Flaring in the Oilfield

Resources and strategies for understanding and reducing flaring.

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NEW MEXICO OIL AND GAS ASSOCIATION

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Introduction

Members of the New Mexico Oil and Gas Association (NMOGA) are committed to capturing as much natural gas, which contains methane and VOCs, as possible for beneficial use to reduce flaring to the lowest amount possible, consistent with practical, safe operations. In addressing this issue, NMOGA's members have recognized that there is a need to provide greater clarity as to why natural gas is flared. Therefore, NMOGA's members prepared this report, "Flaring in the Oilfield," to closely examine the issue of flaring, educate the public about this important process, and highlight opportunities to further reduce volumes of flared natural gas. This report, and the Industry's effort to reduce flaring of natural gas, is a part of an ongoing effort to respond to Governor Lujan Grisham's Executive Order 2019-003 to "secure reductions in oil and gas sector methane emissions and to prevent waste from new and existing sources."

Industry and royalty owners, including the State of New Mexico, all wish to maximize the capture and sale of produced natural gas. As explained more fully in this report, there are, however, circumstances when natural gas must be flared in order to maintain a safe operating environment for workers and the public. All jurisdictions, both state and federal, acknowledge that flaring may be necessary under certain circumstances, and no state has banned flaring outright. Industry has invested, and continues to invest, billions of dollars in infrastructure to capture more natural gas and reduce flaring. These investments span from building the pipeline systems that gather natural gas from thousands of production sites, through construction of new natural gas processing plants, to building thousands of miles of long-range transport pipelines so that natural gas can be delivered to end users. In those circumstances where natural gas gathering and processing capacity is temporarily lacking, industry has made significant investments in flare and other combustion devices and also continues to explore alternative gas capture/utilization technology where applicable.

What is flaring?

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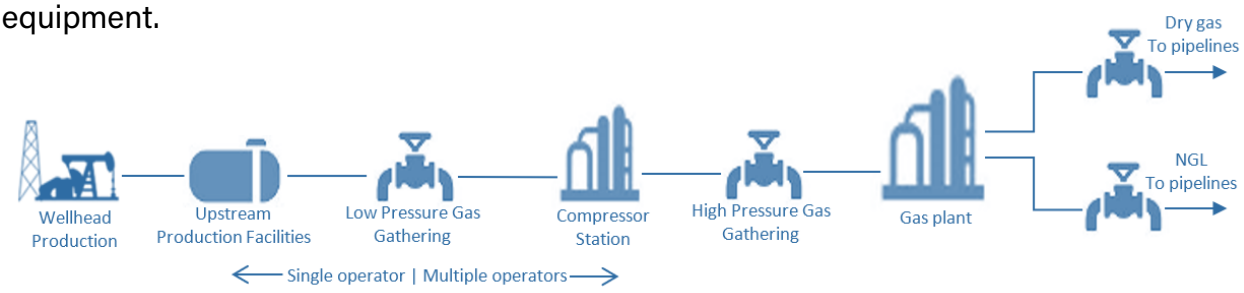
Flaring is the controlled combustion of natural gas with a flare stack that is elevated above the ground or in a combustor, both of which would be situated at a safe distance from surface facilities and personnel. Natural gas is burned in an attempt to eliminate potentially unsafe, flammable vapors and to destroy unwanted emissions of methane and VOCs. Properly designed flare systems destroy 98% of methane and VOCs before they are released into the atmosphere.[1] The alternative to flaring is venting, which is the controlled release of hydrocarbon vapors into the atmosphere. Flaring is safer than venting because it effectively destroys more than 98% of the methane and VOCs in the waste gas stream.

Flaring occurs in drilling and completion operations, routine field production operations, and gas gathering and processing operations. This report will explore each of these phases and how, in each setting, limited flaring is essential to provide a safe work environment.

Flaring is necessary for safe operations during the production of oil and natural gas

Flaring is an essential and necessary part of oil and gas production and processing operations. Flaring is primarily the result of safety considerations and transportation constraints and may occur in a variety of operational scenarios.

