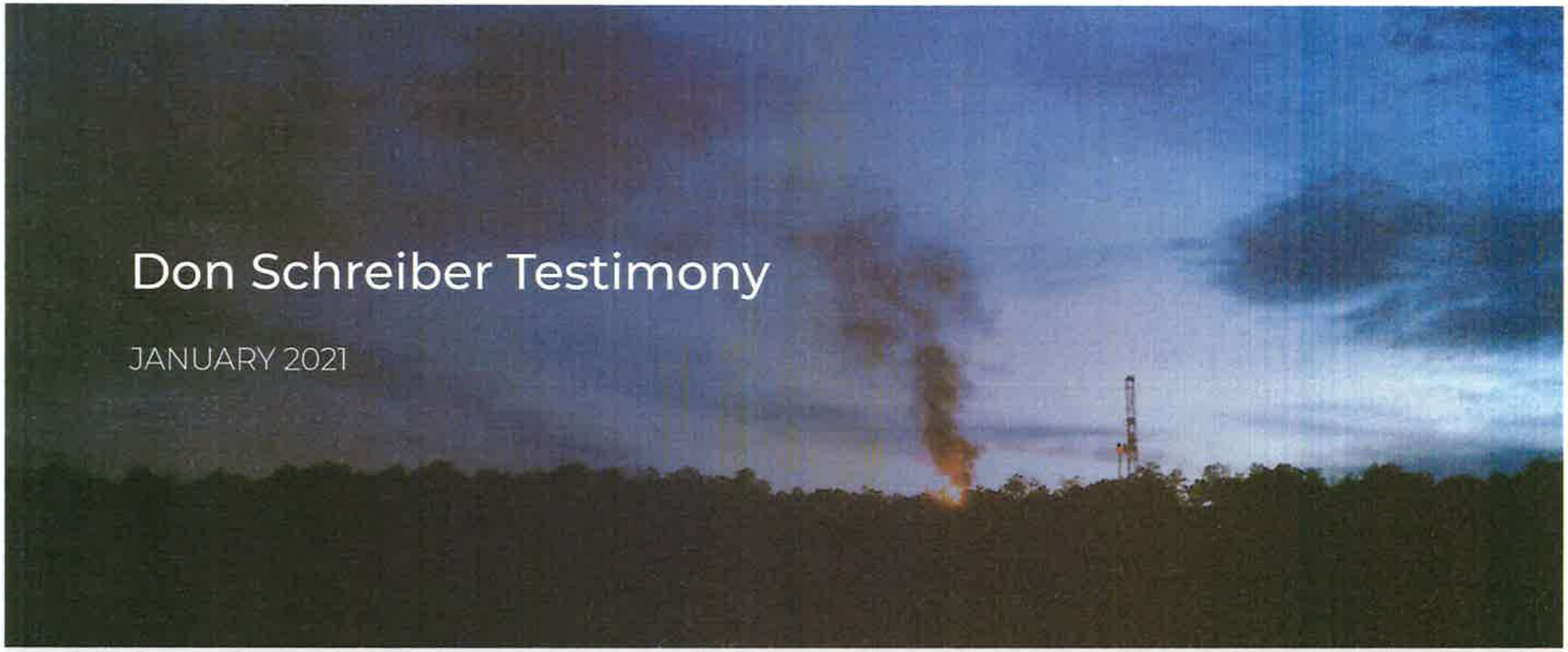
Probe Serial Number



Hilcorp monitor well depth vs. pressure chart



View from New Mexico into Colorado near the Devil's Springs Ranch



Don Schreiber Testimony

JANUARY 2021

New Mexico Oil Conservation Division

Adrienne Sandoval, Chair
Jordan Kessler, JD
Thomas Engler, PhD, PE

Don Schreiber, Devil's Spring Ranch

APPALACHIAN BASIN

NATURAL GAS AND GREEN COMPLETION IN A NUT SHELL

BY [redacted] NOV. 26, 2012 31

Green completion may be a foreign term for some people but it's real and is one more demonstration of how technology is always one step ahead of the natural gas opposition.

Green completions are now becoming standard in the natural gas industry, eliminating one of the latest objections of natural gas opponents who like to say the industry is venting too much methane into the air and contributing to global warming (when it's actually doing the exact opposite by lowering carbon emissions). When a natural gas well is developed, there is an excess of natural gas which, in the past, was released into the air or flared (burned off) but now companies are moving toward capturing the natural gas at the well head instead of releasing it.

Let's take a closer look at green completions and how the process is regulated because a new report suggests this technique is already having a major impact in reducing greenhouse gas emissions.

WHAT IS A GREEN COMPLETION?

The Clean Air Act authorized the Environmental Protection Agency to regulate certain aspects of natural gas development. It adopted a rule in April of this year, that, by it's own description, "generally requires owners/operators to use reduced emissions completions, also known as "RECs" or "green completions," to reduce VOC emissions from well completions. To achieve these VOC reductions, owners and/or operators may use RECs or completion combustion devices, such as flaring, until January 1, 2015; as of January owners and/or operators must use RECs and a completion combustion device."

CA Ex. 14
Ex. i

Green completion essentially requires natural gas companies to capture the gas at the well head immediately after well completion instead of releasing it into the atmosphere or flaring it off. Here's how Environmentally Friendly Drilling Systems (EFD), a service company to the industry, describes them:

> Green completions are systems to reduce methane losses during well completions. After a new well completion or workover, the well bore and formation must be cleaned of debris and fracture fluid. Conventional methods for doing this include producing the well into an open pit or tank to collect sand, cuttings and reservoir fluids for disposal. Typically, the natural gas that is produced is vented or flared. The large volume of natural gas that is lost may not only affect regional air quality, it might also affect the profitability of drilling operations.
>
> Green completion systems present a significant opportunity for cost savings. By using portable equipment to process gas and condensate, the recovered gas can be directed to a pipeline and sold. These truck or trailer mounted systems can typically recover more than half of the total gas produced and industry results have shown that investment in portable three phase separators, sand traps and tanks can be recovered in 2 years or less.

Example of Green Completion Equipment (FracmasterUSA)

Combined with the shift to closed-loop systems that eliminate the need for open pits, this development means both air emissions and flowback water are being recaptured and reused with both economic and environmental benefits; the classic "win-win." Here's a concise technical definition:

> In green completions, gas and hydrocarbon liquids are physically separated from other fluids and delivered directly into equipment that holds or transports the hydrocarbons for productive use. There is no venting or flaring. This practice then links upstream activities with mid and downstream efforts.

Flaring of course, is a process of burning excess natural gas instead of just releasing it to the environment. Not commonly understood is the fact flaring of natural gas actually puts more water into the hydrologic cycle than not burning it, because one of the two byproducts of methane is water. Nonetheless, gas companies are in the business of selling the product, so capturing it for sale makes even more sense.

WHAT ARE THE EXPECTED IMPACTS OF GREEN COMPLETIONS?

The EPA has, as noted above, established the standards for green completions, and here is their expectation, as reported by the *The State Journal* (West Virginia).

> The EPA's New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants will improve air quality and reduce health risks.
>
> "The action taken today is expected to yield nearly a 95 percent reduction in smog-forming volatile organic compounds emitted from more than 13,000 hydraulically fractured gas wells each year," said EPA Office of Air and Radiation Assistant Administrator Gina McCarthy.
>
> Under the rule, operations are required to use "reduced emissions" or "green well completion" equipment to capture gas and condensate that comes up with hydraulic fracturing flowback, preventing their release into the air and making the valuable hydrocarbons available to the producer for sale.

And, this is what EPA says:

> To ensure that smog-forming volatile organic compounds (VOCs) are controlled without slowing natural gas production, EPA's final NSPS for VOCs establishes two phases for reducing VOCs during well completion. This approach will provide industry time to order and manufacture enough equipment to capture natural gas using a process called green completions, also known as "reduced emissions completions.

They go on to describe the other stages as well.

> **Phase 1:** In the first phase (before Jan. 1, 2015), industry must reduce VOC emissions either by flaring using completion combustion device or by capturing the gas using green completions with a completion combustion device (unless combustion is a safety hazard or is prohibited by state or local regulations).
>
> A completion combustion device burns off the gas that would otherwise escape during the well-completion period (combustion generally would occur through pit flaring). Industry may use completion combustion devices to reduce VOC emissions until Jan. 1, 2015, unless state or local requirements prohibit the practice or require more stringent controls. EPA encourages industry to begin using green completions during this time.
>
> **Phase 2:** Beginning Jan. 1, 2015, operators must capture the gas and make it available for use or sale, which they can do through the use of green completions.
>
> - EPA estimates that use of green completions for the three- to 10-day flowback period reduces VOC emissions from completions and recompletions of

> hydraulically fractured wells by 95 percent at each well.
>
> – Both combustion and green completions will reduce the VOCs that currently escape into the air during well completion. However, capturing the gas through a green completion prevents a valuable resource from going to waste and does not generate NOx, which is a byproduct of combustion.

Interestingly, a study has just been released by MIT that indicates "The use of flaring and **reduced emission completions reduce the levels of actual fugitive emissions from shale well completion operations to about 216 Gg CH_4, or 50 Mg CH_4 per well**, a release substantially lower than several widely quoted estimates." It looks like the Howarth study just took yet another hit.

ARE GREEN COMPLETIONS SOMETHING NEW? NOT EXACTLY.

Some companies have been doing green completions for almost a decade. One example is Devon Energy Corporation and here's what they have to say:

> Green completions have been Devon's standard practice in the Barnett Shale since 2004. The company uses the same process to complete wells in New Mexico, Wyoming, Oklahoma and south Texas. Using this process, Devon has reduced methane emissions by more than 15 billion cubic feet in the Barnett Shale area of north Texas. Not long ago, green completions were so uncommon that Devon had to look as far as Wyoming to rent the necessary filtering equipment. Now, more than 2,000 green completions later, that rental equipment is available readily and locally.
>
> Devon's green completions practice stems from their voluntary participation in the EPA's Natural Gas STAR Program. The procedure generally is not required in the Barnett Shale except in the city of Fort Worth and at Dallas Fort Worth International Airport. The vast majority of Devon's Barnett Shale wells are outside those locales.

EFD reports, based on input from Devon, that "the rental cost for the equipment is roughly $1,000 per day and can save an average of 11,900 Mcf of natural gas per well from being vented into the atmosphere. In their case, the conservative net value of gas saved was $50,000 per well."

Green completions are yet another demonstration of technology advancing faster than natural gas opponents, who are always debating yesterday's issues. They're still talking flaring and open pits, while the industry has moved well beyond both. It just keeps getting better, while our friends on the other side only see doom and gloom because they're focused on the past and refuse to see the future.

TAGS: EID, green completion, Hydraulic fracturing, Marcellus Shale, natural gas

31 COMMENTS

POST A COMMENT

Write your comment here..

Your full name

E-mail address

Website

Save my name, email, and website in this browser for the next time I comment.

I'm not a robot

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SUBMIT

Proof of Performance

On federal and private well sites within New Mexico's prolific San Juan Basin, the Open Space Pilot Project has successfully been implemented with cooperation between the BLM, the energy companies and the grazing permitee/landowner. The OSPP is 5,760 acres, contains 99 existing wells with another 44 to be drilled, and 23 miles of roadway.

This Planned Drilling Approach for Natural Gas Development began in 2008. Using the Holistic Management framework, scientific principles, engineering and knowledge of local conditions are integrated, and result in a minimum footprint, and a best management practices solution to the multi-use challenges faced by federal and state agencies. Future construction is undertaken so as to minimize long-term potential impacts to the land while the energy companies get full access to their mineral interests at a more efficient rate, with minimal surface exposure and lower overall costs.

Faster. Safer. Cheaper.

CA. Ex. 14
Ex. 2

SAVE THE LAND

The key is reducing land disturbance by twinning wells - using an existing well pad to drill a new well. Out of a possible 44 new wells, OSPP saved the land 40 times with twinned wells. In fact, 66% of the time directional drilling was not required for the new well. Vertical drilling was used 29 times, saving the energy company money at the same time OSPP is saving the land.

SAVE THE WATER

The key is subtle road design changes using Bill Zeedyk's water harvesting engineering for rural and low maintenance roads. Zeedyk road design returns the water to the landscape in a beneficial way, keeping the road surface dryer and safer. On just one mile of typical oilfield road, half-a-million gallons of water falls in an average year. There are 23 miles of road within the OSPP. That's a World of Water!

