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Vast energy resources wasting away in the Texas Permian Basin

A special report on natural gas flaring

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I. Introduction

A new Texas oil boom is in full swing. The United States Geological Survey (USGS) estimates 20 billion barrels of untapped oil reserves in one single area of the Permian, an oil and gas basin contained largely by the western part of Texas and extending into southeastern New Mexico [1].

Earlier this year [2], the Energy Information Administration (EIA) predicted the Permian Basin would experience the country's highest growth in oil production, and in August EIA reported the Permian has more operating rigs than any other basin in the nation, with oil production exceeding 2.5 million barrels per day [3]. Meanwhile, companies including ExxonMobil are investing billions in leases [4], and oilfield services giant Halliburton reports hiring 100 employees a month to keep pace with demand[5].

Oil isn't the only resource in abundant supply. There's also ample natural gas (known as associated gas), freed from underground shale during hydraulic fracturing, the process of pumping millions of gallons of chemicals, sand and water down a well to break apart rock and release the fuel. A rush to produce higher value oil, however, has some Permian drillers simply throwing away the gas. Lack of access to gas pipelines, low gas prices, and outmoded regulations are driving this waste.

A new analysis of the amount of Texas Permian gas lost due to intentional releases (venting) and burning of the gas (flaring) by the top 15 producers in recent boom years reveals a wide performance gap. Data suggests that companies and regulators can do much more to limit routine flaring [6].

In 2015 alone, enough Permian natural gas was flared to serve all of the Texas household needs in the Permian counties for two and a half years[7].

This is wasteful, environmentally harmful and, for some oil and gas operators, business as usual.

Emissions of unburned natural gas are also harmful to human health. Although West Texas counties tend to be more rural, oil and gas air pollution is a concern for families living nearby. A Clean Air Task Force report ranked seven Texas Permian counties in the top 10 worst U.S. counties at risk for asthma attacks[8].

When methane leaks, it also does so with toxins like benzene, hydrogen sulfide, toluene, and xylene, as well as smog-producing volatile organic compounds. Flaring helps to combust most of these, but spawns a host of other pollutants like particulate matter[9] and sulfur dioxide[10]. The potential health impacts of these air pollutants range from irritation of eyes, nose, and throat to chronic or fatal illnesses such as cancer [11,12].

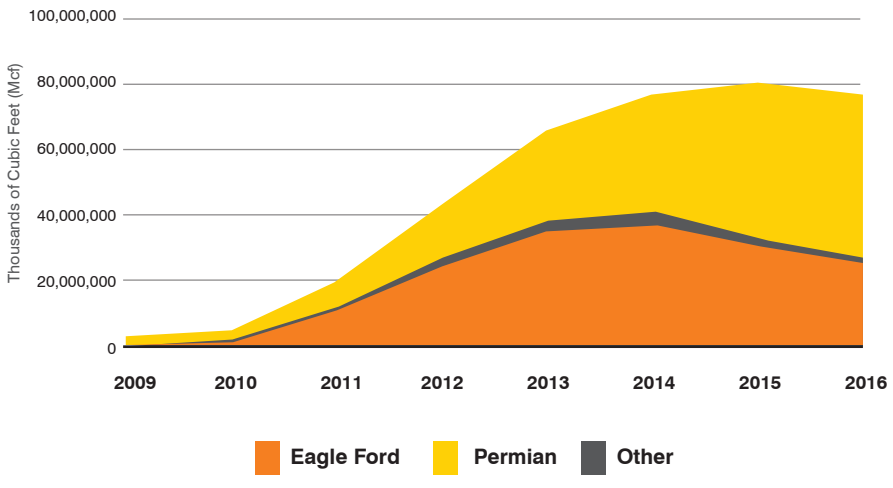
II. Trends in the Texas Permian Basin

Oil and gas air pollution in the Permian is not a new problem. Of Texas' top 25 flaring counties in 2014, ten were in the South Texas Eagle Ford shale and 14 were in the Permian. When oil prices sank in 2015, flaring in the Eagle Ford dropped (Figure 1). In the Permian, however, where oil recovery remained somewhat profitable, flaring volumes increased for 2015. Increased venting and flaring tightly links to the number of well completions, as this activity is highest in the months following new well construction. With more flaring coming, it is imperative for both companies and state agencies to consider practical regulatory and operational changes to avoid pollution and stop the needless waste of a valuable natural resource.