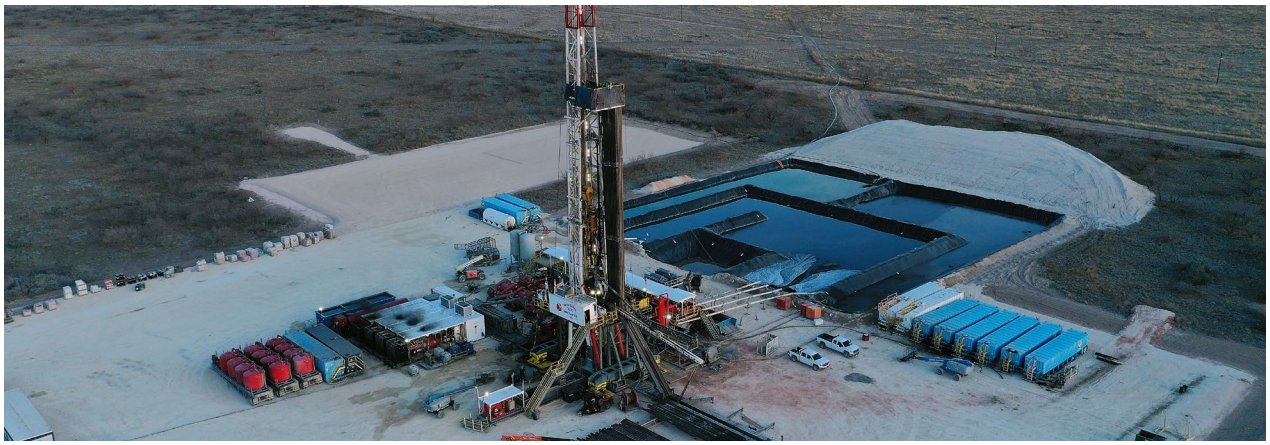
There are many steps and mechanical components involved in the complex process of moving natural gas from the wellhead to the end user. This process starts with the natural gas at the well itself; the gas then continues to an upstream production facility (sometimes called a production battery); then moves through a low pressure pipeline "gathering" system; then typically through a compressor station where the natural gas is boosted in flowing pressure; then through more high pressure piping to a gas processing plant where the gas is stripped of some of the "heavy" components like ethane, propane, butane, and the like. The "dry" natural gas, which is now nearly 100% methane, is then sent through larger transportation pipelines to end users across the country. The "heavy" components are also sent through pipelines to markets where they are used to create many valuable products. All throughout this process, fail-safe devices, which sometimes send gas to a flare system, are used to protect people, the environment, and essential equipment.



[1]https://www.epa.gov/sites/production/files/2019-08/documents/flarescostmanualchapter7thedition_august2019vff.pdf

Drilling

During drilling operations, geologic formations are encountered that can lead to natural gas being brought to the surface by the circulating fluid (called "mud") at the rig site. This natural gas must be managed at the drilling rig to keep personnel safe. Typically, this natural gas is routed to a flare device which destroys the methane and VOCs in order to maintain a safe operating environment on site. These flaring events, if they occur at all, are of short duration, typically lasting no more than a few days on a given well and are managed by the rig crew to keep the gas flow rate to the flare at a safe, low level.



Completion/Flowback

Once an oil well has been drilled, it is completed, which entails "connecting" the oil-bearing reservoir formation to the well so that oil and gas can flow to the surface. After the completion process, flowback operations begin. Flowback is the period when fluids are first recovered from the wellbore. This fluid may consist of crude oil; completion and produced water; solid particulates ("solids"), such as sand; and natural gas. Because of the solids in the flow stream, the flow cannot be handled through normal production facilities until these particulates "clean up." The duration of the flowback period varies from well to well. During flowback, the combined fluid stream from the wellhead is sent through specially designed equipment that safely removes the solids and separates crude oil, natural gas, and water. Production volumes of oil, natural gas, and water are typically measured to understand the well's performance (well testing) during this "flowback" phase. The liquids are typically stored in tanks at the well site and the hydrocarbon vapors are sent to a nearby flare for destruction on these manned sites until the well is cleaned up and flowing consistently, at which time the flow is routed to a pipeline for delivery to an upstream production facility or the well is shut in and the temporary flowback/well testing facilities are removed. Current regulations (19.15.18.12A NMAC) allow for a 60-day period of flaring, with some exceptions, during the flowback/well testing phase, recognizing the practical need for the industry to safely manage this important phase of development.