SAVE THE SOIL

The key is soil covered with vegetation. For 60 years, local topsoils have been washed and blown away, leaving area well pads with over 50% bare ground. On a typical well pad, there are more weeds and woody plants than grasses (26% vs. 21%). Holistic reclamation methods, using managed grazing and the tool of animal impact, have demonstrated spectacular success in the area. Grass coverage has increased to 100%, even on steep slopes. We owe it to our children to find a better way.

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tfavre@holisticmanagement.org
www.holisticmanagement.org

OPEN SPACE PILOT PROJECT

A Planned Drilling Approach for Natural Gas Development

DEVIL'S SPRINGS RANCH

Site restoration is accomplished using animal impact and progressive livestock management – to positively impact the land around a well site.

Using the Holistic Site Management Framework can:

- Address concerns of environmental groups, landowners and regulatory agencies through implementation of a progressive site restoration program
- Reduce direct drilling expenses by eliminating costly transportation and operation down time
- Improve accident loss ratios by addressing the number one oilfield cause of accidents: Transportation
- Save money by coordinating construction, drilling, completion and first delivery phases

HOLISTIC SITE MANAGEMENT

The Holistic Site Management program in the Open Space Pilot Project is a comprehensive planning and implementation program for management of energy development site disturbances. For new sites, the program provides a framework for site development and management. For existing sites, it provides a means of site restoration that is ***economically viable, environmentally responsible, and socially acceptable.***

ECONOMICALLY VIABLE:

With all stakeholders participating in the Planned Drilling Approach, the heavy costs of permitting delay can be minimized; redundancies in the field can be eliminated; trucking costs, vehicle accidents and carbon footprints are reduced by equipment and material stockpiling. Savings compound as long-term maintenance costs for additional well pads, roads and pipelines are avoided; the safety of the workplace is permanently improved with fewer trips and roads.

The Planned Drilling Approach reduces development costs.

Long-term maintenance costs are avoided and safety improved.

ENVIRONMENTALLY RESPONSIBLE:

Twinned wells, Zeedyk roads and sustainable vegetative regrowth combine to address the heavy surface impacts of drilling. Land is immediately and permanently saved (an estimated 5 acres for each eliminated new site) when the need for new well pads, new roads and new pipelines are eliminated. Production facilities, such as waste pit tanks and condensate storage, can be combined to reduce, by half or more, the chances of spills and leaks.

Below grade roads destructively route millions of gallons of water.

Twinning wells reduces the chance of tank spills and leaks.

SOCIALLY ACCEPTABLE:

Outside the boundaries of the Open Space Pilot Project lie the 30,000 well locations, 20,000 miles of roads and pipelines of the sprawling 4 million acre San Juan Basin, a maze of unplanned natural gas development, much of it drilled before any modern environmental regulations were in place. Overlaying countless Native American cultural heritage sites, wildlife areas, and whole rural communities of ranching and agriculture, isn't now the time to honor the land that has given such great gifts to all Americans?

Wildlife habitat can be enhanced with holistic site restoration.

Rural livelihoods can thrive with planned drilling development.

Reducing Methane Emissions from Production Wells: Reduced Emission Completions

Lessons Learned from the
Natural Gas STAR Program

Producers Technology Transfer Workshop

ConocoPhillips Petroleum Company,
New Mexico Environment Department,
New Mexico Oil & Gas Association

Farmington, New Mexico
May 11, 2010

epa.gov/gasstar

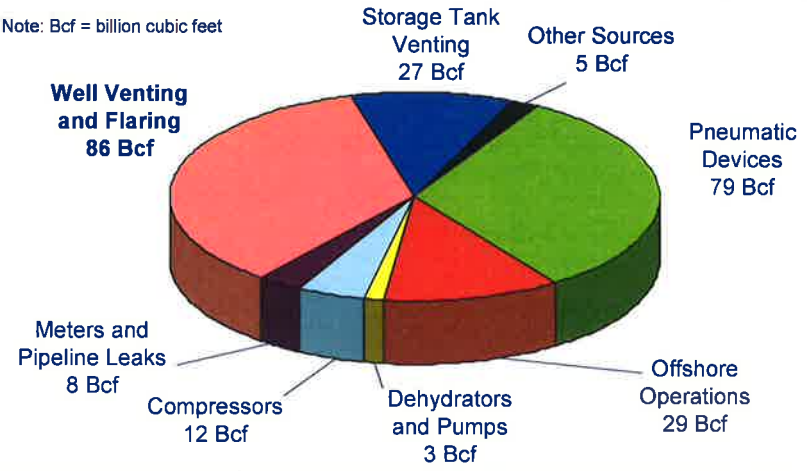
Agenda

- **Reduced Emissions Completions**
  - Methane Losses
  - Methane Recovery
  - Is Recovery Profitable?
  - Partner Experience
- **Discussion**

CA Ex. 14
Ex. 3

U.S. Production Sector Methane Emissions (2007)

Note: Bcf = billion cubic feet



EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2007*. April, 2009. Available on the web at: epa.gov/climatechange/emissions/usinventoryreport.html. Updated with revised emissions estimates for glycol dehydrators, well venting, pneumatic devices, and storage tanks.

2

Methane Losses During Gas Well Completions

- Gas wells in tight formations and coal beds require hydraulic fracture
- It is necessary to clean out the well bore and formation
  - After new completion
  - After well refracturing workovers
- Operators produce to an open pit or tank to collect sand, cuttings, and fluids for disposal
- Vent or flare the natural gas produced
- 54 Bcf[1] of methane is vented or flared from completions and workovers in the U.S., 27 Bcf of methane is emitted

Williams E&P, Glenwood Springs, CO

1 – EPA estimate – well completions and workovers only.
Bcf = billion cubic feet

3

Methane Recovery by Reduced Emission Completions

- Recover natural gas and condensate produced during flow-back following hydraulic fracture
- Portable equipment separates sand and water, processes gas and condensate for sales
- Route recovered gas through dehydrator and meter to sales line, reducing venting and flaring

Portable REC Equipment

Source: Weatherford

4

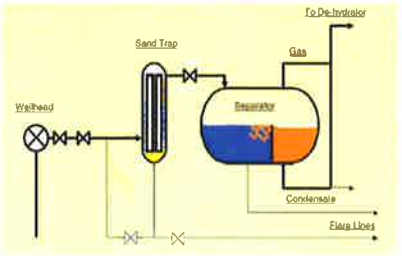
Reduced Emission Completions: Preconditions

- Permanent equipment required on site before cleanup
  - Piping from well head to sales line
  - Dehydrator
  - Lease meter
  - Stock tanks for wells producing significant amounts of condensate
- Sales line gas can be used for compressor fuel and/ or gas lift in low pressure wells

5

Reduced Emission Completions: Equipment

- Skid or trailer mounted portable equipment to capture produced gas during cleanup
  - Sand trap
  - Three-phase separator
- Use portable desiccant dehydrator for workovers requiring glycol dehydrator maintenance



Temporary, Mobile Surface Facilities, Source: BP

Source: Williams

6

Reduced Emission Completions: Low Pressure Wells

- Partners and vendors are perfecting the use of portable compressors when pressure in reservoir is too low to enter sales line
  - Artificial gas lift to clear fluids
  - Boost gas to sales line
  - Manage slug flow
  - Adds cost to project

Source: Herald

7

Reduced Emission Completions: Benefits

- Reduced methane emissions during completions and workovers
- Sales revenue from recovered gas and condensate
- Improved relations with government agencies and public neighbors
- Reduced environmental impact
- Improved safety
- Reduced disposal costs

8

Is Recovery Profitable?

- Partners report recovering 2% - 89% (average of 53%) of total gas produced during well completions and workovers
- Estimate 7,000 – 12,500 thousand cubic feet (Mcf) of natural gas can be recovered from each cleanup
  - $50,000 to $85,000 savings at $7/Mcf
- Estimate 1 – 580 barrels (bbls) of condensate can be recovered from each cleanup
  - Up to $30,000 additional revenue at $50/barrel
- Incremental contracted cost of typical REC is $700 to $6,500/day for 3 to 10 days of well cleanup
- Purchase of REC equipment costs $500,000
  - Payback in 3 to 5 months for 25 well/year drilling program
  - Assuming gas prices of $7 and $3/Mcf, respectively

9

REC Partner Experience: BP

- Capital investment of about $500,000 per skid on portable three-phase separators, sand traps, and tanks in the Rocky Mountain Region
- Used Green Completions on 106 wells
- Total natural gas recovered about 350 million cubic feet per year (MMcf/year)
  - 3.3 MMcf per well average
    - Conservative net value of gas saved is $20,000 per well[1]
- 6,700 barrels/year condensate recovered
- 1.5 year payback based on British Petroleum's prices for natural gas and condensate

[1] Natural gas valued by company to be $7/Mcf

10

REC Partner Experience: BP

- Through the end of 2005 British Petroleum reports:
  - 4.1 Bcf of gas and
  - 53,000 barrels of condensate recovered[1]

Portable Three Phase Separator, Source: BP

[1] Combination of activities in Montana and Wyoming, U.S.

11

REC Partner Experience: Williams

- Williams Fork Formation (Piceance Basin) – low permeability, tight, lenticular sandstone (10% porosity, permeability range of 1 to 10 microdarcies.
- Wells drilled to depths of 6,500 ft to 9,000 ft
- Flow pressures range from 1,500 to 2,500 psi
- Fracture stimulation needed to make wells economical
- Frac about 5 to 6 stages per well
- BRECO flowback skids used to separate sand, water and gas during initial flowback
- BRECO flowback skid resides on typical 4 well pad for 32 days

[1] Natural gas valued by company to be $7/Mcf

12

REC Partner Experience: Williams

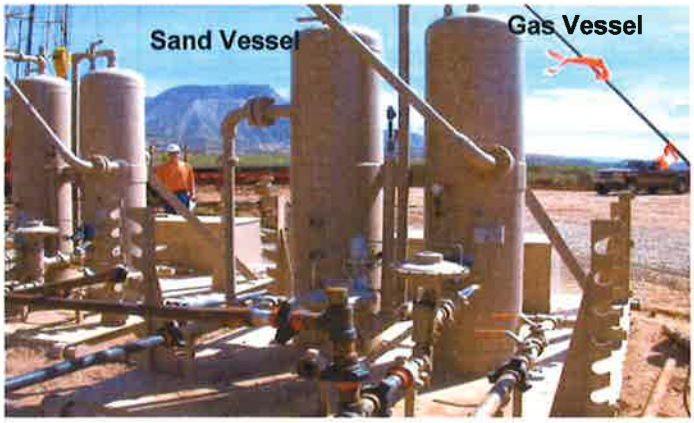
Piceance Well Completions

- Well Completion Type = Mechanical Isolation
- Perforate casing prior to Stage 1 – makes fracture stimulation possible
- Frac Stage 1
- Flow back well, first 12 hours is water, afterwards routed to BRECO skid
- Set plug to isolate frac stage
- REPEAT for each stage (avg. 5 to 6 stages/well)
- Plugs drilled out by workover rig
- Producing to flowback skid after frac'ing and before plugs drilled out

13

REC Partner Experience: Williams

BRECO Flowback Skid



14

REC Partner Experience: Williams

How BRECO Works?

- Sand vessel separates sand from backflow fluids
- Gas vessel separates gas from water used for hydraulic fracturing
  - Gas routed to sales line
- Sand is dumped to reserve pit manually
- Water dumps to holding tanks automatically
  - Water is filtered and reused for future frac jobs
- Flowback skid operates at 20 to 40 psi greater than gas gathering line pressure which is about 260 to 320 psi in Piceance Basin

15

REC Partner Experience: Williams

Flowback Skid – When Is It Used?

- Used after each zone is fracture stimulated (frac'd)
- Used when all zones are fractured and waiting for workover rig to drill out plugs for final completion (Up to 10 days)
- Production well must be located near gathering system
- Wildcat and step-out wells are not completed with Green Completion Technology
- One Month = time wells at typical 4-well pad are routed to flowback skid

16

REC Partner Experience: Williams

Two rows of four wells closely spaced.