FIGURE 1

Comparing Wasted Gas Volumes in Eagle Ford Shale and Permian Basin

Vented and flared volumes of associated gas have steadily risen in the Permian from 2009 to 2016. After 2014, it makes up the majority of vented and flared associated gas in all of Texas.



How Do Permian Operators Stack Up And What Can We Learn?

EDF analyzed Texas Railroad Commission data detailing industry's flaring activity in several Permian counties[13] to assess how top producers performed compared to the region's average flaring rate in 2014 and 2015[14]. High-performing companies captured more of their associated natural gas, posting lower flaring rates. Low-performing companies did not capture as much and therefore had higher flaring rates. Some are wasting nearly 10 percent of the associated gas they produce.

> **On average, Texas Permian operators flared their associated natural gas at a rate of 3 to 4 percent in 2014 and 2015, over 80 billion cubic feet (Bcf) in total volume.**

Because of the steep drop in new drilling activity in 2016 and subsequent drop in flaring, EDF analyzed 2014 and 2015 data to examine operators in a "high well completion" context – similar to what can be expected in the coming boom years.

High performers

Companies in Figure 2 that were high-performers in 2014 and 2015 include Pioneer, Kinder Morgan, Laredo Petroleum, Parsley Energy, Endeavor Energy, and Crownquest Operating.

There may be valuable lessons from these operators that should be applied throughout the Basin. The high-performing companies' production has remained high while their rate of flaring has remained lower than the basin average. It is possible for an operator to have varying rates of flaring for a given period due to different operational circumstances. But because these operators maintained a lower rate over a prolonged period of high production, from 2014 through 2015, they are likely attaining some consistency in performance that could be replicated by other companies.

Low performers

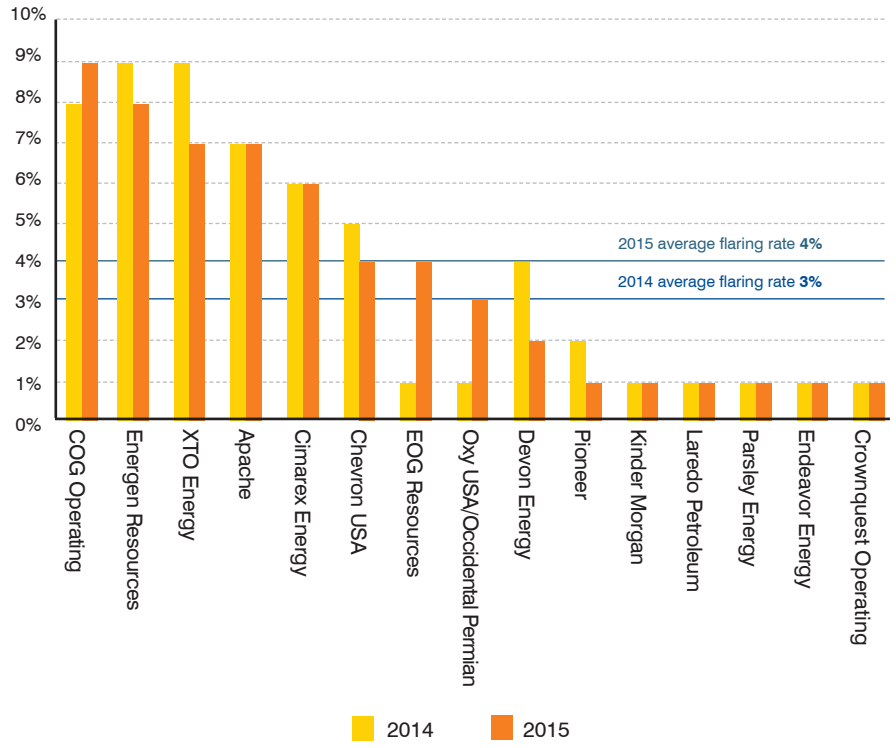
Companies from Figure 2 that were low-performers in 2014 and 2015 include COG Operating, Energen Resources, XTO Energy, Apache, and Cimarex Energy.

Low-performing companies may have encountered unique operational situations (remote well location, high percentage of new wells, etc.) that could have led to a high rate of flaring. Yet consistent under-performance suggests that better practices and approaches would lead to improvements.