Operators have worked to reduce the number of days needed to "clean up" the majority of wells. With reasonable exceptions, NMOGA recommends that this rule be changed to reduce the standard clean-up period to 30 days.

Upstream Production

There is virtually no flaring at the wellhead itself during the long production phase, so this report will concentrate on other aspects of the production process, starting with the upstream production facility (which could be on the same pad as one or more wellheads).

One of the first facility components that a production stream, starting at a well, encounters is a separator at the upstream production facility. This is a vessel that receives flow from a well and uses gravity to separate gas, oil, and water for further handling. A separator uses devices to allow the right amount of oil or water to flow out of the vessel while maintaining proper liquid levels and pressure inside. A failure of a "level control" device can allow all the liquid to drain from the separator and thus allow natural gas to flow unrestricted to a storage tank meant for liquids. That unexpected natural gas flow would overwhelm the system and, if not handled properly, create a serious safety concern. Design engineers build in fail-safe devices to respond to such upsets to send natural gas to a safety flare system.

Level control devices on separators are just one example of the many components used in oil and gas facilities. Other control devices are used to manage pumps, flow rates, compressor operations, and many other critical aspects of the entire process that moves oil and gas from the wellhead to the market through each of the phases discussed in this report. All facilities are designed with fail-safes that can route natural gas to flare devices, safely destroying the gas to protect personnel and eliminate virtually all methane and VOC emissions in most instances.

An emergency relief flare system can also become overwhelmed. When this occurs, a second level safety system activates to prevent equipment rupture, which, again, is designed to protect personnel and the environment from even worse consequences. Pressure relief valves, pressure sensitive tank hatches, and other similar devices activate if over-pressured, causing the release of natural gas to the atmosphere in order to prevent tanks, separators, and other vessels and piping from a catastrophic failure. All of these systems are designed to activate only when necessary to maintain a safe working environment.

Maintenance

The failure of a level control device, as mentioned above, could require an instantaneous, automatic response. There are other events that operators must manage with more discretion while maintaining a safe operating environment. When these events occur, operators must weigh many factors in order to make the best decision.

Most equipment at an upstream production facility requires periodic maintenance. Design engineers build facilities in a manner that gives operators the ability to perform maintenance without disrupting the flow stream. Unfortunately, it is impractical to build facilities such that every component can be serviced without flow disruption. When operators plan to perform maintenance on certain components, they must decide whether to curtail production or flare gas during the work. Curtailing production carries the risk of damaging the wells and/or the pump system in the wells, thereby potentially reducing the ultimate recovery of the wells served by a facility to the detriment of all stakeholders. Further, curtailing production, at a minimum, defers revenue to the owners of the well and to royalty owners, including the State of New Mexico. Finally, all citizens of New Mexico suffer harm by deferring the taxes paid on all oil and gas sales. If a planned maintenance would cause a small portion of the gas stream to be flared while all oil production and the majority of gas production continued to be produced for sales, it can be beneficial to all parties to choose to keep wells producing and flare a limited amount of gas to allow safe, uninterrupted operations during maintenance activities.