Source: Williams

17

Green Completion Economics

AVERAGE PER WELL FLOWBACK STATISTICS	
Average Number of Days of Flowback =	32
Average MMcf Gas Recovered During Flowback =	23
Average MMcf Gas Flowback Recovered/Day =	0.71
Average Revenue Per Flowback ($) =	$139,941
Average Cost Drill/Complete Well ($) =	$1.3 to $1.5 MM
Average Cost Per Flowback ($) =	$11,855
Average Net Saving Per Flowback ($) =	$129,510
CH_4 recovered in 2005 = Estimated Mean Methane Concentration Gas: 89.043 vol. %	5982 MMscf or 16 MMscf/day

18

Conclusions

- Reduces methane emissions, a potent greenhouse gas (GHG)
- Well completion type determines viability of green completion technologies
- Produced water and stimulation fluids from green completions are recycled
- Eliminates emissions, noise and citizen complaints associated with flaring
- Increases economic value added

19

Discussion Questions

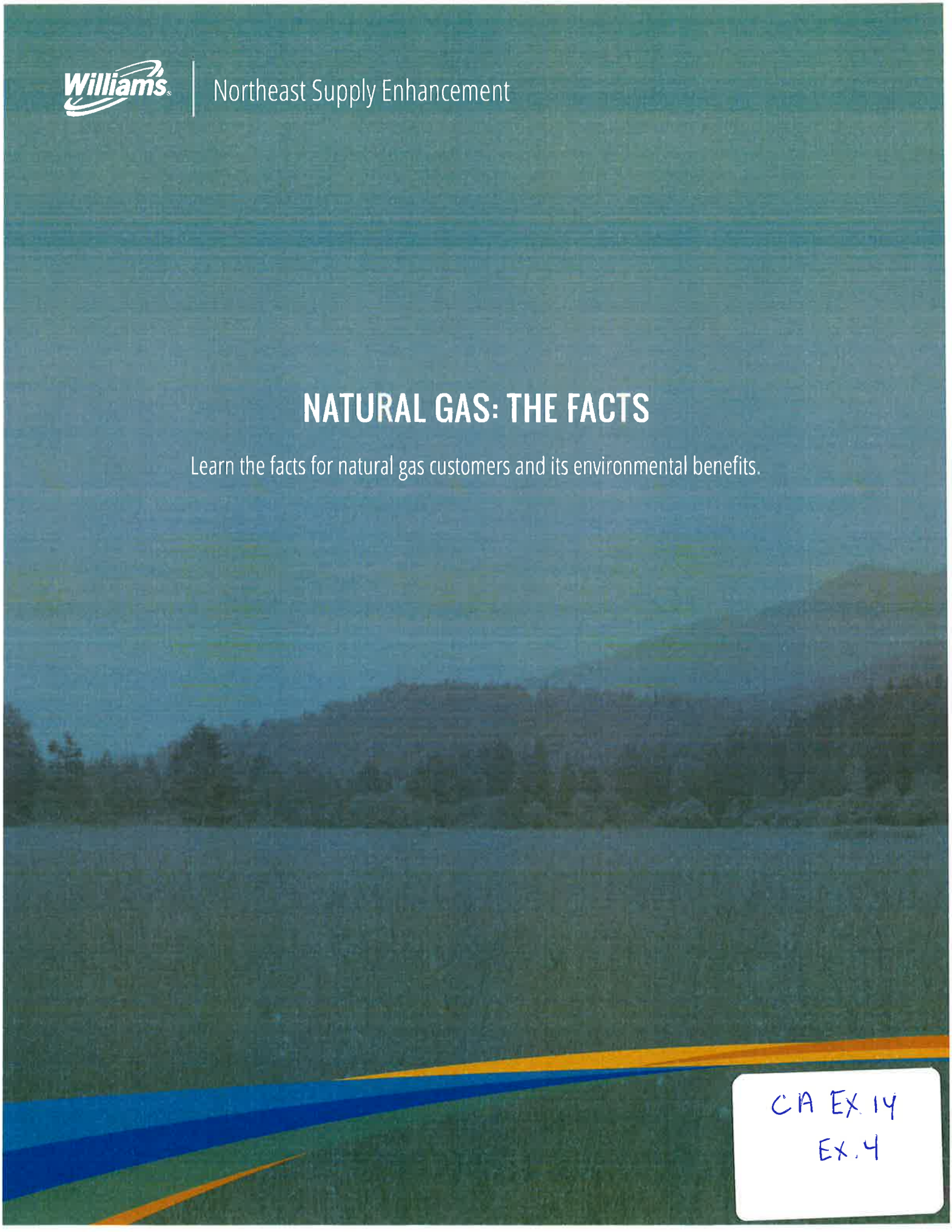
- What industry experiences do you have applying these technologies and practices?
- What are your limitations on applying these technologies and practices?
- Actual costs and benefits

20

Williams | Northeast Supply Enhancement

NATURAL GAS: THE FACTS

Learn the facts for natural gas customers and its environmental benefits.



CA Ex. 14
Ex. 4

2016

Natural Gas: The Facts

Natural Gas Customers

- Natural gas serves nearly 66.7 million homes; 5.4 million businesses like hotels, restaurants, hospitals, schools and supermarkets; 192,000 factories; and 1,900 electric generating units. On a daily basis, the average U.S. home uses 196 cubic feet of natural gas.
- Natural gas comprises almost one-fourth of all primary energy used in the U.S. and is directly linked to jobs and economic health. The natural gas industry supports the employment of nearly 3 million Americans in all 50 states.
- Residential space heating and water heating cost analyses show that natural gas costs less to use than other major home energy sources. Households that use natural gas appliances for heating, water heating, cooking and clothes drying spend an average of $840 less per year than homes using electric appliances.
- Fertilizer used to grow crops is composed almost entirely of natural gas components, so U.S. agricultural producers rely on an affordable, stable supply of natural gas.
- Natural gas utilities do not earn a profit on the natural gas they deliver. They earn their revenues from the service and delivery fees they charge customers to transport the natural gas to them. This fee is directly linked to the volume of natural gas consumed, rather than the price of natural gas being delivered.

Environmental Benefits

- Washington State University conducted a nationwide field study in 2015 that found that as little as 0.1 percent of the natural gas delivered nationwide is emitted from local distribution systems.
- Due to the higher efficiency of natural gas combined cycle generation compared with coal-fired boilers, natural gas emits 52 to 56 percent less GHG than coal for the same amount of electricity.
- Natural gas is the cleanest fossil fuel on the market today because it produces much lower emissions than those of other fossil fuels like coal or oil. It is also extraordinarily efficient.

72 MILLION

There are more than 72 million natural gas customers in the United States.

"Natural gas comprises almost one-fourth of all primary energy used in the U.S. and supports the employment of nearly 3 million Americans in all 50 states."

2016

Natural Gas: The Facts

Efficiency

- The direct use of natural gas in America's homes and businesses achieves 92 percent energy efficiency.
- The average American home consumes 40 percent less natural gas than it did 40 years ago.
- By funding natural gas efficiency programs, natural gas utilities helped customers save 175 trillion Btu of energy and offset 9.1 million metric tons of carbon dioxide emissions in 2014.

Domestically Abundant

- Domestic gas production accounts for nearly 93 percent of all natural gas consumed in the United States and shale gas production now accounts for about 50 percent of gas produced.
- According to the Energy Information Administration and the Potential Gas Committee, the U.S. estimated future supply of natural gas stood at 2,884 trillion cubic feet (Tcf) at year end 2014 – enough to meet America's energy needs for more than 100 years.

Safe and Reliable

- According to the U.S. Department of Transportation, pipelines are the safest form of energy transportation. Safety is the number one priority for America's natural gas utilities.
- There are more than 2.5 million miles of pipeline that transport natural gas to more than 177 million Americans throughout the U.S.
- Natural gas utilities spend more than $22 billion annually to help enhance the safety of natural gas distribution and transmission systems.
- The dedicated efforts of natural gas utilities over the past decade have led to an approximately 40 percent decline in serious pipeline incidents throughout the natural gas distribution system.
- There are nearly 1.3 million miles of plastic pipe – the leading edge of advanced utility pipeline materials. In the past decade, natural gas utilities have installed updated plastic lines at a rate of 30,000 miles per year.

"The U.S. estimated future supply of natural gas stood at 2,884 Tcf at year end 2014 – enough to meet America's energy needs for more than 100 years."

There are more than 2.5 million miles of pipeline that transport natural gas to more than 177 million Americans.

2.5 MILLION

To Learn More Visit www.aga.org

or connect with us on Twitter @AGA_naturalgas and facebook.com/naturalgas

24/7 WALL ST. April 9, 2016

New Mexico home to fastest-shrinking city in the nation

By Matthew Reichbach

With reports that New Mexico has a net-negative job growth, it should perhaps come as no surprise that the fastest-shrinking city in the country is in New Mexico.

A report by 24/7 Wall St. (http://247wallst.com/special-report/2016/04/04/americas-fastest-shrinking-cities-3/) found that the Farmington, New Mexico metropolitan statistical area is the fastest-shrinking city in the country. Farmington was the only New Mexico city to land on the list, which tracked cities from 2010 to 2015.

According to the report, Farmington has seen its population shrink by 8.8 percent in the last five years. This is more than two percentage points higher than second place, Pine Bluff, Arkansas with 6.38 percent.

Pine Bluff and Farmington are the only two cities with at least a 5 percent decline in population. Farmington's 8.8 percent was good for

The blog looked at U.S. Census Bureau estimates for 2015 and compared to the U.S. Census numbers from 2010. They reviewed the population changes from July 2010 to July 2015 n 381 metropolitan statistical areas; New Mexico has four such areas.

CIA Ex. 14
Ex. 5

The report said that "jobs are perhaps the single most important driver of urban expansion." This means that areas with fewer job opportunities are likely those that will lose populations.

This makes an intuitive sense; if you can't find a job in a city, you can move to another city with more job options.

Farmington has an unemployment rate of 7.8 percent.

One reason is that the are has been hit hard by dropping oil and natural gas prices. San Juan County depended in large part on oil and gas jobs and has had an unemployment rate higher than the state at large for years.

The report also mentioned the area "has a relatively high violent crime rate and relatively low incomes."

Both are cited as reasons for why people would move away and others would choose not to move to the area.

Share this:

(https://nmpoliticalreport.com/2016/04/09/new-mexico-home-to-fastest-shrinking-city-in-the-nation/#print)

More (#)

Related

(https://nmpoliticalreport.com/2015/03/26/as-crude-oil-price-drops-nm-loses-jobs/)

As crude oil price drops, NM loses jobs

(https://nmpoliticalreport.com/2015/03/26/as-crude-oil-price-drops-nm-loses-jobs/)

March 26, 2015

In "Featured"

NM's younger generations most Hispanic in the nation

(https://nmpoliticalreport.com/2016/07/11/nms-younger-generations-most-hispanic-in-the-nation/)

New Mexico, already the most Hispanic-heavy state in the nation, is poised to become even more

July 11, 2016

In "Quick Reads"

(https://nmpoliticalreport.com/2020/08/23/the-2020-census-is-doing-a-number-on-rural-america-in-places-like-lordsburg-new-mexico-that-could-spell-doom/)

The 2020 census is doing a number on rural America. In places like Lordsburg, New Mexico, that could spell doom.

(https://nmpoliticalreport.com/2020/08/23/the-

2020-census-is-doing-a-number-on-rural-america-in-places-like-lordsburg-new-mexico-that-could-spell-doom/)
August 23, 2020
In "News"

Form 3160-5
(June 2015)

OCD Received
6/17/2020

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FORM APPROVED
OMB NO. 1004-0137
Expires: January 31, 2018

SUNDRY NOTICES AND REPORTS ON WELLS

Do not use this form for proposals to drill or to re-enter an abandoned well. Use form 3160-3 (APD) for such proposals.