FIGURE 2

Rate of Permian Gas Wasted by Top 15 Oil Producers

Venting and flaring as a percent of total production in 2014 and 2015 for the top Permian producers



The analysis in this report is drawn from publicly available data from the Texas Railroad Commission and its findings are therefore limited to oil and gas operations in the Texas portion of the Permian basin. However, a significant portion of the Permian also extends into southeastern New Mexico which is also experiencing intensive, new development. While it is beyond the scope of this report, nothing in this dataset indicates that flaring is any less of a problem in New Mexico's Permian and an analysis of New Mexico-specific Permian flaring data is a worthy focus of further investigation.

III. Regulatory solutions

A central factor of this more than 80 billion cubic feet of natural gas waste are state regulations that make it easy to burn energy resources rather than capture and sell them. Texas can, and should, create a regulatory environment that encourages companies to not flare gas and supports a level playing field for operators already employing flare-reducing best practices.

Require the Texas Railroad Commission and operators to treat wasted gas as a valuable resource.

Under current state policy, producing oil takes precedence over the waste and other detrimental impacts of flaring[15]. Under Texas' current flaring rule (Rule 32), flaring is "not wasting" associated gas, and, in fact, it is a "necessity" if there is no immediately available gas pipeline. The presumption is that economic loss will result if the oil is not produced immediately, but there is no requirement to prove that such a loss would occur.

EDF agrees with University of Houston law professor Bret Wells, who proposes that Rule 32 should be changed such that flaring would only be allowed when operators show proof that a no-flare policy would cause physical waste or prevent a mineral owner from accessing their fair share of the mineral resources. This would give associated gas stronger regulatory status as a valuable natural resource requiring sound conservation practices rather than a byproduct to be conserved only if there is an immediately available pipeline[16].

Eliminate permanent flaring permit exemptions and require operators with flaring permits to plan ahead.

If a company's desire to flare associated gas is simply due to a matter of timing, whether it be two, three, or six months until a pipeline can be installed, it should not be allowed. However, if there is a set of circumstances in which the operator can prove that the inability to flare associated gas will actually impede their ultimate recovery of oil, or result in a production delay longer than six months, a permit to flare could then be issued if the operator provides a gas capture plan that includes the following:

- An affidavit affirming that the operator met with a proximate gas gathering company and provided the company with the anticipated completion date of the wells, anticipated production rate of the wells, and anticipated pipeline connection date.
- A detailed map of the gas gathering pipeline system indicating the proposed point of tie-in.
- Information about the capacity of the gathering line.

An analysis and plan for the use of alternative on-site gas capture technology options at the proposed well site and how much such alternatives would reduce or eliminate flaring. If gas capture technology can be economically deployed and reduce the need for flaring, the flaring permit should require the use of the gas capture strategy as a condition of the permit to flare.

Require best flaring technologies to minimize waste and protect air quality.

In those instances where a producer can't capture the associated natural gas of its wells and a permit to flare is issued, the gas should be burned off as efficiently as possible. At present, however, Texas only requires "high efficiency" flares – those that perform with a design destruction efficiency of 98 percent - in the Barnett Shale[17]. Additionally, rules in the Barnett allow the use of an automatic ignition system or a continuous pilot. These rules can help reduce pollution from flaring and should apply throughout the state of Texas.

Improve record keeping and reporting requirements to ensure vented and flared volumes are reported separately.

Currently, Texas requires vented and flared gas volumes to be reported as one volume. Separating the reporting of vented and flared gas would yield data that allows for better tracking of compliance with venting and flaring rules. Some jurisdictions, such as Arkansas[18] and Alberta, Canada[19], already do this. Moreover, current venting and flaring data are kept in archaic record formats and are difficult and expensive to access and analyze. Greater transparency and public accessibility should be a key goal of any amended record-keeping requirements.

IV. On-site gas capture opportunities

Many technologies exist to help companies capture gas. To assess possible deployment of such technologies in the Permian, EDF reviewed monthly volumes of gas vented and flared by oil leases in 2015. Companies can hold thousands of leases, and multiple oil wells can live in one lease.

> **Our analysis found that over 30 percent of Permian oil leases could deploy gas recovery solutions at minimal to no cost.**

Doing so would substantially reduce how much Permian gas is wasted, as these leases account for 95 percent of the problem.

Technologies can address the most common issues in the Permian, including limited access to gas pipelines and insufficient pressure for gas to enter an existing sales line [20]. Table 1 highlights the cost-effective solutions that could be deployed at greater scale if regulatory changes required operators to limit gas waste.