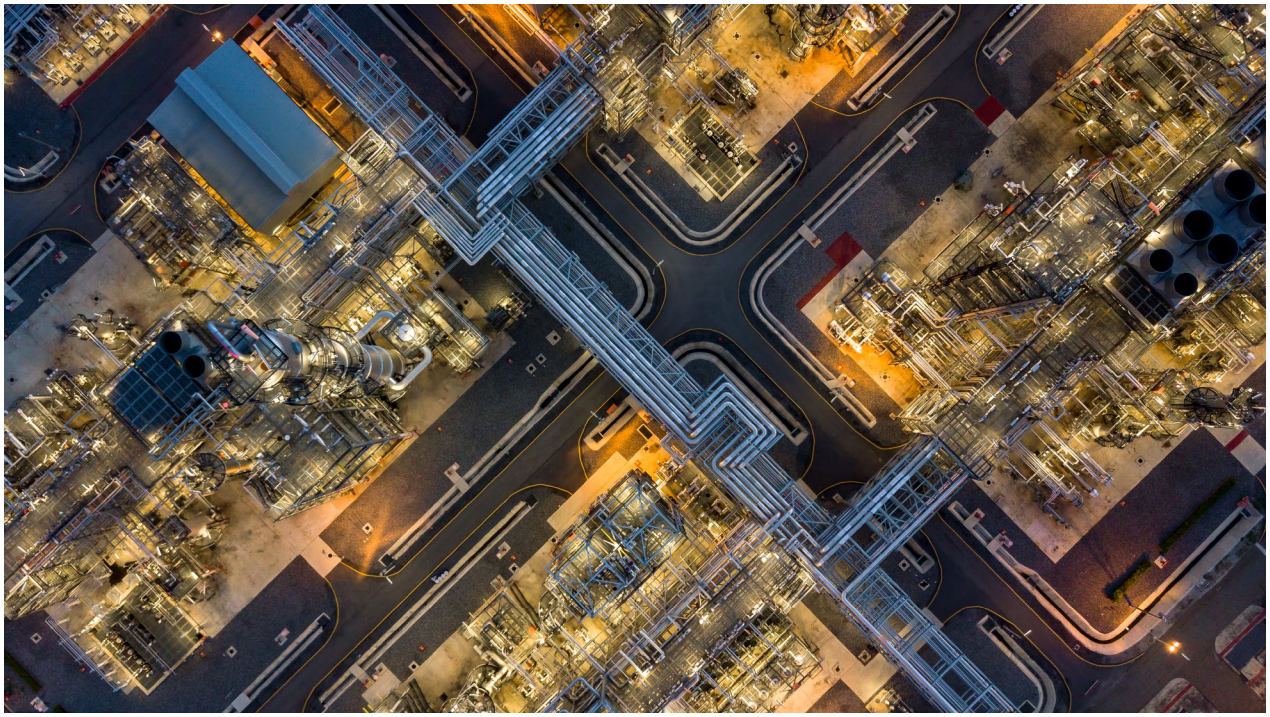
Unplanned maintenance can create an even more difficult situation for operators. Sometimes a component in a facility will fail in a manner that creates an unsafe condition but does not cause a fail-safe device to trip. A seal on a pump or other device might begin leaking and is detected by operations personnel. The device must be repaired but this might require time to gather replacement parts and repair crews to address the issue. Again, the operator must consider many factors when deciding whether to curtail production or flare natural gas. Flaring a small portion of the overall production for a short time may be the best decision for all stakeholders even if the exact timeframe for repair is uncertain.

Midstream

Once natural gas leaves the upstream production facility, it enters the midstream sector, which is typically owned and operated by a company that is different than the upstream operator. This midstream company invests money in low pressure pipeline systems, compressor stations that boost the natural gas to a pressure more suitable for their natural gas processing plants, and the processing plants themselves. Midstream facilities are no different than upstream facilities in that they must be designed to react to maintain a safe working environment during upset events. These facilities include fail-safe devices that, when tripped, shut off gas flow or send gas automatically and instantly to a relief system, like a flare to maintain a safe working environment and destroy the methane and VOCs in the gas stream. Failure of some 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.

Gas gathering systems periodically require removal of liquids that build up in the pipelines. Water and natural gas liquids condense in this portion of the gas transportation system and create a safety hazard if left too long. The removal of these liquids (and sometimes some solids) is performed by sending a plunger-like device called a "pig" through the pipeline to push the liquids and solids out. Some of these "pigging" operations cause a small amount of gas to be sent to a safety flare. Liquids build-up in a gas gathering system can be unexpectedly large. So much so that that sometimes, when such a large "slug" of liquid arrives at a midstream facility, it will overwhelm the receiving equipment and can cause a significant upset of the facility without warning to the operator. Such an upset can result in safety flaring at the facility and even at production facilities further upstream of the receiving site. Even if such an event is associated with pigging operations (not all are), the size of a slug cannot be known by a midstream operator. These periodic events cause a small percentage of the entire gas flow to be unavoidably flared.