SUBMIT IN TRIPLICATE - Other instructions on page 2

5. Lease Serial No.
NMSF079391

6. If Indian, Allottee or Tribe Name

7. If Unit or CA/Agreement, Name and/or No.
8910009500

1. Type of Well
☐ Oil Well ☐ Gas Well ☒ Other: UNKNOWN MW

8. Well Name and No.
SAN JUAN 27-5 UNIT POW 916

2. Name of Operator
HILCORP ENERGY COMPANY
Contact: PRISCILLA SHORTY
E-Mail: pshorty@hilcorp.com

9. API Well No.
30-039-30300-00-C1

3a. Address
1111 TRAVIS STREET
HOUSTON, TX 77002

3b. Phone No. (include area code)
Ph: 505-324-5188

10. Field and Pool or Exploratory Area
BASIN DAKOTA
BLANCO MESAVERDE

4. Location of Well *(Footage, Sec., T., R., M., or Survey Description)*
Sec 8 T27N R5W SENW 2541FNL 2541FWL
36.588798 N Lat, 107.382497 W Lon

11. County or Parish, State
RIO ARRIBA COUNTY, NM

12. CHECK THE APPROPRIATE BOX(ES) TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

TYPE OF SUBMISSION	TYPE OF ACTION			
☐ Notice of Intent	☐ Acidize	☐ Deepen	☐ Production (Start/Resume)	☐ Water Shut-Off
☒ Subsequent Report	☐ Alter Casing	☐ Hydraulic Fracturing	☐ Reclamation	☐ Well Integrity
☐ Final Abandonment Notice	☐ Casing Repair	☐ New Construction	☐ Recomplete	☒ Other
BP	☐ Change Plans	☐ Plug and Abandon	☐ Temporarily Abandon	
	☐ Convert to Injection	☐ Plug Back	☐ Water Disposal	

13. Describe Proposed or Completed Operation: Clearly state all pertinent details, including estimated starting date of any proposed work and approximate duration thereof. If the proposal is to deepen directionally or recomplete horizontally, give subsurface locations and measured and true vertical depths of all pertinent markers and zones. Attach the Bond under which the work will be performed or provide the Bond No. on file with BLM/BIA. Required subsequent reports must be filed within 30 days following completion of the involved operations. If the operation results in a multiple completion or recompletion in a new interval, a Form 3160-4 must be filed once testing has been completed. Final Abandonment Notices must be filed only after all requirements, including reclamation, have been completed and the operator has determined that the site is ready for final inspection.

Attached is the annual POW report taken from the subject well on 6/10/2020.

14. I hereby certify that the foregoing is true and correct.

Electronic Submission #518762 verified by the BLM Well Information System
For HILCORP ENERGY COMPANY, sent to the Farmington
Committed to AFMSS for processing by JOE KILLINS on 06/17/2020 (20JK0611SE)

Name *(Printed/Typed)* PRISCILLA SHORTY — Title OPERATIONS REGULATORY TECH SR

Signature (Electronic Submission) — Date 06/12/2020

THIS SPACE FOR FEDERAL OR STATE OFFICE USE

Approved By ACCEPTED — JOE KILLINS
Title ENGINEER — Date 06/17/2020

Conditions of approval, if any, are attached. Approval of this notice does not warrant or certify that the applicant holds legal or equitable title to those rights in the subject lease which would entitle the applicant to conduct operations thereon.

Office Farmington

Title 18 U.S.C. Section 1001 and Title 43 U.S.C. Section 1212, make it a crime for any person knowingly and willfully to make to any d
States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

CA Ex. 14

Ex. 6

(Instructions on page 2)

**** BLM REVISED ** BLM REVISED ** BLM REVISED ** BLM REVISED ** BLM**

Pressure Test Report

COMPANY INFORMATION

Company Name	HILCORP
Representative	PRISCILLA SHORTY
Phone	
Fax	
Address	
E-Mail Address	
Service Company	EXPERT DOWNHOLE SERVICES, INC.

WELL INFORMATION

Well Name	SAN JUAN 27-5 UNIT POW 916
Well Location	T27N-R5W-SEC8
Field and Pool	MV/DK
Status (Oil, Gas, Water, Injection)	OBSERVATION
Perforated Intervals	4564-7876
Mid-point of Perforated Intervals (MPP)	
Drilling Rig Number	
Elevations	
Kelly Bushing (KB)	15
Casing Flange (CF)	
KB-CF	
Ground Level	6599
Plug Back Total Depth	7968
Total Depth	8040
Production Casing	
Production Tubing	2 3/8

TEST INFORMATION

Type of Test	POOH STATIC GRADIENT
Date(s) of Test	6/10/20
Dead-weight Gauge Tubing Pressure	112
Dead-weight Gauge Casing Pressure	60
Shut-in Date (Duration)	
Date / Time on Bottom	6/10/20 @0857
Date / Time off Bottom	6/10/20 @0957
Probe Serial Number	
Probe Offset from End of Tool String	0-6000
Run Depth at Probe Pressure Port	7500

PRESSURE TEST RESULTS

Maximum Recorded Probe Pressure	251.5 psig
Maximum Recorded Probe Temperature	198.5 deg F
Final Buildup Pressure	
Gradient Survey Information	
Extrapolated Pressure to MPP	
Final Gradient at Depth	
Job Number	

PROBE INFORMATION

Probe Serial Number
Model
Pressure
- Calibrated Pressure Range
- Accuracy
- Resolution

Temperature
- Calibrated Temperature Range
- Accuracy
- Resolution

Calibration File Used for Reports

PROGRAMMING DETAILS

Step	Sample Mode	Period	Duration	Comment

Program Start Time
Program End Time
Total Samples Taken
Usage for this Test
Generic Data File Name

COMMENTS

Reported By EXPERT DOWNHOLE SERVICES, INC.

RIH WITH 1.50 IMPRESSION BLOCK, TAGGED FILL @7600 WLM. RIH WITH BHP GAUGE TO 7500 WLM FOR 1 HOUR, THEN POOH MAKING 5 MINUTE STOPS PER REQUEST.

Company Name	HILCORP
Well Name	SAN JUAN 27-5 UNIT POW 916
Type of Test	POOH STATIC GRADIENT
Date(s) of Test	6/10/20

zed.i solutions

Pressure vs. Depth

Probe Serial Number

		(ft)	(psig)	(psi/ft)	(deg F)	(deg F/ft)
0857	0957	7500.000	250.836	-	191.683	-
0958	1003	7000.000	126.664	0.2483	191.503	0.0004
1005	1010	6500.000	125.215	0.0029	186.555	0.0099
1012	1017	6000.000	123.544	0.0033	178.833	0.0154
1018	1023	5500.000	122.001	0.0031	170.487	0.0167
1025	1030	5000.000	120.482	0.0030	161.208	0.0186
1031	1036	4500.000	118.867	0.0032	152.159	0.0181
1037	1042	4000.000	117.324	0.0031	144.154	0.0160
1044	1049	3500.000	115.716	0.0032	135.442	0.0174
1050	1055	3000.000	114.221	0.0030	124.902	0.0211
1057	1102	2500.000	112.687	0.0031	113.032	0.0237
1103	1108	2000.000	111.229	0.0029	102.706	0.0207
1109	1114	1500.000	109.750	0.0030	93.396	0.0186
1116	1121	1000.000	108.260	0.0030	85.244	0.0163
1122	1127	500.000	106.761	0.0030	77.504	0.0155
1128	1133	0.000	105.206	0.0031	70.279	0.0145

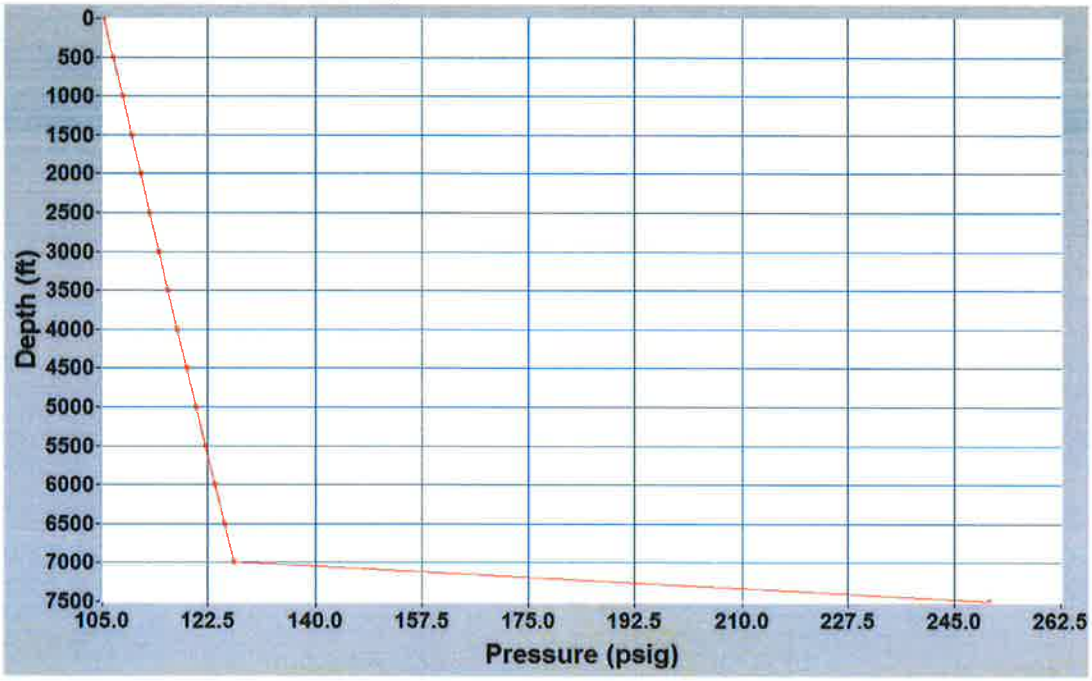
Extrapolated to MPP:

(ft)	(psig)	(deg F)
0.000		

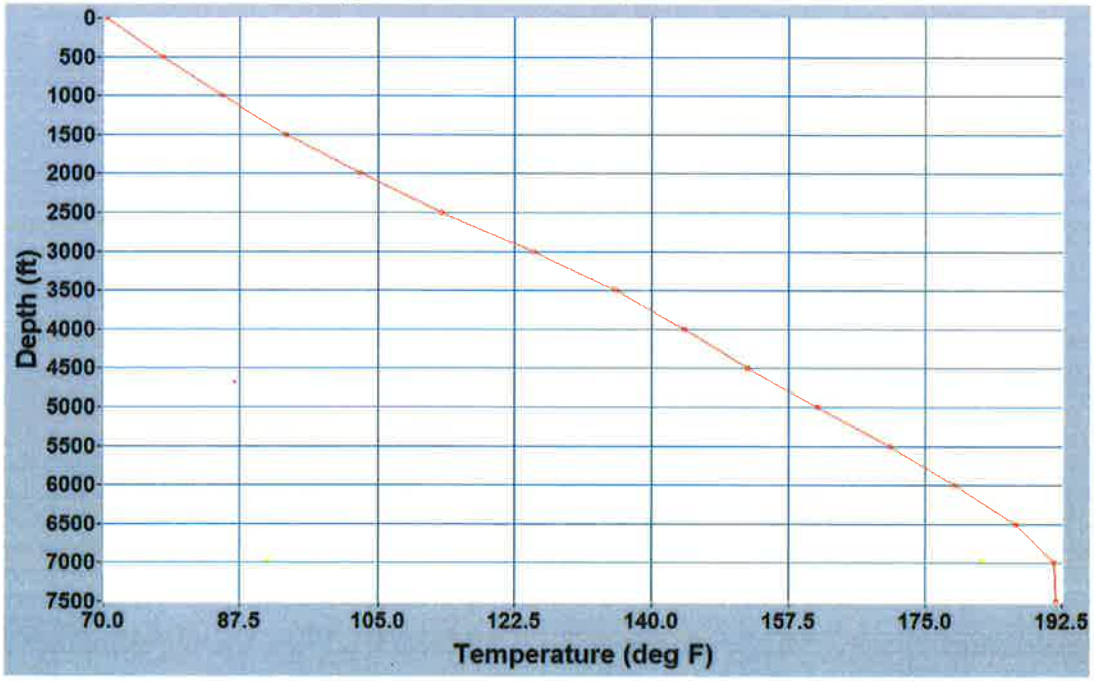
Company Name	HILCORP
Well Name	SAN JUAN 27-5 UNIT POW 916
Type of Test	POOH STATIC GRADIENT
Date(s) of Test	6/10/20