The consultancy ICF International studied the volumes of gas needed for operators to recoup investment costs of select gas capture technologies (Table 1)[21]. The figures represent the gas production totals that a well or group of wells would need to hit in order to have one of the four technologies pay for itself within ten years. Potential breakeven volumes were estimated (Table 1) based on a range of gas prices ($2, $3, and $4/Mcf) and discount rates (three percent, seven percent, and 12 percent) that vary over time.

On average, 32 percent of leases reported flared gas volumes greater than six million cubic feet (MMcf), the lowest breakeven point (see Table 2), with three percent reporting volumes greater than the highest breakeven point of 146,000 Mcf. Only eight percent of leases in the Permian flared more than 55,000 Mcf in 2015, the minimum breakeven volume at which all four technologies can be deployed (Table 2). Breakeven calculations factor in an operator's ability to potentially move purchased equipment from one site to another as associated gas volumes dwindle and become uneconomic.

While problems solved by each technology are unique, in the Permian it is clear that the more gas a company produces, the more options the company has at its disposal to reduce flaring. Further, much of the Permian's venting and flaring problem can be dealt with by handling the relatively small number of high producing leases (Table 3).

TABLE 1 Four technologies and the production volumes required from a well or a group of wells for the cost of the technology to be paid for through the sale of captured gas. (Source: ICF Consulting, 2016)

TECHNOLOGY OPTIONS	GAS VOLUME NEEDED TO RECOUP COSTS	PROBLEM SOLVED
(A) Booster Compressor on a Low Pressure Well	6,000 and 17,000 Mcf	Insufficient pressure to move gas to sales line
(B) Booster Compressor on a Low Pressure Well with a Joule-Thompson Skid for Treatment	14,000 and 39,000 Mcf	Insufficient pressure to move gas to sales line and poor gas quality
(C) Compressed Natural Gas and Tube Truck Transport	49,000 and 126,000 Mcf	No pipeline availability
(D) Compressed Natural Gas and Tube Truck Transport with a Joule-Thompson Ski for Treatment	55,000 and 146,000 Mcf	No pipeline availability and poor gas quality

TABLE 2 Below, the breakeven volumes from Table 1 are listed, along with the percentage of leases in the Permian that meet that breakeven volume, and the technology options potentially available at each breakeven volume.

			TECHNOLOGIES APPLICABLE TO BREAKEVEN VOLUME			
ANNUAL BREAKEVEN VOLUME (MCF)	AVERAGE % OF 2015 REPORTING LEASES	CUMULATIVE AVERAGE % OF REPORTING LEASES	(A)	(B)	(C)	(D)
> 146,000	3%	3%	X	X	X	X
> 126,000	1%	3%	X	X	X	X
> 55,000	4%	8%	X	X	X	X
> 49,000	1%	9%	X	X	X	
> 39,000	2%	10%	X	X		
> 17,000	8%	18%	X	X		
> 14,000	2%	20%	X	X		
> 6,000	12%	32%	X			

TABLE 3 Our analysis of the percent of total 2015 vented and flared associated gas from leases meeting the breakeven volumes required for technologies A through D listed in tables 1 and 2 above.

ANNUAL BREAKEVEN VOLUME (MCF)	AVERAGE % OF 2015 REPORTING LEASES	CUMULATIVE % OF PERMIAN GAS WASTED BY 2015 REPORTING LEASES
> 146,000	3%	47%
> 126,000	1%	51%
> 55,000	4%	71%
> 49,000	1%	73%
> 39,000	2%	77%
> 17,000	8%	88%
> 14,000	2%	90%
> 6,000	12%	95%

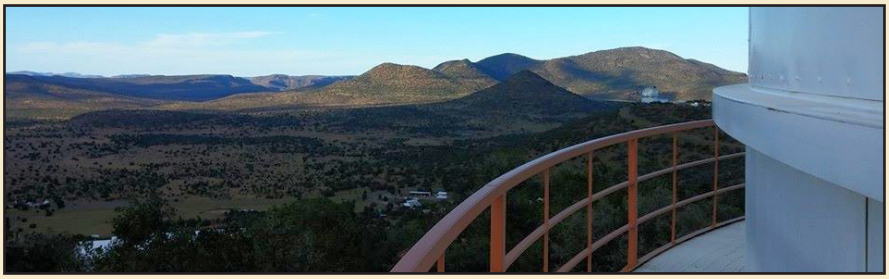
V. Conclusion

The Texas Railroad Commission's mission is to prevent waste and pollution from the industry it regulates. To that end, the Commission should learn from past successes and failures and use that knowledge to create a regulatory environment consistent with the agency's mission. So far, the Commission has missed the mark. The state's citizens, landowners, environment, and natural resources deserve better.