Midstream (continued)



Midstream operators also face many of the same challenges as upstream operators, such as operational upsets, scheduled maintenance, and unscheduled maintenance. Since midstream operators have no associated crude oil production to create significant revenues while temporarily flaring natural gas, these operators face a different challenge in balancing value for all stakeholders when faced with flow interruptions. Shutting down a compressor station, or especially a processing plant, will cause a domino effect on all upstream producers on the gathering system. Midstream operators have communications procedures to inform all upstream operators of an impending, planned outage. Even so, shut-down durations for midstream maintenance are best estimates and can be impacted by many factors, so upstream operators must make flare/curtailment decisions during these planned midstream outages that balance the needs of all stakeholders based on the best information available.

The New Mexico Environment Department (NMED) is responsible for permitting all processing plants and most other midstream facilities. Many upstream production facilities are also permitted through the NMED. Any emissions, including those from flaring, that exceed permitted amounts must be reported to NMED.

Downstream

Long range transportation pipelines in the downstream sector can also be impacted by upsets and maintenance which can, again, cascade to impact midstream and upstream operators. When these events occur, scheduled or not, impacts can be felt throughout the natural gas chain. In every event, some flaring can occur in order to maintain a safe work environment.

Operational Safety Flaring Summary

The natural gas volumes that are flared in order to maintain a safe operating environment while managing all of the many aspects of natural gas production, from drilling to downstream operations, tend to be unsteady, unpredictable, and short-lived so they are virtually impossible to capture for beneficial use using some alternate technology like electrical power generation. Flaring is the best and safest way to manage these events.

As discussed above, limited flaring is necessary throughout the production of oil and natural gas for safe, responsible operations. While flaring is a necessary safety technique in oil and natural gas operations, the oil and gas industry continues to innovate and develop new ways to reduce the amount of natural gas that is flared during operations. The next section of this report discusses the major obstacle challenging the oil and gas industry as operators try to achieve even greater reductions in volumes of flared natural gas: temporary infrastructure capacity constraints (even after such great progress has been made in this area to date).

Infrastructure Capacity Constraints

Infrastructure capacity limitations are a separate, but important cause of natural gas flaring. The oil and natural gas industry has invested billions of dollars in existing gas capture, processing, and transportation infrastructure. Even so, the unprecedented development pace, especially in southeast New Mexico, has led gas production rates to temporarily exceed the capacity of existing midstream and downstream pipelines and facilities. One fundamental reality is that billions of dollars are required to build natural gas gathering, processing, and long-range delivery facilities. These investments are only built after upstream development (drilling and completion) has proven that a minimum necessary natural gas volume has been developed to warrant the investment. Therefore, economic necessity creates limited periods of time where a shortage of infrastructure exists until gas capture, processing and transportation facilities can be permitted and constructed.

Industry continues making massive investments in the natural gas processing and takeaway infrastructure necessary to serve present and future oil and gas production activity in New Mexico. These new gathering system projects and long-range natural gas pipelines are intended to gather stranded gas and connect Permian Basin gas production to various Gulf Coast industrial centers and export terminals as well as to markets on the east and west coasts. This will benefit both upstream and midstream operators in southeast New Mexico. Further, planned (and under construction) new capacity additions will remove natural gas transportation bottlenecks and provide sufficient capacity for all expected production through 2030.

While the oil and gas industry continues to plan and build new infrastructure to capture gas for beneficial use and further reduce infrastructure capacity constraints, these large infrastructure projects take time. Besides the actual construction process, a significant amount of time is needed for obtaining permits from regulatory agencies and gaining permission from landowners to build these pipeline systems. Delays in any phase of these projects, from pre-construction to final certification of completion, slows construction of the infrastructure it needs to achieve even greater reductions in volumes of flared natural gas.

Strategies to Reduce Flaring

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Operator Strategies for Continuing Reductions in Flaring Across the Oil and Gas Industry

Communication and Planning Reduce Flaring

Even when gas capture infrastructure is adequate in an established area, good planning and communication between an upstream producer and midstream operator can reduce flaring. Operators are proactively working with midstream solution providers to construct and commission facilities and pipelines in advance of drilling. Leases and other oil and gas agreements often require operators to drill in given time frames. Whenever possible, operators adjust drilling and production schedules to minimize the number of wells that need to flare gas due to a lack of takeaway pipelines or downstream facilities. In addition, operators are designing multiple well pads which provide additional time to install the required pipelines and facilities prior to a well's initial production. Even the best communications and planning cannot ensure gas will not be flared due to lack of infrastructure as actual production volumes sometimes exceed expectations and some business plans are forced to change, impacting the available capacity.