Probe Serial Number

Depth vs. Pressure

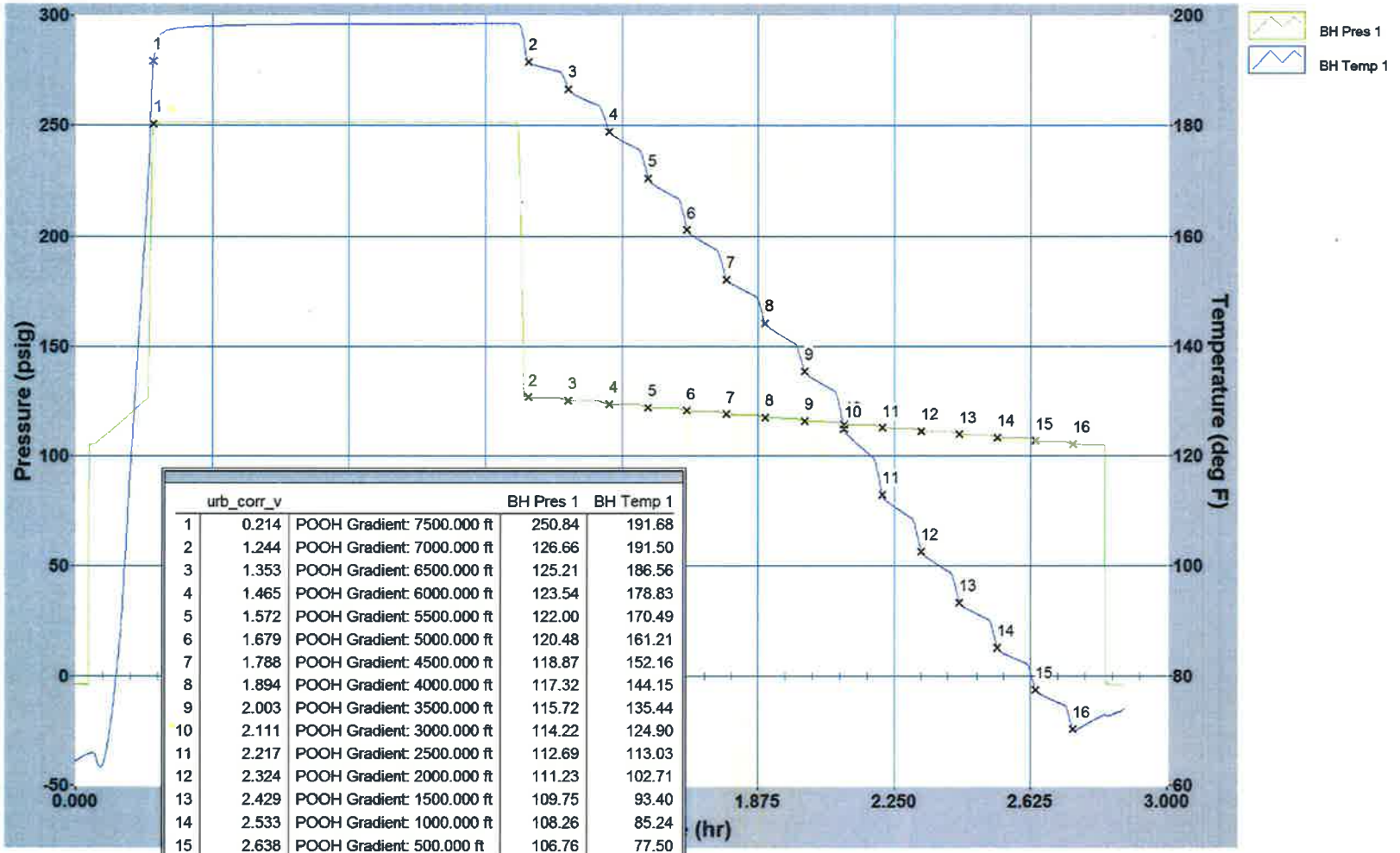


Depth vs. Temperature



Company Name	HILCORP
Well Name	SAN JUAN 27-5 UNIT POW 916
Type of Test	POOH STATIC GRADIENT
Date(s) of Test	6/10/20

SAN JUAN 27-5 UNIT #916 POW 2020



	urb_corr_v		BH Pres 1	BH Temp 1
1	0.214	POOH Gradient: 7500.000 ft	250.84	191.68
2	1.244	POOH Gradient: 7000.000 ft	126.66	191.50
3	1.353	POOH Gradient: 6500.000 ft	125.21	186.56
4	1.465	POOH Gradient: 6000.000 ft	123.54	178.83
5	1.572	POOH Gradient: 5500.000 ft	122.00	170.49
6	1.679	POOH Gradient: 5000.000 ft	120.48	161.21
7	1.788	POOH Gradient: 4500.000 ft	118.87	152.16
8	1.894	POOH Gradient: 4000.000 ft	117.32	144.15
9	2.003	POOH Gradient: 3500.000 ft	115.72	135.44
10	2.111	POOH Gradient: 3000.000 ft	114.22	124.90
11	2.217	POOH Gradient: 2500.000 ft	112.69	113.03
12	2.324	POOH Gradient: 2000.000 ft	111.23	102.71
13	2.429	POOH Gradient: 1500.000 ft	109.75	93.40
14	2.533	POOH Gradient: 1000.000 ft	108.26	85.24
15	2.638	POOH Gradient: 500.000 ft	106.76	77.50
16	2.740	POOH Gradient: 0.000 ft	105.21	70.28

Company Name HILCORP
Well Name SAN JUAN 27-5 UNIT POW 916
Type of Test POOH STATIC GRADIENT
Date(s) of Test 6/10/20

zed.i solutions

Date	Time	Cum.Time BH1	BH Pres 1	BH Temp 1
		hr	psig	deg F
2020/06/10	08:44:15	0.0000	-3.704	64.449
2020/06/10	08:45:15	0.0167	-3.829	65.143
2020/06/10	08:46:15	0.0333	-3.847	65.710
2020/06/10	08:47:15	0.0500	105.229	65.948
2020/06/10	08:48:15	0.0667	107.457	63.302
2020/06/10	08:49:15	0.0833	109.749	66.006
2020/06/10	08:50:15	0.1000	111.871	73.159
2020/06/10	08:51:15	0.1167	114.127	83.523
2020/06/10	08:52:15	0.1333	116.529	98.764
2020/06/10	08:53:15	0.1500	119.017	117.910
2020/06/10	08:54:15	0.1667	121.845	135.036
2020/06/10	08:55:15	0.1833	124.426	153.001
2020/06/10	08:56:15	0.2000	136.994	171.801
POOH Gradient: 7500.000 ft				
2020/06/10	08:57:05	0.2139	250.836	191.683
2020/06/10	08:57:15	0.2167	250.927	193.393
2020/06/10	08:58:15	0.2333	251.229	196.473
2020/06/10	08:59:15	0.2500	251.379	197.182
2020/06/10	09:00:15	0.2667	251.420	197.445
2020/06/10	09:01:15	0.2833	251.459	197.620
2020/06/10	09:02:15	0.3000	251.477	197.739
2020/06/10	09:03:15	0.3167	251.462	197.816
2020/06/10	09:04:15	0.3333	251.440	197.893
2020/06/10	09:05:15	0.3500	251.420	197.962
2020/06/10	09:06:15	0.3667	251.307	198.016
2020/06/10	09:07:15	0.3833	251.335	198.066
2020/06/10	09:08:15	0.4000	251.347	198.093
2020/06/10	09:09:15	0.4167	251.367	198.144
2020/06/10	09:10:15	0.4333	251.363	198.183
2020/06/10	09:11:15	0.4500	251.366	198.199
2020/06/10	09:12:15	0.4667	251.355	198.237
2020/06/10	09:13:15	0.4833	251.346	198.266
2020/06/10	09:14:15	0.5000	251.339	198.289
2020/06/10	09:15:15	0.5167	251.329	198.311
2020/06/10	09:16:15	0.5333	251.315	198.333
2020/06/10	09:17:15	0.5500	251.334	198.342
2020/06/10	09:18:15	0.5667	251.303	198.347
2020/06/10	09:19:15	0.5833	251.326	198.358
2020/06/10	09:20:15	0.6000	251.329	198.374
2020/06/10	09:21:15	0.6167	251.316	198.378
2020/06/10	09:22:15	0.6333	251.324	198.387
2020/06/10	09:23:15	0.6500	251.349	198.405
2020/06/10	09:24:15	0.6667	251.341	198.421
2020/06/10	09:25:15	0.6833	251.325	198.428
2020/06/10	09:26:15	0.7000	251.343	198.430
2020/06/10	09:27:15	0.7167	251.330	198.437
2020/06/10	09:28:15	0.7333	251.328	198.446
2020/06/10	09:29:15	0.7500	251.325	198.451
2020/06/10	09:30:15	0.7667	251.326	198.457
2020/06/10	09:31:15	0.7833	251.309	198.462
2020/06/10	09:32:15	0.8000	251.334	198.457
2020/06/10	09:33:15	0.8167	251.313	198.466
2020/06/10	09:34:15	0.8333	251.328	198.469
2020/06/10	09:35:15	0.8500	251.361	198.466
2020/06/10	09:36:15	0.8667	251.380	198.471
2020/06/10	09:37:15	0.8833	251.395	198.478
2020/06/10	09:38:15	0.9000	251.396	198.482
2020/06/10	09:39:15	0.9167	251.401	198.489
2020/06/10	09:40:15	0.9333	251.391	198.493
2020/06/10	09:41:15	0.9500	251.404	198.487
2020/06/10	09:42:15	0.9667	251.416	198.495
2020/06/10	09:43:15	0.9833	251.405	198.495
2020/06/10	09:44:15	1.0000	251.399	198.496
2020/06/10	09:45:15	1.0167	251.410	198.498
2020/06/10	09:46:15	1.0333	251.418	198.504
2020/06/10	09:47:15	1.0500	251.403	198.500
2020/06/10	09:48:15	1.0667	251.396	198.498
2020/06/10	09:49:15	1.0833	251.399	198.498
2020/06/10	09:50:15	1.1000	251.401	198.513
2020/06/10	09:51:15	1.1167	251.404	198.505
2020/06/10	09:52:15	1.1333	251.415	198.505
2020/06/10	09:53:15	1.1500	251.422	198.505
2020/06/10	09:54:15	1.1667	251.422	198.505
2020/06/10	09:55:15	1.1833	251.419	198.509
2020/06/10	09:56:15	1.2000	251.427	198.511
2020/06/10	09:57:15	1.2167	240.056	198.462
2020/06/10	09:58:15	1.2333	126.997	193.555
POOH Gradient: 7000.000 ft				
2020/06/10	09:58:55	1.2444	126.664	191.503
2020/06/10	09:59:15	1.2500	126.551	191.192
2020/06/10	10:00:15	1.2667	126.528	190.796
2020/06/10	10:01:15	1.2833	126.494	190.481
2020/06/10	10:02:15	1.3000	126.497	190.193
2020/06/10	10:03:15	1.3167	126.514	189.914
2020/06/10	10:04:15	1.3333	126.194	189.414
2020/06/10	10:05:15	1.3500	125.239	187.016
POOH Gradient: 6500.000 ft				
2020/06/10	10:05:25	1.3528	125.215	186.555
2020/06/10	10:06:15	1.3667	125.138	185.707
2020/06/10	10:07:15	1.3833	125.092	185.110
2020/06/10	10:08:15	1.4000	125.084	184.595
2020/06/10	10:09:15	1.4167	125.047	184.140
2020/06/10	10:10:15	1.4333	125.046	183.722
2020/06/10	10:11:15	1.4500	124.229	181.796
POOH Gradient: 6000.000 ft				
2020/06/10	10:12:10	1.4653	123.544	178.833
2020/06/10	10:12:15	1.4667	123.535	178.671
2020/06/10	10:13:15	1.4833	123.464	177.818
2020/06/10	10:14:15	1.5000	123.428	177.208
2020/06/10	10:15:15	1.5167	123.401	176.634
2020/06/10	10:16:15	1.5333	123.410	176.088
2020/06/10	10:17:15	1.5500	123.319	175.489
2020/06/10	10:18:15	1.5667	122.200	171.869
POOH Gradient: 5500.000 ft				
2020/06/10	10:18:35	1.5722	122.001	170.487
2020/06/10	10:19:15	1.5833	121.943	169.529
2020/06/10	10:20:15	1.6000	121.851	168.847
2020/06/10	10:21:15	1.6167	121.818	168.204