As production ramps up in the Permian Basin, now is the time for regulators to take steps to reduce flaring pollution and waste, and create a level playing field for all operators.

Reduced flaring is beneficial for the environment and helps preserve our state's resources. Analysis of Railroad Commission flaring data from the Permian includes important success stories and suggests that some companies are willing to invest resources and implement processes that greatly limit the amount they flare. In the case of Apache Corporation's recent Alpine High discovery, in southern Reeves County, the company has pledged to install necessary pipeline infrastructure before fully developing the field to help prevent the waste of associated gas and bring more of it to market[22]. This capability of waiting until infrastructure is available, which is not unique, should be adopted industry-wide. Regulations can help turn leading practices into the standard practice and not put companies doing the right thing at a competitive disadvantage.

Light pollution & the McDonald Observatory



Flikr/JenniferDukedodd

For large telescopes to see deep into space, it needs to be dark--very dark. Located near Fort Davis, TX, the McDonald Observatory sits in one of the darkest places in the United States. However, the oil and gas boom, and the rig lights and constant flaring that has come with it, have threatened the dark skies and the research conducted at the world-class astronomical research facility[23]. Satellite images show light visible at night increased dramatically from 2010 to 2013, attributable to oil and gas flaring in the region (see yellow circles in the illustration below[24]. Apache's "Alpine High" discovery in southern Reeves County would push oil and gas development to within 40 miles of the observatory.

Last year, the Railroad Commission sent a notice to operators reminding them of the need to reduce night lighting near the McDonald Observatory[25]: "industry operators active in the seven county region have worked with the McDonald Observatory to adopt new lighting practices to help prevent ambient lighting from interfering with the highly sensitive and important scientific study conducted at the McDonald Observatory." Efforts to reduce light pollution have focused on operational lighting, but at least a portion of this pollution can also be attributed to flaring.

This year, in collaboration with the observatory, the Permian Basin Petroleum Association released recommended lighting practices for operators in the Permian, including a recommendation for the use of flare shield technology where "technically and commercially feasible." It did not call specifically for a reduction in flaring.

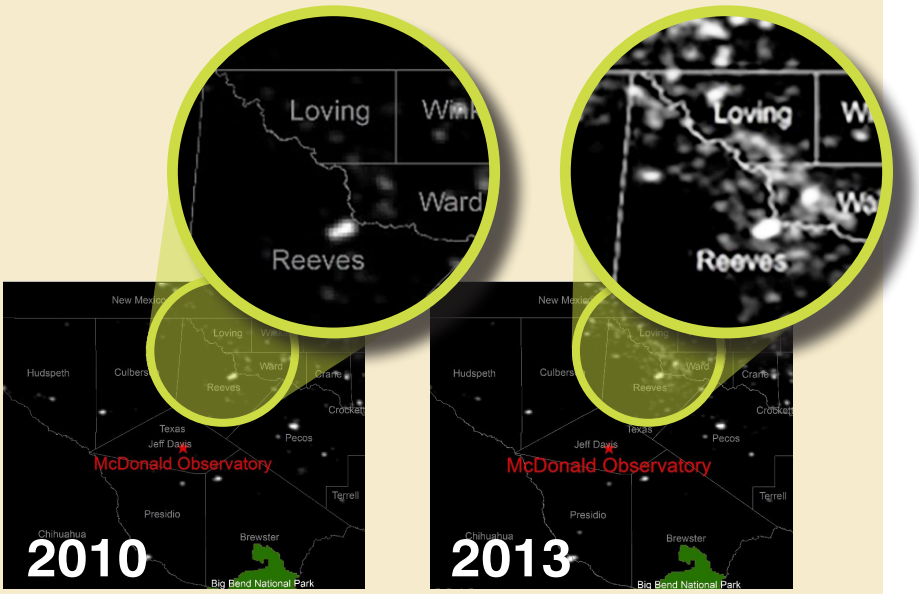


FIGURE 3 Images of night lights taken by the Department of Defense show where flares in the Permian Basin increased from 2010 to 2013 (note area outlined in yellow). Maps adapted from Wren and Locke (2015).

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