Short Term Production Curtailment

Operators will occasionally curtail production to mitigate a flaring event. However, curtailing production could result in the loss of royalties paid to all interest holders, including the public if the New Mexico State Land Office or Federal Bureau of Land Management receive revenue from the affected lease.

Development and Implementation of Advanced Technologies

The industry continues to investigate and test new techniques and technologies that reduce flaring. An example is the onsite generation of power production using produced hydrocarbon vapors as fuel mentioned above. A power provider's ability and willingness to accept distributed generation from oil and gas sites could allow the gas to be utilized to support the electrical demands of the state, thus offsetting flaring. Distributed generation could allow for on-site equipment to utilize electricity, reducing demand on diesel generators or the grid and supplement the grid with power generated in excess of site demand. The economics of such systems are challenging but operators continue to pursue these creative concepts. Besides the economic considerations, the regulatory challenges to employ such systems can be daunting. A streamlined and coordinated regulatory framework could encourage further deployment of such alternative use ideas.

Regulatory Strategies for Continuing Reductions in Flaring Across the Oil and Gas Industry

Flexible Regulatory Approaches Focused on Reducing Emissions Without Stifling Innovation

Flaring will continue to be necessary in oil and gas operations because of safety considerations (personnel and equipment) and its effectiveness in combusting harmful emissions. However, technically sound and science-based regulatory approaches, which allow flexibility and promote innovation and development, can help also reduce volumes of flared natural gas. To that end, NMOGA believes the following regulatory approaches will achieve greater emission reductions without chilling innovation:

1 The New Mexico Oil Conservation Division Operators (NMOCD) Monthly Report (C-115) requires gas production volumes to be reported, including flared gas. Midstream operators report emissions, including those from flared natural gas, in excess of permitted levels to the New Mexico Environment Department (NMED). More consistency in how flared gas volumes are determined and reported (i.e., by cause) across all oil and gas production and midstream operations, will benefit the state as it establishes future rules, requirements, and reduction targets. The reporting requirement should include a protocol for high pressure flaring and approved standards for estimating and measuring flared gas.

2 A "Gas Capture Plan" should be required and made part of NMAC 19.15.14.8 – Permit to Drill, Deepen, or Plug Back.

A) A Gas Capture Plan should outline the actions to be taken by the operator to reduce the well/production facility flaring for new completion (new drill, recomplete to new zone, or re-frac) activity.

B) A Gas Capture Plan should require the operator and pipeline company to more formally plan for projected volumes and schedules ahead of drilling.

Flexible Regulatory Approaches Focused on Reducing Emissions Without Stifling Innovation (continued)

3

Current regulation (19.15.18.12A NMAC) prohibits an operator from flaring or venting casinghead gas produced from a well after 60 days of the well's completion.

A) The exception process could be better defined, acknowledging when flaring is acceptable (i.e., safety, scheduled and non-scheduled maintenance, emergencies, facility malfunctions).

B) Provided the exception process above is better defined and includes a notice provision, regulators should reduce the 60 days currently authorized to 30 days.

Sound and science-based regulatory approaches, which allow flexibility and promote innovation and development, **can help also reduce volumes of flared natural gas.**

Conclusion

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Conclusion

Under Governor Lujan Grisham's leadership, the State of New Mexico has committed to identifying and implementing new ways for the oil and gas industry to reduce waste of natural gas through reductions in flaring. NMOGA has and continues to encourage all operators in New Mexico to employ industry best practices to achieve the lowest level of natural gas flaring that is consistent with safe operations. NMOGA agrees with the Governor's goal and remains committed to working with federal and state leaders to reduce emissions and combat climate change through pragmatic and cost-effective regulations that promote creativity and innovation.

About NMOGA

The New Mexico Oil & Gas Association (NMOGA) is a statewide coalition of oil and natural gas stakeholders, individuals, and companies dedicated to promoting the safe and environmentally responsible development of New Mexico's oil and natural gas resources. With more than 1,000 members, NMOGA advocates for sensible and balanced policies for the development, production, and transportation of oil and natural gas, and works to increase the public's awareness and understanding of industry operations and contributions to the state.


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