Company Name HILCORP
Well Name SAN JUAN 27-5 UNIT POW 916
Type of Test POOH STATIC GRADIENT
Date(s) of Test 6/10/20

zed.i solutions

Date	Time	Cum.Time BH1	BH Pres 1	BH Temp 1
		hr	psig	deg F
2020/06/10	10:22:15	1.6333	121.787	167.592
2020/06/10	10:23:15	1.6500	121.767	167.009
2020/06/10	10:24:15	1.6667	121.078	164.714
POOH Gradient: 5000.000 ft				
2020/06/10	10:25:00	1.6792	120.482	161.208
2020/06/10	10:25:15	1.6833	120.448	160.655
2020/06/10	10:26:15	1.7000	120.316	159.841
2020/06/10	10:27:15	1.7167	120.285	159.172
2020/06/10	10:28:15	1.7333	120.257	158.529
2020/06/10	10:29:15	1.7500	120.234	157.912
2020/06/10	10:30:15	1.7667	119.932	156.880
2020/06/10	10:31:15	1.7833	118.970	153.003
POOH Gradient: 4500.000 ft				
2020/06/10	10:31:30	1.7875	118.867	152.159
2020/06/10	10:32:15	1.8000	118.808	151.410
2020/06/10	10:33:15	1.8167	118.774	150.823
2020/06/10	10:34:15	1.8333	118.727	150.238
2020/06/10	10:35:15	1.8500	118.705	149.675
2020/06/10	10:36:15	1.8667	118.693	149.128
2020/06/10	10:37:15	1.8833	117.863	146.611
POOH Gradient: 4000.000 ft				
2020/06/10	10:37:55	1.8944	117.324	144.154
2020/06/10	10:38:15	1.9000	117.294	143.677
2020/06/10	10:39:15	1.9167	117.216	142.939
2020/06/10	10:40:15	1.9333	117.176	142.250
2020/06/10	10:41:15	1.9500	117.149	141.580
2020/06/10	10:42:15	1.9667	117.123	140.932
2020/06/10	10:43:15	1.9833	116.770	139.665
2020/06/10	10:44:15	2.0000	115.746	136.047
POOH Gradient: 3500.000 ft				
2020/06/10	10:44:25	2.0028	115.716	135.442
2020/06/10	10:45:15	2.0167	115.676	134.461
2020/06/10	10:46:15	2.0333	115.610	133.792
2020/06/10	10:47:15	2.0500	115.580	133.131
2020/06/10	10:48:15	2.0667	115.534	132.492
2020/06/10	10:49:15	2.0833	115.529	131.873
2020/06/10	10:50:15	2.1000	114.689	128.561
POOH Gradient: 3000.000 ft				
2020/06/10	10:50:55	2.1111	114.221	124.902
2020/06/10	10:51:15	2.1167	114.193	124.124
2020/06/10	10:52:15	2.1333	114.067	123.006
2020/06/10	10:53:15	2.1500	114.041	122.007
2020/06/10	10:54:15	2.1667	114.004	121.044
2020/06/10	10:55:15	2.1833	114.008	120.108
2020/06/10	10:56:15	2.2000	113.597	118.161
POOH Gradient: 2500.000 ft				
2020/06/10	10:57:15	2.2167	112.687	113.032
2020/06/10	10:58:15	2.2333	112.623	111.578
2020/06/10	10:59:15	2.2500	112.553	110.808
2020/06/10	11:00:15	2.2667	112.545	110.064
2020/06/10	11:01:15	2.2833	112.534	109.337
2020/06/10	11:02:15	2.3000	112.532	108.624
2020/06/10	11:03:15	2.3167	111.476	104.605
POOH Gradient: 2000.000 ft				

Date	Time	Cum.Time BH1	BH Pres 1	BH Temp 1
		hr	psig	deg F
2020/06/10	11:03:40	2.3236	111.229	102.706
2020/06/10	11:04:15	2.3333	111.172	101.844
2020/06/10	11:05:15	2.3500	111.130	101.097
2020/06/10	11:06:15	2.3667	111.104	100.375
2020/06/10	11:07:15	2.3833	111.085	99.676
2020/06/10	11:08:15	2.4000	111.068	99.001
2020/06/10	11:09:15	2.4167	110.361	96.647
POOH Gradient: 1500.000 ft				
2020/06/10	11:10:00	2.4292	109.750	93.396
2020/06/10	11:10:15	2.4333	109.731	92.946
2020/06/10	11:11:15	2.4500	109.644	92.280
2020/06/10	11:12:15	2.4667	109.630	91.715
2020/06/10	11:13:15	2.4833	109.612	91.157
2020/06/10	11:14:15	2.5000	109.607	90.608
2020/06/10	11:15:15	2.5167	109.229	89.433
POOH Gradient: 1000.000 ft				
2020/06/10	11:16:15	2.5333	108.260	85.244
2020/06/10	11:17:15	2.5500	108.179	84.231
2020/06/10	11:18:15	2.5667	108.158	83.714
2020/06/10	11:19:15	2.5833	108.133	83.201
2020/06/10	11:20:15	2.6000	108.130	82.693
2020/06/10	11:21:15	2.6167	108.008	82.186
2020/06/10	11:22:15	2.6333	106.792	78.517
POOH Gradient: 500.000 ft				
2020/06/10	11:22:30	2.6375	106.761	77.504
2020/06/10	11:23:15	2.6500	106.689	76.683
2020/06/10	11:24:15	2.6667	106.645	76.183
2020/06/10	11:25:15	2.6833	106.604	75.677
2020/06/10	11:26:15	2.7000	106.600	75.184
2020/06/10	11:27:15	2.7167	106.599	74.698
2020/06/10	11:28:15	2.7333	105.553	71.929
POOH Gradient: 0.000 ft				
2020/06/10	11:28:40	2.7403	105.206	70.279
2020/06/10	11:29:15	2.7500	105.174	70.108
2020/06/10	11:30:15	2.7667	105.102	70.723
2020/06/10	11:31:15	2.7833	105.078	71.343
2020/06/10	11:32:15	2.8000	105.062	71.964
2020/06/10	11:33:15	2.8167	105.068	72.572
2020/06/10	11:34:15	2.8333	-3.836	72.765
2020/06/10	11:35:15	2.8500	-3.900	72.986
2020/06/10	11:36:15	2.8667	-3.956	73.416

Excerpt from Colorado Methane Emission Completion/Recompletion Rules/ AQCC & COGCC

Reg 7 – AQCC

VI.A.1 "Commencement of operation" means when a source first conducts the activity that it was designed and permitted for. In addition, for oil and gas well production facilities, commencement of operation is the date any permanent production equipment is in use and product is consistently flowing to sales lines, gathering lines, or storage tanks from the first producing well at the stationary source, but no later than end of well completion operations (including flowback).

VI.A.2 "Drill-out" means the process of removing the plugs placed during hydraulic fracturing or refracturing. Drill-out ends after the removal of all stage plugs and the initial wellbore clean-up.

VI.A.4 "Flowback" means the process of allowing fluids and entrained solids to flow from a well following stimulation, either in preparation for a subsequent phase of treatment or in preparation for cleanup and placing the well into production. The term flowback also means the fluids and entrained solids flowing from a well after drilling or hydraulic fracturing or refracturing. Flowback ends when all temporary flowback equipment is removed from service. Flowback does not include drill-out.

VI.A.5 "Flowback vessel" means a vessel that contains flowback.

VI.A.8. "Pre-production operations" means the drilling through the hydrocarbon bearing zones, hydraulic fracturing or refracturing, drill-out, and flowback of an oil and/or natural gas well.

VI.D. Emission reduction from pre-production flowback vessels

VI.D.1. Control

VI.D.1.a. Owners or operators of a well with flowback that begins on or after May 1, 2021, must collect and control emissions from each flowback vessel on and after the date flowback is routed to the flowback vessel by routing emissions to and operating air pollution control equipment that achieves a hydrocarbon control efficiency of at least 95%. If a combustion device is used, it must have a design destruction efficiency of at least 98% for hydrocarbons.

VI.D.1.a.(i) Owners or operators must use enclosed, vapor-tight flowback vessels.

VI.D.1.a.(ii) Flowback vessels must be inspected, tested, and refurbished where necessary to ensure the flowback vessel is vapor-tight prior to receiving flowback.

VI.D.1.a.(iii) Owners or operators must use a tank measurement system to

CA Ex. 14
Ex. 7

determine the quantity of liquids in the flowback vessel(s).

VI.D.1.a.(iii)(A) Thief hatches or other access points to the flowback vessel must remain closed and latched during activities to determine the quantity of liquids in the flowback vessel(s).

VI.D.1.a.(iii)(B) Opening the thief hatch or other access point if required to inspect, test, or calibrate the tank measurement system or to add biocides or chemicals is not a violation of Section

VI.D.1.a.(ii)(A).

VI.D.1.a.(iv) Combustion devices used during pre-production operations must be enclosed, have no visible emissions during normal operation, and be designed so that an observer, by means of visual observation from the outside of the enclosed combustion device, or by other means approved by the Division, determine whether it is operating properly.

VI.D.1.a.(iv)(A) Combustion devices must be equipped with an operational auto-igniter upon installation of the combustion device.

Statement of Basis and Purpose...

Flowback vessels The Commission also adopted in the new Section VI. a requirement for owners of operators of preproduction operations to control emissions from flowback vessels. After hydraulic fracturing, operators bring the frac fluids and entrained solids to the surface. EPA's NSPS OOOOa Section 60.5375a requires operators to route flowback during the initial flowback stage into one or more well completion vessels or storage vessels and commence operation of a separator unless it is technically infeasible for a separator to function. During the separation flowback stage, NSPS OOOOa requires operators to route all recovered liquids from the separator to one or more well completion vessels or storage vessels, re-inject the liquids into a well, or route the liquids to a collection system. NSPS OOOOa allows operators to use open vessels to contain flowback fluids and solids and does not consider a well completion vessel a storage vessel, which means operators are not required to control well completion vessel emissions. Therefore, to build on the NSPS reduced emission completion requirements and further reduce preproduction tank emissions, owners or operators of pre-production operations must use enclosed flowback vessels after the drill-out phase, which the Commission recognizes has a high ratio of solids to liquids, and route emissions from flowback vessels to air pollution control equipment.

COGCC 900 Series

COMMENCEMENT OF PRODUCTION OPERATIONS means the date that product consistently flows to a sales line, Gathering Line, or Tank from a Well.

FLOWBACK means the process of allowing Fluids and entrained solids to flow from a Well following Stimulation, either in preparation for a subsequent phase of treatment or in preparation for cleanup and placing the Well into production. The term Flowback also means the Fluids and entrained solids that emerge from a Well during the Flowback process.

903. VENTING OR FLARING NATURAL GAS

Venting and Flaring of natural gas represent waste of an important energy resource and pose safety and environmental risks. Venting and Flaring, except as specifically allowed in this Rule 903, are prohibited.

c. Emissions During Completion Operations.

(1) Reduced Emission Completions Practices. Operators will adhere to reduced emission completion practices as specified in 40 C.F.R. § 60.5375a, as incorporated by reference in Rule 901.b, on all newly Completed and re-completed oil and gas Wells regardless of whether the Well is hydraulically fractured, unless otherwise specified in this Rule 903.c.

(2) Flowback Vessels. Operators will enclose all Flowback vessels and adhere to the AQCC Regulation No. 7 standards for emission reduction from pre-production Flowback vessels as specified in 5 C.C.R. § 1001-9:D.VI.D, as incorporated by reference in Rule 901.b.

(3) Operators may Flare gas during completion operations with specific written approval from the Director under any of the following circumstances:

A. The Operator obtains the Director's approval to Flare through an approved gas capture plan pursuant to Rule 903.e;

B. The Operator submits, and the Director approves, a Form 4 allowing the Operator to Flare gas that would otherwise not be permitted pursuant to Rule 903.c.

i. On the Form 4 the Operator will explain why Flaring is necessary to Complete the Well, and will protect and minimize adverse impacts to public health, safety, welfare, the environment, and wildlife resources.

ii. On the Form 4 the Operator will estimate anticipated Flaring volume and duration.

iii. On the Form 4 the Operator will explain its plan to connect the facility to a Gathering Line or otherwise utilize the gas in the future.

iv. The Director may approve a Form 4 requesting permission to Flare during completion if the Director determines that the Flaring is necessary to Complete the Well and will protect and minimize adverse impacts to public health, safety, welfare, the environment, and wildlife resources; or

C. The Operator may direct gas to an emission control device and combust the gas if necessary to ensure safety or during an Upset Condition for a period not to exceed 24 cumulative hours. If Flaring pursuant to this Rule 903.c.(3).C exceeds 24 hours, the Operator will seek the Director's approval to continue Flaring. Within 7 days of the Flaring event, the Operator will submit a Form 4 reporting the Upset Condition or safety issues that resulted in the Flaring event and include the estimated volume of gas Flared.

Statement of Basis and Purpose:

Page 76 of 219 Final Draft November 23, 2020

Flowback

Also consistent with the new definition of Commencement of Production Operations and the revised definition of Completed Well, the Commission adopted a new definition of Flowback. This definition codifies and clarifies the EPA definitions of initial Flowback stage and separation Flowback stage that the Commission has used for several years in its March 18, 2016 Notice to Operators ("NTO") re: Rule 912.

The Commission chose not to specify when the flowback period begins and ends in the 100 Series Definition of Flowback, because such specification was not necessary given the limited uses of the term in the Commission's 400 Series Rules and Rule 903.c.(2). However, the Commission intends for operators to control separable gas as soon as possible. The Commission recognizes that Flowback is a term that is commonly used in the oil and gas industry, and that the defined term "Flowback" in the Commission's Rules does not necessarily match that definition. The Commission also recognizes that its definition is similar to, but somewhat different from, the AQCC's definition. This is the reason the Commission has provided a definition of the term—because it is a term used in specific contexts in the Commission's Rules, governing only a limited subset of operations, and accordingly the Commission narrowly tailored the definition to match those specific uses in the Commission's Rules.

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Page 82 of 219

Some stakeholders questioned why Rule 903.c.(1) did not explicitly prohibit venting during completion operations. The Commission determined that expressly prohibiting venting during the completion stage is unnecessary, but did not intend to permit venting during the completion stage. First, based on the definition of "Commencement of Production Operations," wells would produce very little or no natural gas to vent prior to the commencement of production operations. Thus the prohibition on venting in Rule 903.d.(1) obviates the need for a distinct prohibition on venting in Rule 903.c. Second, Rule 903.c.(1)'s reduced emission completion standards require capture or combustion of natural gas in nearly all circumstances. See 40 C.F.R. § 60.5375a(a)(4) (2016). That leaves only flaring, rather than venting, as an alternative with the Director's prior approval pursuant to Rule 903.c.(3).

3. 19.15.27.8 NMAC Completion and Re-completion Operations

We strongly support requirements to reduce venting and flaring from completion and recompletion operations. We are concerned, however, that reduced emission completion requirements ("RECs") are absent from OCD's draft rule. Hence, the rule as drafted would continue to allow large quantities of gas to be vented directly to the atmosphere, with all of the resulting harms to human health and the environment from methane and related releases and

loss of state revenues. Regardless of air quality enforcement issues, RECs are a long-standing, proven solution for preventing waste from completions and recompletions that OCD should require in its rule.

EPA rules adopted for gas wells in 2011 and extended to oil wells in 2016 require the use of REC equipment for completions and recompletions. The requirement for so-called "green completions" has been widely and appropriately acclaimed as a major advance in reducing the significant volumes of methane emissions associated with uncontrolled emissions during the completion process for hydraulically fractured or refractured wells. Unfortunately, over the past few years some operators have exploited ambiguities in the EPA regulatory text to avoid diligently employing the use of REC equipment to reduce emissions in line with the text and spirit of the EPA rules. In particular, extensive anecdotal evidence indicates that operators in NM are not using REC equipment as a standard, required, and prudent practice.

CA Ex. 14
Ex. 8

Specifically, there are issues with the EPA regulatory text regarding "separators" and with what was intended to be a narrow exception to address rare situations of infeasibility. A recent technical amendment to the EPA regulations helpfully clarifies the meaning of "separator" and

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adds a requirement that a separator be available for use during the entire flowback process. The recent amendments do not, however, otherwise tighten the regulations as needed to ensure that the regulations fulfill the intent to require operators to deploy and use REC equipment for every completion and recompletion operation. OCD has the opportunity now to address this significant source of methane waste in New Mexico, and to do so in a way that allows OCD to enforce the requirements. We urge you to seize this opportunity and ensure that operators are not allowed to vent gas during completions.

For over two decades, industry has used REC equipment to handle initial flowback from hydraulically fractured wells and capture the gas. Natural gas producers developed and deployed this equipment at a time when gas was more valuable and they could recover their costs through sales. Since 2012, hydraulically fractured natural gas wells have been required to use it by law, with hydraulically fractured oil wells added in 2016. REC equipment is designed to be temporary and easily moved from well-site to well-site. It normally includes filters such as plugs, sandcatchers, and one or more attached separators, and it is designed for the pressures and volumes associated with initial flowback. Where well pressures are too low for REC

[4] *See* 85 Fed. Reg. 57,398, 57,439 (Sept. 15, 2020) (40 C.F.R. § 60.5375a(a)(1)(i), (iii))

equipment to function properly, the pressure going into the REC equipment is boosted with compressors.

EPA regulations provide an exemption if it is "technically infeasible" for a separator to function, but this exemption is not necessary and has been subject to abuse, substantially undermining the effectiveness of the requirement. The whole point of REC equipment is to allow gas capture during the entire flowback process, and if equipment is not able to accomplish that, it should not be considered REC equipment. The operator should be responsible for obtaining REC equipment adequate for the particular job, and if it is not adequate, either the equipment is insufficient or the operator may be using a fracking technique that is not compatible with the equipment deployed. Either way, these factors are under the *operator's* control. If there is a problem, the burden should be on the operator to address it, not shifted, through exceptions, onto the public's shoulders through increased air quality and health impacts as well as lost revenues.

Thus, we strongly urge OCD not to include an open-ended exemption for "technical infeasibility." We are skeptical that there are in fact normal flowback situations (absent emergencies, which are already exempted from the proposed venting prohibitions) that REC equipment cannot be acquired to address and that operators cannot avoid through their choice of fracking techniques. But if such normal flowback situations exist, OCD should require industry to specifically identify them before making an attempt to draft regulatory exemptions. If OCD decides to include any such exemption, we urge OCD to do so only if it can be drafted in a way that it cannot be used as a loophole to evade the intent of the regulation to require the use of REC equipment and avoid the venting of gas.

A second problem with the EPA regulations is that the text has sometimes been misread to claim that the use of the terms "initial flowback" and "separation flowback" allows venting up until the point

that the flowback gas is clean enough for a permanent onsite separator to function. As these separators are generally not designed to handle flowback gas, this interpretation allows venting throughout the flowback period. This is a blatant misreading of the text and intent of the EPA regulations, and EPA has just finalized amended text to disallow this interpretation. EPA has added: "The separator may be a production separator, but the production separator also must be designed to accommodate flowback."[5] It is critical that any

[5] *See* 85 Fed. Reg. 57,439 (Sept. 15, 2020) (40 C.F.R. § 60.5375a(a)(1)(i)).

rule reference to a "separator" during completion operations make clear that a separator is part of the REC equipment and hence designed to accommodate the volumes and pressures associated with initial flowback. If OCD allows use of a permanent separator during the flowback period, it must be contingent upon the use of a separator capable of handling the flowback, in conjunction with the REC equipment, when the flowback begins.

In summary, there is no circumstance in which an operator should be able to avoid routing the initial flowback through REC equipment. The "flowback period" begins at the initiation of flowback and extends until well completion or recompletion is terminated and a (permanent) separator is connected to the wellhead. In practical terms, this means that the OCD rule should be structured to prohibit *any* venting during flowback.

The rules should also include a requirement that the operator have REC equipment onsite and connected prior to initiation of flowback and use that equipment to capture gas throughout the entire flowback period. A

requirement to have the equipment onsite and connected is relatively easy to verify and enforce, and it reduces the incentive for operators to avoid the REC requirements overall (EPA's recent amendments also added language to require that the separator be available and ready for use during the entire flowback period).

This is consistent with the approach of other jurisdictions, which have recognized that venting during any stage of the completion/recompletion process is neither technically necessary nor hugely costly to avoid. For example, the Colorado Air Pollution Control Division has proposed to require control of at least 95% of emissions during the entire flowback period:

Owners or operators of a well with flowback that begins on or after May 1, 2021, must collect and control emissions from each flowback vessel on and after the date flowback after drill-out is routed to the flowback vessel by routing emissions to and operating air pollution control equipment that achieves a hydrocarbon control efficiency of at least 95%. If a combustion device is used, it must have a design destruction efficiency of at least 98% for hydrocarbons. VI.D.1.a.(i) Owners or operators must use enclosed flowback vessels.

Similarly, Canada's federal rules provide that "Hydrocarbon gas associated with flowback at a well at an upstream oil and gas facility must not be vented during flowback but must instead be captured and routed to hydrocarbon gas conservation equipment or hydrocarbon gas

destruction equipment."[6] The only exception to this venting prohibition is "if all the gas associated with blowback at the well does not have sufficient heating value to sustain combustion." We understand that this

exemption is intended to address the flowback when nitrogen is used as the fracking material, but the exemption is overbroad. When nitrogen is used as the fracking material, the gas is not initially suitable for sales and it may be difficult to achieve sustained combustion. Operators can readily address the combustion issue, however, by providing sufficient additional combustible gas to sustain combustion.

Colorado and Canadian regulators recognize that venting is not necessary during initial or subsequent flowback from hydraulically fractured wells, and technology to control it is affordable and available, and we urge OCD to be no less protective of New Mexico.

In addition to prohibiting venting, OCD's completion rules should also require operators to avoid flaring except as may be necessary in a few specific situations as part of the operation of the REC equipment. For example, we recognize that when nitrogen is used for fracking, the flowback gas may require flaring as an integral part of the REC process and equipment, while still allowing delivery of the remainder of the gas to the sales line, other beneficial use, or reinjection. Thus, OCD could allow for flaring during flowback, but only where it is an integral and necessary part of the REC process. As a general matter, the operator should be required to capture and route to a sales line, beneficially use, or re-inject the gas.

We urge OCD to require, by rule, that operators not only deploy and connect REC equipment prior to flowback and use it upon initiation of flowback, but also capture, use, or re-inject the gas from the initiation of flowback until the well completion or recompletion is terminated and a separator is connected to the wellhead.

Consistent with our recommendation for an overarching requirement applying to drilling,

completions, recompletions and production operations to flare rather than vent except in

specifically identified circumstances, we recommend deleting paragraph 19.15.27.8(C)(4)

NMAC, which provides a less precise and less protective requirement to flare rather than vent

during completions and recompletions.

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[6] Government of Canada, *Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)* (SOR/2018-66), § 11(2) (online at:https://laws-lois.justice.gc.ca/eng/regulations/SOR-2018-66/page-2.html).

In addition, we recommend that OCD add "and re-completions" wherever completions are

referenced (or define "completions" up front to include re-completions) to clarify that the

requirements for completions also apply to re-completions.

Green Completions

Lessons Learned
from Natural Gas STAR

Producers Technology Transfer Workshop

ExxonMobil Production Company,
American Petroleum Institute and
EPA's Natural Gas STAR Program

September 21, 2004

CA Ex. 14
Ex. 9

Green Completions: Agenda

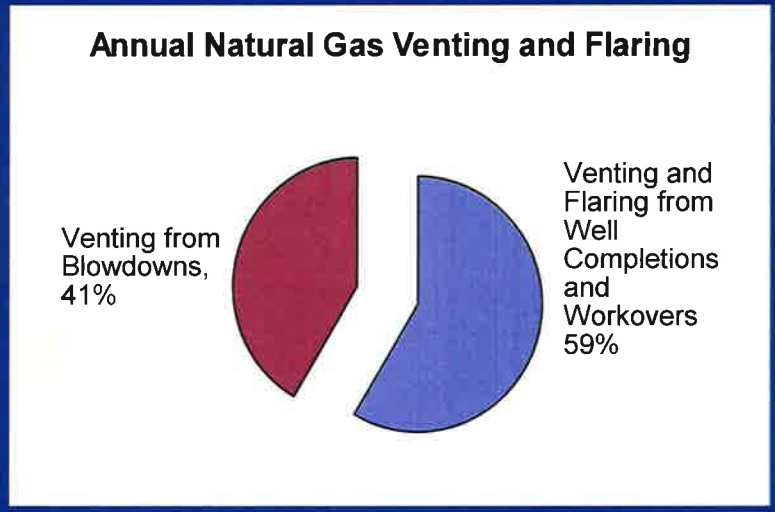
- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions

Methane Loss During Well Completions

- It is necessary to clean out the well bore and formation surrounding perforations
  - **After new well completion**
  - **After well workovers**
- Produce the well to an open pit or tankage to collect sand, cuttings and reservoir fluids for disposal
- Vent or flare the natural gas produced
  - **Venting may lead to dangerous gas buildup**
  - **Flaring is preferred where no fire hazard or nuisance**

Methane Losses: Well Completions and Workovers

- EIA reported annual losses due to flaring and venting from onshore gas well completion, workovers and blowdowns to be 76 Bcf
- Estimated 45 billion cubic feet (Bcf) of natural gas lost annually due to well completions and workovers[1]
- Estimated a total of 480,000 barrels (Bbl) condensate lost annually due to venting and flaring
- A total of $145 million lost due to well completions and workovers



Note:

- [1]Percentage that is flared and vented is not known
- Value of natural gas at $3/Mcf
- Value of condensate at $22/bbl

NaturalGas
EPA POLLUTION PREVENTER

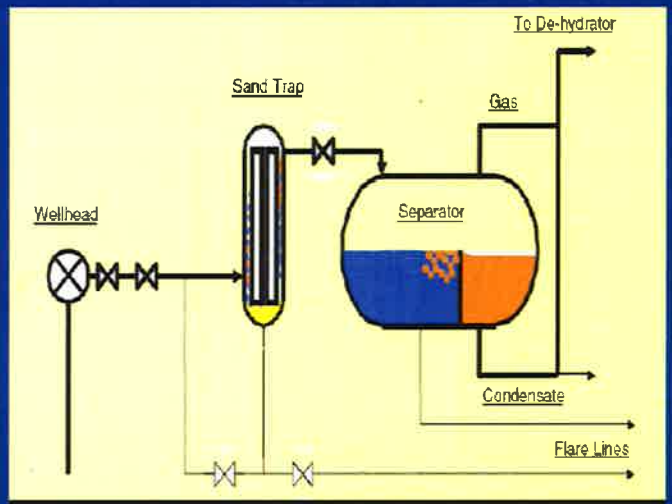
Reducing Emissions, Increasing Efficiency, Maximizing Profits

Methane Recovery by Green Completions

- Recover natural gas and condensate produced during well completions or workovers
- Estimated 24 Bcf of natural gas can be recovered annually using Green Completions
- Use portable equipment to process gas and condensate suitable for sales
- Direct recovered gas through permanent dehydrator and meter to sales line, reducing venting and flaring

Green Completions: Equipment

- Truck- or trailer- mounted equipment to capture produced gas during cleanup
  - **Sand trap**
  - **Three-phase separator**
- Use portable desiccant dehydrator for workovers requiring glycol dehydrator maintenance



Temporary, Mobile Surface Facilities, Source: BP

Green Completions: Preconditions

- Permanent equipment on site before cleanup
  - **Piping to well head**
  - **Dehydrator**
  - **Lease meter**
  - **Stock tank**
- Sales line gas can be used for energy and/ or gas lift in low pressure wells

Green Completions: Low Pressure Wells

- Use portable compressors when pressure in well is low
  - **Artificial gas lift to clear fluids**
  - **Boost gas to sales line**
  - **Higher cost to amortize investment**

Portable Compressors, Separator and Other Equipment on a trailer

Source: Herald

Green Completions: Benefits

- Reduced methane emissions during completions and workovers
- Sales revenue from recovered gas and condensate
- Improved relations with state agencies and public neighbors
- Improved safety
- Reduced disposal costs

Is Recovery Profitable?

- Partners report recovering 2% to 89% (average of 53%) of total gas produced during well completions and workovers
- Estimated 7 to 12,500 thousand cubic feet (Mcf) (average of 3,000 Mcf) of natural gas can be recovered from each cleanup
- Estimate 1 to 580 Bbl of condensate can be recovered from each cleanup

Note: Values for high pressure wells

Commercial:	REC technology is commercially available and can be rented through service providers or purchased. In a large basin with high drilling activity levels it may be economic for an operator to purchase its own REC portable skid. Most producers may prefer contracting a third party service to perform completions
Environmental:	RECs help reduce methane, criteria pollutants and hazardous air pollutant emissions. Produced water and stimulation fluids from green completions can be recycled for future frac jobs as water is recovered in the three-phase separator [4]. Green completions also eliminate emissions, noise and public complaints associated with flaring practices. Some jurisdictions have begun requiring green completions as emissions reduction mechanisms
Economic rule-of-thumb:	Payback time has been reported to be as little as 3 months by natural gas operators, but tends to be around one year on average [1]. Generally, lengthy completions, such as those following hydraulic fracturing, imply a significant amount of gas that could potentially be recovered and sold for additional revenue to justify the additional cost of a REC. When assessing the economic viability of green completions, gas prices influence the decision making process, as they will impact the return on investment and the payback time for purchases of REC equipment, as well as determine the value of natural gas savings. The amount of condensate recovered and the sales price will also affect profitability.

Additional comments

Ultimately, a key decision driver for performing green completions may be government regulations. Recent U.S. federal regulations like NSPS Subpart OOOO will require RECs for hydraulically-fractured natural gas wells that take place from 2015 onward. Exceptions are made in the federal regulations for exploratory or delineation wells. The States of Wyoming and Colorado

have regulations requiring the implementation of "flareless completions". Operators of new wells in this region are required to complete wells without flaring or venting. These completions have reduced flaring by 70 to 90 percent [Reference 1 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-1)].

The advantages and shortcomings [References 4,5,6 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-4)] of green completion technology are summarized below:

Advantages:

- Reduce greenhouse gas emissions and other criteria pollutants
- Selling captured gas instead of venting / flaring
- No visible flares, thus less conflict with operations near populated areas
- Improved overall safety at the well site
- Water and stimulation fluids can be recovered for re-use in other fracking jobs; hence reduced water disposal costs.
- Offers potential compliance pathway for future regulation

Disadvantages:

- Must have an operational gathering system in place
- Requires specialized equipment
- Requires adequate reservoir pressure
- Incremental cost of "green" completion unit - approximately 30% more than a conventional well completion unit
- Profitability depends on value of gas sold – profit margin may be small

Alternative technologies

Alternative technologies to capture produced gas during well cleanup other than RECs are not readily available, however, the oil and gas industry has been working on methods to make well completions more efficient, in terms of decreasing the duration of the operations, and also the amount of gas that is vented or flared during this lengthy procedure. An example of these efforts is Marathon Oil's completion technology EXcape® or Casing-Conveyed Perforating System (CCP) [Ref 7 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-7)], a new method for completing natural gas wells that consists of a different casing design that allow well cleanup to occur much faster; CCP allows the completion team to perforate and stimulate all intervals in a single day. According to reviews,

completions performed with CCP technology are more cost effective due to shorter operations, while simultaneously reducing methane emissions and improving safety conditions. Marathon Oil estimates a reduction in venting anywhere from 2,750 MCF to 7,850 MCF per well - gas that ends up in sales. This is accomplished by the multi-stage completion design of the casing that has perforating guns and isolation devices externally mounted to the casing, enabling the performance of simultaneous and quicker perforations of each completion stage **[**Ref 8 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-8)**]**.

Operational issues/risks

There is a reduction of safety risks at the well site by using green well completions, associated with the removal of flares and reduction of vented emissions.

However, there may be other operational and safety risks that could be encountered during REC operations **[**Ref 9 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-9)**]**:

> Wellbore damage by fluids pumped down hole can diminish production.
>
> Flowing fluids to REC equipment can result in decreased flowback rates due to high back pressure from the piping system (versus no back pressure when venting is performed).
>
> The piping configuration leading to the sand traps is critical as the abrasion from high velocity water and sand can erode a hole in steel pipe elbows, creating a "washout" of the pipe and releasing hydrocarbon liquids, water and gas into the well pad. That is why it is also recommended to use plug catchers to catch large solids that could damage separation equipment. Pipe fittings and elbows should be reinforced with high strength metal.
>
> REC operator should check location frequently (every 1 to 2 hours) during the well completion operation to identify leaks before they become washouts.
>
> Pressure of the gas must not exceed the rating of the sand trap or separator vessels. REC equipment not suitable to handle blowouts.

Opportunities/business case

Natural Gas Star Partners have reported recovering 2% to 89% (average of 53%) of total gas produced during well completions and workovers from high-pressure wells [Ref. 10 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-10)]

An estimated 500 to 2,000 MCF/day/well of natural gas can be recovered during a well cleanup. The amount of gas recovered is therefore a function of the duration (days) of the flowback period. An average green completion may last about nine days, which would translate in gas savings from 4,000 to 18,000 MCF/well. Delivering this amount of gas to the sales line can produce revenues between $28,000 to $126,000 based on gas price of $7/MCF. Revenues from captured gas sales will vary according to the market price of natural gas; however even at low gas prices of $3/MCF, it is estimated that it would still be economical to perform green completions [Ref 1 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-1)].

In addition, 1 to 580 barrels of condensate may be recovered from each cleanup depending on reservoir conditions. This could translate into upwards of $30,000 additional revenue from condensate sales at $50/barrel (Natural Gas Star, 2010). The benefits of using green completions will vary considerably among individual wells and reservoirs, but can often be economically favorable. The following benefits are identified:

Sales revenue from natural gas and gas liquids captured during the green completion may be sold.

Lower methane emissions

Lower safety risks at well site

Improved relations with government agencies and public neighbors

Reduced cost for disposal of fracking liquids (as these can be recycled).

Industry case studies

Experience for Noble Energy in Ellis County, Oklahoma [Ref. 1 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-1)]

Noble Energy implemented RECs on 10 wells using inert gas energized fracturing.

Employed membrane separation in which the permeate was a CO_2 rich stream that was vented and the residue was primarily hydrocarbons which were recovered.

Total of nine wells were tested, eight of which the REC system processed flowbacks from a single well completion, and one of which was a commingled stream from two well flowbacks

Total cost of $325,000 including equipment and rental labor

Total gas savings of approximately 175 MMcf.

Estimated net profits were $340,000

The project resulted in the reduction of methane emissions and yielded economic revenues from selling gas that would have otherwise been flared. Commodity prices and the practicality of combining the

flowback gas from different wells will be important in determining future use. Commingling the flowback gas can double the gas savings for the same rental and set-up costs.

Experience of BP in Green River Basin [Ref. 10 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-10)]

Implemented RECs in the Green River Basin of Wyoming in 2002.

RECs were performed on 106 wells, which consisted of high and low pressure wells.
BP reported a capital investment of about $500,000 per skid on portable three-phase separators, sand traps, and tanks in the Rocky Mountain Region.

Average 3,300 Mcf of natural gas sold versus vented per well. Well pressure varies from reservoir to reservoir, thus affecting the rate of production. Conservative net value of gas captured is $20,000 per well.

Total natural gas recovered about 350 million cubic feet per year (MMcf/year) in that year.

Total of 6,700 barrels of condensate recovered per year total for 106 wells

This Natural Gas Star partner reports a total of 4.17 Bcf of gas and more than 53,000 barrels of condensate recovered and sold rather than flared through the end of 2005. This is a combination of activities in the Wamsutter and Jonah/Pinedale fields.

Experience from Williams Corporation [Ref 11 (http://www.ipieca.org/energyefficiency/solutions/78161#reference-11)]

Williams Corp. performed RECs in the Williams Fork Formation (Piceance Basin) – a low permeability, tight, lenticular sandstone.]

BRECO flowback skids were used to separate sand, water and gas during initial flowback **(Figure 3).** The flowback skids reside on a typical 4-well pad for 32 days.

Figure 3. BRECO Reduced Emissions Completions Skid (Source: Williams. Natural Gas Star. 2006)

Flow pressures range from 1,500 to 2,500 psi; these are high pressure wells, no requirement for gas lift.

Operator reported average gas volume recovered per flowback was 23 MMCF.

The revenue per flowback was $139,941, based on gas prices of approximately $6/MCF.

Other economic characteristics of this case study are shown in **Table 1.**

AVERAGE PER WELL FLOWBACK STATISTICS	
Average Number of Days of Flowback =	32
Average MMcf Gas Recovered During Flowback =	23
Average MMcf Gas Flowback Recovered/Day =	0.71
Average Revenue Per Flowback ($) =	$139,941
Average Cost Drill/Complete Well ($) =	$1.3 to $1.5 MM
Average Cost Per Flowback ($) =	$11,855
Average Net Saving Per Flowback ($) =	$129,510
CH_4 recovered in 2005 = Estimated Mean Methane Concentration Gas: 89.043 vol. %	5982 MMscf or 16 MMscf/day

Table 1. Green Completion Economics for Williams REC Experience (Source: Williams. Natural Gas Star. 2006)

Case studies presented here show that variations in the operational and reservoir conditions will have a major impact in the level of profitability of each REC implementation project. High maintenance wells, such as those requiring inert gas stimulation (like in Noble Energy's experience) appear to have a lower revenue per completion (~$34,000) than high pressure wells requiring a simpler REC configuration, such as the case for Williams, where revenue was as high as $129,510 per completion. Moreover, the effective usage of a REC equipment in multi well pads where flowbacks from various wells can be combined into a single skid set-up seems to be a key way to reduce costs. The usage of the Breco skid for four wells in the Williams experience, as wells as the commingling of two flowback streams in the Noble Energy case study appears to suggest this.

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